AR SANDBOX IN EDUCATIONAL PROGRAMS FOR DISASTER RESPONSE

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Abstract
The development of technologies nowadays is moving in such speed that the computer graphics and simulations are being convincingly displaced by the augmented reality. The AR Sandbox, created by Oliver Kreylos, is just one of the many examples in which the reality is supplemented with computer generated input. In this case the reality is a box full of sand and the input is hypsometric coloring and elevation contours. A Kinect sensor detects the micro relief forms in the sandbox and after unnoticeable computer estimation, a relief map is projected over them. If the sand forms are changing, the coloring and the lines are changing with them to project the new accurate relief.
Actually AR Sandbox represents important conceptions of geology, hydrology, ecology, topographic mapping, etc. in a very entertaining and spectacular way for children and students and this is a main reason this system to be part of our equipment in the Laboratory of Cartography in UACEG. Included in lessons and games the AR Sandbox is an irreplaceable tool for improving their knowledge of disastrous events such as floods, drought and fire especially when it gives the opportunity of making virtual rain and isolating flooded areas depending on the relief and the watersheds. In this paper after the detailed presentation of the AR Sandbox as a working system, proposals for educational activities for large age range of children and university students are made in order to use the augmented reality as a special instrument for displaying disastrous events. Some new ideas are suggested in consideration of future improvement with which AR Sandbox will meet more needs of the educational training for disaster response of children.

Keywords: *disaster response, children education, AR Sandbox, augmented reality*

INTRODUCTION

Society nowadays is deeply connected with the technologies. People are so used to be supported in various situations and activities by machines and computers that they have become inseparable part of the social daily routine. There is no social or professional sphere (agriculture, medicine, building construction, etc.) which is not constantly being improved by the fast developing technologies. In a world where cars will be driven without human interaction in the very close future, augmented reality (AR) is just one small part of the great technology world. The sharp distinction between virtual and real world in the past is now fading due to the successful attempts to combine them.

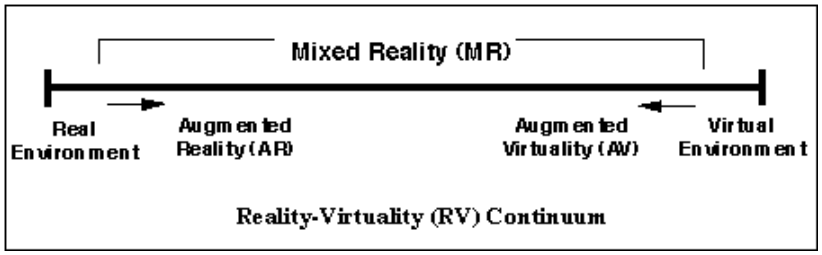

Figure 36. Milgram's Reality-Virtuality Continuum (Milgram at. al., 1994)

Milgram at al. [1] place AR somewhere between the reality and the virtuality which they put on the opposite ends of continuum called: Reality – Virtuality Continuum (Figure 1). This representation classifies AR as part of the mixed reality and points out the connection between Virtual Reality (VR) and AR. Bimber and Raskar [2] write that Augmented Reality is more questionable area because in contrast with the VR, the reality here has main role and as it is known the real environment is harder to be controlled than the completely synthetic one. One of the first things to know about the augmented reality is that its main aim is to combine virtual and real [3]. Enhancing the user's perception by supplementing the actual surrounding world with 3D visualizations of objects, the user experience can be described as seeing the real world, superimposed with virtual objects which appear to be coexisting in the same place as the real ones [4]. Another specific characteristic of AR is that the right placement of these virtual objects in the reality is based on strong geometrical relationships between real and virtual. As third important characteristic Azuma defines AR as being interactive in real time [5].

In this digital world it is impossible the technology not to impact the programs in the educational institutions. Digital learning is becoming not only optional but a necessary method in schools, colleges and universities as it is offering new experiences, unconventional approaches to students at any age and improvement of their motivation to learn. As part of the 21st century technologies augmented reality already has an impact on improving the activities at class. Although its development has been started in 1990s, this century the augmented reality systems have experienced great development and their daily use is becoming more and more common. In the educational fields they are enhancing the traditional school practices and activities when supplementing the real environment with virtual objects [6]. According to Johnson et al. [7] AR can give to the learner not only in situ experiences but also contextual information in a very strong combination. Using AR students and trainees obtain supplementary information about the surrounding environment. Today's children are closely familiar with mobile technologies and from early age are capable of working with tablets, notebooks and smartphones. It is almost natural that the classic learning methods which are applied to them to be replaced with new and modern such as AR systems. No matter what the school subject is: biology, geometry, geography etc. augmented reality could be suitable for impressionable, interesting and intuitive way of information representation for children and students of all ages.

