CARTOGRAPHIC APPLICATION ON THE BASE OF CHILDREN’S UNDERSTANDING OF EARLY WARNING AND DISASTER/CRISIS MANAGEMENT

BANDROVA T., MILANOVA Y.
University of Architecture, Civil Engineering and Geodesy, SOFIA, BULGARIA

ABSTRACT
When millions of people are affected by natural disasters each year (Ajmar A. et al., 2010) the tasks of cartographers are to make special maps for the needs of Early Warning and Crisis Management (EW & CM). Ones of our special users are children. They need simple maps for fast and easy understanding of map contents. How to make such maps? We need to know how much knowledge children have about represented subjects, how they are prepared to use maps and what do they expect to be visualized on the maps. The attention to children is the most important thing for many organizations caring about EW & CM. Some of the researchers (de León Juan Carlos Villagrán et al., 2010) identified five groups as highly vulnerable: women; children; people with permanent or temporary incapacities; fishermen and people who work in coastal areas. Our aim is to work and help children to be ready and know how to behave in danger situations of natural disasters.

When children are well prepared for disasters, their life could be saved and the damages could be reduced. After map producing the role of cartographers could be to teach children how to use maps easily, to orientate in the surrounding area with a help of a map, how to use a symbol system. The report presents a pilot project with children participation based on a game and questionnaire of children’s knowledge about disasters, EW and CM. A proposal of a symbol system (describing dangerous phenomena and nature disasters) could be used for maps and cartographic materials made for children use. The pilot project will be a base to enlarge it to international one. On this base conclusion for international standards for symbol system and ways how to make maps for children in EW & CM process will be done.

INTRODUCTION
We are living in a vulnerable world which is full with every day news for disasters. What happens with children in such situations, are they well prepared, educated, do they have enough knowledge to manage their self in disasters?

Only a few researchers have investigated the role of cartography for children in the context of early warning and crisis management. More children-related research can be found in environmental sustainability and education areas. For example, Taylor et al. (2003) investigated the views of primary and secondary teachers about sustainability education in New South Wales. Other studies are directed at children’s understanding of object presentations on maps (Bandrova T., A. Deleva, 1998), gender comparisons for understanding and extracting information from atlases (Bandrova T., V. Nikolova, 2005), and students’ knowledge of maps (Bandrova T., V. Nikolova, 2000). All of these studies aim to connect cartographers and children and to find a way for these studies to help cartographers to make maps more attractive and understandable to children. We conducted similar research on a detailed subject connected with EW and CM: how cartographers can help children and students in disaster situations to make their lives safer and minimise damage using maps created for these purposes (Bandrova T. et al., 2010).

Our investigations (Bandrova T. et al., 2010) show that students in many countries have some knowledge about EW & CM without education, but this is not enough for them to be well prepared when a disaster occurs. This conclusion is documented by all of the responses of our questionnaire. The goal of all international and national organisations working on this topic is to educate a large number of students and to follow the good practice and examples of the educated Australian students from special schools “where three-quarters of children reported participating in a hazard education program. These programs were generally carried put in school by Civil defence personnel or a teacher” (Kirsten F. et al., 2004).

To propose national or international education programs, more similar studies should be carried out and more good practices should be investigated. Institutions such as FEMA and EMA are well developed for American and Australian conditions. Taking everything that could be adopted for Europe as well as all results from such studies should help to investigate ways to develop good education programs for students in EW & CM. The new perspectives in cartography (Konecny M., 2008) will give us tools and power to achieve our aims: to make appropriate and adaptive maps for special users (children) and to help them in EW & CM.
In this project we will try to create a cartographic symbol system for EW & CM which should be appropriate for children’s use. Other topic of cartography is to understand what kind of objects should be represented on the maps, used in situations of disaster, how children think in stress situation, what they know about maps, can they recognize the symbols on the maps, what information will be useful for them when the disaster comes. We would like to ask children if they can read and understand map information, if it is enough clear for them. For this aim a game about early warning and disaster management is created and realised and a questionnaire with fourteen questions is prepared and children’s answers are analysed.