This paper aims to focus on the need of educational activities and programs for children and students in order to be trained on basic safety rules and moves in case of the most common disaster events. The augmented reality is one great approach the terminology and various crisis scenarios to be represented in a fun, non-scary and memorable way and to give the basic knowledge to the young audience. In this paper will be presented one particular AR system called Augmented Reality Sandbox or for short AR Sandbox. Detailed description will be given of this system and the concepts that it represent in order to be used as educational tool in programs and activities for children disaster trainings.

CHILDREN AND STUDENTS IN DISASTROUS SITUATIONS. WHY EDUCATIONAL PROGRAMS ARE NEEDED?

Children - the most vulnerable part of sociality

Children are meant to be one of the most vulnerable part of our society especially in case of emergencies. Whether the origin of the event – natural or man-made, this fragile social group need special attention before, during and after it. Not only their lack of independence and their inability to make reasonable decisions but also their low physical strength and weaker psyche, can be the reasons for them to experience the feel of abandonment, lack of support and fear while disaster is happening. Bullock's at al. [8] book is focused on children and their management in cases of disaster and it is based on detailed research on their physical and psychological vulnerabilities. Provoked by the events during and after the Hurricanes Katrina and Rita, another author: Greenman [9] publish a guidance for psychological relief of children who have gone through natural disasters. Policy brief of the organization *Save the Children*, which main activity is children protection around the world, points out the different types of protection children need in such emergency cases

[10]. There is a tendency in recent days the subject of children protection and management in disaster emergencies to become more often broached. Researches are made in order to use psychological approaches for developing trainings, activities and lessons to educate and prepare the future generations for times of natural disasters.

According to Building Research Institute (BRI) and National Graduate Institute for Policy Studies (GRIPS) [11] the concept of disaster safety must be included in the education from early childhood in order to reach the goal of sustainable disaster reduction. It is necessary to be build "a new culture of disaster prevention" in the society and the schools are the only opportunity this culture to be given to the future citizens. FEMA [12] also share the same concept, saying that the preparedness and the knowledge of the citizens is the best practice for proper prevention and reactions in emergency situations. They advert closely to the children and their potential role as influencers spreading information about preparedness to their families. Empowered by their knowledge they can act as leaders which can take the initiative with less anxiety in such cases. Three school-related activities are meant to be important, according to Priority 3 of Hyogo Framework for Action [13]:

1. *"Inclusion of disaster risk reduction knowledge in relevant sections of school curricula at all levels."*
2. *"Implementation of local risk assessment and disaster preparedness programmes in schools and institutions of higher education."*
3. *"Implementation of programmes and activities in schools for learning how to minimize the effects of hazards."*

Many organizations and institutions around the world are working on improving the children's knowledge in disasters and no matter of the differences in their concepts and methods, they are always crossing in the same place: educational trainings and activities are necessary and they should be organized in all grade levels. This is prerequisite the programs for disaster response to be specially prepared according to the age of the audience and the easiest way to be accessible to every kid is to be implemented in school. Such trainings and activities have to be a result of collaboration between teachers, psychologists and disaster management specialists and to be based on researches on children's cognition in disastrous events.

Different methods for taking children's attention

In this paper it was mentioned not once that special approaches are needed in order to take children's attention. The information has to be presented to them in a fun but memorable way without any stress. This is the reason for the specialists of disaster management for children to use the advantages of various games and activities conformable to their age group.

Of course in most cases the care of introduction to disasters to the smallest ones is entrusted to teachers in the kindergarten and in the elementary school. One of the great example for such game is Bosai Duck. The first part of the name Bosai means Disaster Reduction in Japanese and the second part in English is referred to the pose which children

Figure 37. Kikkawa and Yamori's game: Bosai Duck (http://www.sonpo.or.jp/)

have to make to *"drop, cover and hold"* in case of earthquake. It is created by Kikkawa and Yamori in 2005 [14] and it is simple game with two groups of cards: the first one is about hazards and the second one is the right response to them (Figure 2). Bosai Duck becomes so effective and popular that it is further applied in the pre-school programs in the Philippines [15] and Indonesia [16]. Another approach for giving memorable instructions is to put them in a song. In that way in case of emergency the safety steps will be followed easily even by the smallest kids.