A GAME ABOUT EARLY WARNING AND DISASTER / CRISIS MANAGEMENT

The best way to teach children is to play games with them. By a game we will not only teach them but also will understand their opinion about different details in the process of early warning and disaster / crisis management, to encourage them to use maps and to take better decisions for their safety behaviour. There are some examples in different countries about games and teaching programmes to educate children in EW & CM. For example children will identify and use safe practices and basic risk management strategies in Sri Lanka by games and studies (Ministry of Education, Sri Lanka, 2008). The experimental game for our pilot project will give us information about children’s preparation for presented topics as well will help them for the next task: fill in the questionnaire. Both tasks were realised in English school during children summer vacation (July, 2010). A garden in central Sofia was chosen as a place for the game. The weather was sunny and hot with temperatures above 35C.

Figure 1. Preparation of children to use maps

Our first goal was to introduce children with maps and cartography in general (see Figure 1). After that we wanted to understand what they already know about natural disasters and early warning system and the third task was to give us enough research experimental results to plan our future works in this topic. Fifteen children from 4 to 12 years old participated in the game. We divided them into three age groups:

- group A – 5 children from 4 to 6 years
- group B – 7 children from 7 to 8 years
- group C – 3 children from 9 to 12 years (see Figure 2).
The children from Group A were in a situation with coming flood. They were in a place where they have to draw a river with fishes, boats and everything that will help them to imagine the situation. One of the adult participants of the pilot project was an artist. He helped them with drawing and in the same time he drew a dam wall with explanation that a lot of water will come from this place (Figure 4).

The children from Group B were in a situation with fire happening. They should draw a forest with many trees, birds, flowers, grass, bushes, fires and everything that will help them to imagine the situation. The hot weather helped us to convince them that so many fires in not big region could instigate a fire (Figure 4).

Figure 2. Three children groups took participation in a game
The children from Group C had a special task. They should draw an evacuation map of the environmental situation, to imagine that they are a brigade for emergency response and should help children from group A and B to save their life. The place for group C was chosen with higher elevation. On this way the children from group C had the possibility to observe the situational position of other two groups. They drew a map of the situation with explanation and help of a cartographer (Figure 3). After that they prepared children balloons with signs for two kinds of disasters: a flood and a fire (Figure 4). In the moment when teachers explained that disaster is coming in the regions of the first two groups, the third group started to be active. All participants in the game gathered and discussed the stories that just happened. Some questions like what is the emergency telephone response for the country, what is the right behaviour, what we should do when disaster happen, received their answers. By the help of children from group C other two groups of children were evacuated on a safety place.
Group B

Group C

Figure 4. Children are participating in a game about early warning and disaster management

After realizing the game in the garden, the questionnaire was filling up in school (Group B and C) and more games were played with the youngest participants from Group A.

We prepared for them outline drawings with images of different disasters, as well as sheets of paper with a game called “Find the path” (Figure 5).
QUESTIONNAIRE - CHILDREN'S UNDERSTANDING OF EW & CM

The questionnaire was prepared in addition of experimental research based on questionnaire in a previous study (Bandrova at al., 2010). The previous research shows some weaknesses in students’ knowledge. Other ones were found in this project. The games will help us to practice everything that children studied and knew. Some serious games and the best ideas could be taken by www.ema.ohio/gov/Kids_Page/index.htm and www.fema.gov/kids/, where “Each game teaches your child safety precautions to take in the event of a natural disaster. The more children know about how to protect themselves from natural disasters, the better prepared they are...and being prepared is their best defence.”

Fifteen children participated in the questionnaire: nine of them participated also in the described game (group A); another six children came from the houses without parents (group B). The differences in knowledge between these two groups are quite serious. The first group (A) of children gave very high quality answers and the second one (B) – very poor answers. It is visible that the difference between the education and culture of these two groups is impressive enough.

The first to fourth questions were connected to general cartography and topographic maps (see Application 1). The aim of this group of questions was to recognise the level of understanding, using and working with maps by children. If we receive a positive result from questions about topographic maps we will decide which layers of represented information could be used as a base to make maps for children using in EW & CM.

Children understood that maps will help them to orient in the space and in the area where they lost the way, to understand what kind of objects are situated in a given territory. Children above nine years old wrote a map definition and described different kinds of maps. Some of the children thought that they can use the maps and orient themselves without special education. Most of the children from group A declared that they learned how to use the map by the help of parents and teachers. Group B also liked to use the maps. They learned how to use them from schools and people. All children above 7 years old recognised what kind of objects are represented on the topographic map except the contour lines and specific objects represented by the standard symbol system (vineyard, meadow, electricity lines, etc.).
The conclusion from these answers is that we can use the topographic maps as base geographical information in making maps for children. These maps will be used for EW & CM. It is clear that we can use the following layers of topographic maps: hydrography (rivers, dams and walls, seas, texts), streets, ways, bridges, houses, etc. We need to represent also terrain but without contour lines. So, the cartographers should find another way: the most probably, using 3D morel of relief and its perspective representation in paper version maps.

The fifth question was connected with the explanation of the terms: risk, hazard, disaster, and crisis. From the answers of Group A is visible that children understood the difference between these terms but it is difficult for them to give good definitions. The children from Group B connected these terms to their poor quality life and give answers as “hazard means when somebody will abduct you”. Some of the children gave examples of disasters as flood, earthquake, volcano eruption, etc. Others tried to write definitions (see Table 1).

*Table 1. Definitions of the terms: risk, hazard, disaster, crisis*

<table>
<thead>
<tr>
<th>Definition</th>
<th>Risk</th>
<th>Hazard</th>
<th>Disaster</th>
<th>Crisis</th>
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<tbody>
<tr>
<td>By Wikipedia; <a href="http://en.wikipedia.org/wiki/">http://en.wikipedia.org/wiki/</a></td>
<td>Risk concerns the deviation of one or more results of one or more future events from their expected value. Technically, the value of those results may be positive or negative. However, general usage tends to focus only on potential harm that may arise from a future event, which may accrue either from incurring a cost or by failing to attain some benefit.</td>
<td>A natural hazard is a threat of an occurring event that will have a negative effect on people or the environment.</td>
<td>A natural disaster is the effect of a natural hazard (e.g., flood, tornado, hurricane, volcanic eruption, earthquake, or landslide) that affects the environment, and leads to financial, environmental and/or human losses.</td>
<td>A crisis is any unstable and dangerous social situation regarding economic, military, personal, political, or societal affairs, especially one involving an impending abrupt change.</td>
</tr>
<tr>
<td>By a child, 9 year old</td>
<td>It is possible something bad will happen.</td>
<td>Something bad is coming.</td>
<td>Nature danger already happened.</td>
<td>Dangerous situation</td>
</tr>
</tbody>
</table>

The conclusion is that these terms could be included in some of the subjects or lessons, specially prepared for EW & CM courses. Generally, the children have some imaginations to the terms used in the project and also in the games and questionnaire.
The sixth question was connected to the shape of a sign associated with a danger situation. This question instigates the children’s thinking. We would like to understand if the shape of the sign / symbol is important or only meaning and association of the sign will represent the necessary information.

The result is the following: most of the children choose triangle as the most appropriate shape. This is expected result and this cannot be connected to the children’s knowledge about traffic signs because they are not familiar with the topic. Five of the children (two of them are six years old and three of them are from home without parents) showed the circle as the most appropriate shape and only two children showed square as the most appropriate.

The conclusion could be that the triangle is the most appropriate shape to design symbols for EW & CM maps for children or education materials. More future experiments and psychological analysis are needed to understand reactions and thinking of some children.

The seventh question was connected with the colours associated with the levels of danger when disaster will happen: green, yellow, orange and red. These colours are defined by UN secretariats and they are used in all presentations connected to EW systems. All children, participated in the project, responded in right way to that question.

The conclusion is that no a child have a problem connected to standardised colour system for EW & CM representations.

The eighth question was connected to the recognition of eleven symbols which represent volcano, tornado, tsunami, fire, earthquake, landslide, avalanche, desertification, flood, hurricane, landslip. Ten of the eleven symbols are recognised by almost all children. Examples for other emergency symbols are presented in (Zhang, An, Qingwen Qi, 2008) and (Friedmannová L., 2010). In that research a lot of symbols are well-designed but authors declare that some of them need to be re-designed. In our project only one of the symbols (the avalanche) was associated with waterfall.

The conclusion could be in direction to change the symbol of an avalanche with another, more associate and understandable for children. All other symbols could be proposed for standard and experimented with children from different countries.

The ninth question was connected with the size of the symbol. Most of the children reported that better symbol means bigger quality of information, small percent have not answered and only one boy reported that the difference of symbol’s size is connected to zooming. The results could be seen in Figure 6. Other possible answers could be connected to the map scale, area of disaster distribution, number of disasters.