As they grow up the children's abilities to use the Internet on computers and tablets widen the possibilities of educational methods. Many countries which suffer from severe disasters have developed sites for children where they can find all the important information, to play games or to solve tests. The good examples are from USA - *Be a Hero* program [17], Japan: Kids Web Japan [18] and Argentina: ABC Desastres [19]. Nevertheless, these are just additions to the standard activities at school such as simulations, trainings and theory lessons.

Cartography, disaster management and children

It is known that cartography in its all variations (including GIS, Web Mapping etc.) takes special place in disaster management. The map plays an irreplaceable role in emergency cases, giving quality information about escape routes, help and medical centers, etc. Such information must be available to children also and this is the reason the cartographic approaches for representing the disasters on a suitable maps for children and their implementation as educational materials to be one of the important topics. Nowadays we are not talking only about the paper maps but also about all of the methods of data representation via digital mapping on the Internet, on mobile phones and tablets. Whatever the technologies of mapping are, the first things to comprehend, when we talk about materials for children, is how they see the hazards, what are their visual associations of the types of disasters and what will be helpful to save their lives in the disastrous moment. Based on previous researches about children's knowledge of maps and their ability to read them: [20], [21], Bandrova and Milanova [22] examined the way children understand maps in stress situations (Figure 3a and 3b).

The main goals are to gain knowledge for their cognition and to create easily recognizable symbols which could be used

Figure 38. a) Introducing cartography to children – outdoor activities; b) A map created by a child (Bandrova & Milanova, 2011).

in specially developed cartographic products for improving the children's orientation and decision-making in cases of emergencies. There must be no doubt that all disaster trainings for kids have to include activities such as map reading and orientation. Example for helpful and in the same time fun game is the child to create its own map, representing the area around school or home. Such activity will turn the children attention to the important objects around them: where are the exits, the stairs, the doctor's office at school or the safest place in case of flood, etc. The implementation of cartographic materials in the educational programs in all of their forms: paper maps, maps in web, virtual maps, interactive maps, etc. will improve their abilities to find the better decisions and save their own or others' lives.

Augmented reality and children

It is hard and unnecessary to separate the education in school from the technology. Just the contrary, the programs have to be improved with the tools that the new technologies give. Nowadays virtuality is quite often seen at class but most of the time it is a place where child's mind wander after it. So if kids want to spend their spare time in this virtual world, it should be quite interesting for them to find it at school, too. And after the virtual reality, here comes the more complex term – augmented reality. The most popular application of this technology today is in Augmented Reality books. This is a new way of making books to come alive, achieved by mobile applications (Figure 4a). In help of the teachers there are specially developed apps which via mobile phones and tablets (Figure 4b) can introduce to students information for solid geometry, biology and anatomy, etc. [23].

The augmented reality presents the lessons in a new light, giving visual meaning of the school subjects. It enriches the classroom environment and improves student's spatial thinking and creativity, designing educational scenarios not achievable via other approaches. In this paper the augmented reality will be represented by the system AR Sandbox

which main use is to visualize the concepts of geography, geology and topography. Exactly the close connection between these sciences and disaster occurrences gave birth to the idea to use the system for children disaster training.

Figure 39. a) Example of augmented reality book (http://appsplayground.com); b) Brain anatomy via mobile application (http://blogeducation.tk).

AUGMENTED REALITY SANDBOX

What is AR Sandbox?

The idea for such types of interactive sandboxes using augmented reality starts back in 2003 at the MIT Media Lab: Tangible Media group where five specialists create the Sandscape, using the very expensive Minolta Vivid-900 laser scanner [24]. After six years, in 2009, the famous company Disney Enterprises Inc. presents the Storyteller box at D23: Expo. This interactive sandbox gives a little different opportunity to the users: to follow and take part of the life story of a turtle eggs and the journey of the eyas turtles into the sea [25].

Later Oliver Kreylos and his team from the University of California: UC Davis are inspired by video presentation on its early prototype: the SandyStation, which is developed by researchers from the University of West Bohemia, the Czech Republic [26]. After that Kreylos and his colleagues make the idea available to everyone by creating the open-source Augmented Reality Sandbox [27]. The free software, the full installation instructions and the quite low cost construction elements of the system are the reason to choose this particular one in order to fulfill the idea of presenting the children in an interesting, fun memorable way some of the disaster types and using it to train them of evacuation and safety steps.