Figure 6. The bigger size of symbol means:
1-quality of information, 2- zooming, 3 – no answer

The answers of question ten give us proposals how to represent a disaster region on a map. The most of children choose answer g) with more than a symbol and a polygon. Because the number of children was not enough it is difficult to make conclusion. We need more experiments with children in different ages and from different countries.
The last four questions (from eleven to fifteen) were connected to local disasters and situation in which children can get in. There were many interesting responses and from these questions is visible that the most appropriate way for children to gather knowledge is the practice.

About different kind of disasters children recognize earthquake, flood, fire, desertification, storm, thunders. The questions twelve and thirteen were connected to the expected objects represented on the maps in the case of flood and fire. It is important what children expect to find on the map and which of the objects are important in these cases to their orientation. Together with usually expected objects as roads, paths, bridges, buildings, cities, mountains, forest, hills, points with higher altitudes, rivers, lakes and dams, huts, medical offices; children expect to find on the maps other objects as caves, safety places, hotel, shops for boats, boat ports, offices of fire brigade, another fires or floods, emergency telephone and place, factories and chemical stores, another stores with dangerous materials as alcohol and paper. The question fourteen asked children if they need information to save their life in a dangerous situation. All children’s responses are right. Some of the answers were: Mobil telephone, TV information, GPS, compass, signs in forest paths to show you huts and safety places directions, car,…

CONCLUSIONS AND DIRECTIONS FOR FUTURE WORKS

The report considers a pilot project about children’s understanding of maps for EW & CM. The aim is to continue these researches in national and international level. The example could be the similar research made in Austria, Bulgaria, Czech Republic and Slovakia (Bandrova T. et al, 2010). Another reason to continue this research is to enlarge the number of children participated in. This will give us a possibility to make conclusions on the base of statistical analysis. Because of this we should have enough number of participants.

On the base of the research we are ready to know which layers of topographic maps could be included as a base to make a map for children useful in situations of EW & CM. They are mentioned in the analyses of the answers from first to fourth question (see above). Another conclusion could be connected with the symbols, designed to be used when we create maps and other materials: brochures, information sheets, and others. Only the symbol represented avalanche could be replaced with more associative one. The research gave us detailed, specific response of the questions: Who will read the map; Why the map is made; What is a map device? General responses of these questions could be seen in (Hřebíček J., Konečný M., 2006).

To propose national or international education programs, more similar studies should be carried out and more good practices should be investigated. Institutions such as FEMA and EMA are well developed for American and Australian conditions. Taking everything that could be adopted for Europe as well as all results from such studies should help to investigate ways to develop good education programs for students in EW & CM.

REFERENCES


FEMA for KIDS - http://www.fema.gov/kids/
Application 1
Questionnaire: Cartography and a Symbol System for Early Warning and Disaster Management for Children’s Use

Name:
Age:
City, where do you live?

1. What do you know about maps? What do the maps represent?
2. This is a part of a topographic map. Please, write down what do you see on it.

3. What is a topographic map? What does it contain?
4. Do you think that you have enough knowledge to work with maps? If the answer is <YES>, where do you learn it from? If the answer is <NO>, what are the reasons?
5. How do you understand the terms: risk, hazard, disaster, and crisis? Please, write a few words for each one of them.
6. What a shape of a sign is associated with a danger situation?
   a) b) c) d)

7. How do you understand the level of dangerous situation with these colours? Please, connect the colour box and the corresponding text with the arrows
   a) Extreme level! Very danger! 1)
   b) Warning! High level of danger! 2)
   c) Be careful! There is a risk of danger! 3)
   d) Safe conditions! There is no danger! 4)

8. What do the different symbols represent? Please, write down your answers under the symbol
9. What do you understand by the difference of the symbols? 
10. How will you draw/represent a disaster region on a map? Please choose one of the following 4 possibilities.

a) with bigger symbol  

b) with a symbol and a polygon

c) with more than a symbol  

d) with more than a symbol and polygon

11. Do you know something about the hazards in your area? Please, write down a list of them?
12. You have a holiday in a tent near a river. In evening time TV forecast informs you that a heavy rain will come this night and floods are expected. You have a map of your region. What kind of objects do you expect to be represented on the map and to help you in expected dangerous FLOOD situation? Please, write at least 5 objects.
13. You have a holiday in a tent near a river. Suddenly somebody informed you that a fire appears not far away from you. You have a map of your region. What kind of objects do you expect to be represented on the map and to help you in expected dangerous FIRE situation? Please, write at least 5 objects.
14. You are in a similar situation like both above. Do you need information, except a map, which will help you to decide where to go or what to do?