In help for learning more about the way that AR Sandbox works was Olwal's work [3] where he describe with details the four types of display technologies for AR as follows:

- **Optical see-trough displays**: in this case an optical combiner is used, usually a half-silvered mirror or a holographic material, which *"provide an optically direct view of the environment, with a simultaneous presentation of computer-generated imagery"*.
- **Video see-trough displays**: it is based on camera, a computer and video display. The camera gives the view of the environment, the computer generates the virtual objects and the display combines the view to the user. Example can be the AR book on Figure 4b.
- **Spatially aware handheld displays:** it is an alternative way to combine the computer graphics and the real environment but while using a tracked handheld display without optical or video see-through capabilities. In this case the geometric connections between the real and the virtual objects are not so strong.
- **Direct projection**: this technology uses direct projecting of graphics onto the real environment. In this case the augmentation is fulfilled over a real surface and the combination between real and virtual is perceived more naturally by the user.

According to this Olwal's classification, the AR Sandbox uses the last technology. The direct light projection is over a real box full of sand and the virtual content in this case is a virtual topography (Figure 5a).

The system is constructed of a computer, equipped with powerful simulation and visualization software, a sensor camera (Kinect sensor), a data projector and a sandbox (Figure 5b). For the development of the driving software the creators ground on Vriu VR development toolkit and Kinect 3D video processing framework.

AR Sandbox is impressive way to present a topographic model. The best quality of this system is that while changing the sand in the box, the user changes also the virtual isolines and the hypsometric coloring in real time. The relief in the sandbox is recalculating according to the depth data, sensed by the Kinect camera and processed by the software in

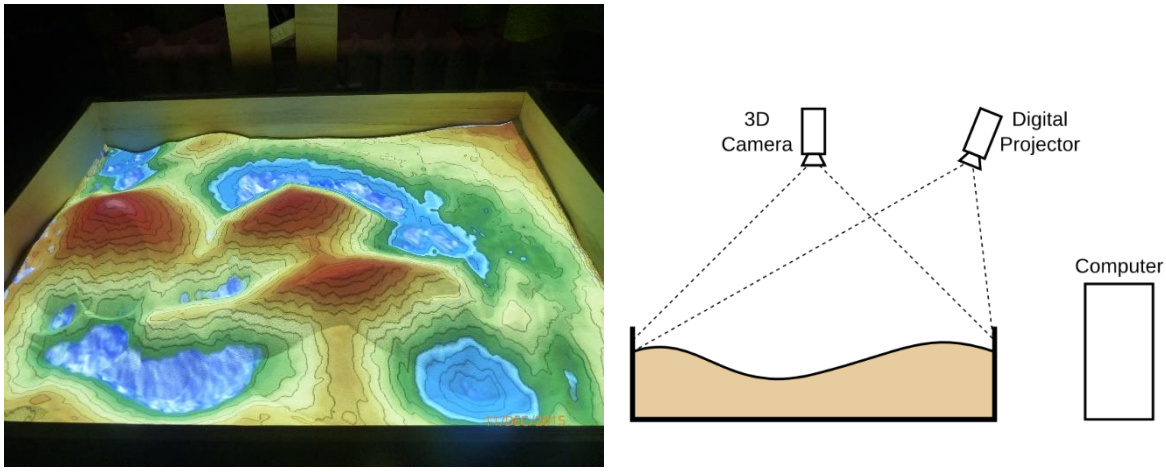

Figure 40. a) Virtual topography projected directly over the sand; b) The AR Sandbox system construction (http://www.blendbureaux.com).

every moment. After these steps, it is rendered from the data projector over the sandbox, depicting perfectly matched virtual relief over the sand landscape. The developers give the users which created their own sandbox, the option to customize the hypsometric color schemes, according to their discretion. This is possible because of the combinations of some GLSL shaders [27].

One of the special characteristic of the AR Sandbox, which is the reason to be chosen for our purposes, is the water simulation. Based on equations from the discipline Fluid Dynamics, the system shows what water does after its falling over the relief after rain. Just like in nature, the simulated water mass follows the relief forms: moving from the highest to the lowest elevations, going faster through the steep landforms and accumulates in the closed ones. This simulation is based on Saint-Venant set of shallow water equations which *"describe the flow below a pressure surface in a fluid"* [28]. The intensity of the rain simulation can be controlled trough a software menu and this helps for acting out different disaster scenarios. The ability of the system to simulate water (Figure 6) is useful and important in our case when visual explanations of emergencies like heavy rain, flood or dam cracking are needed.

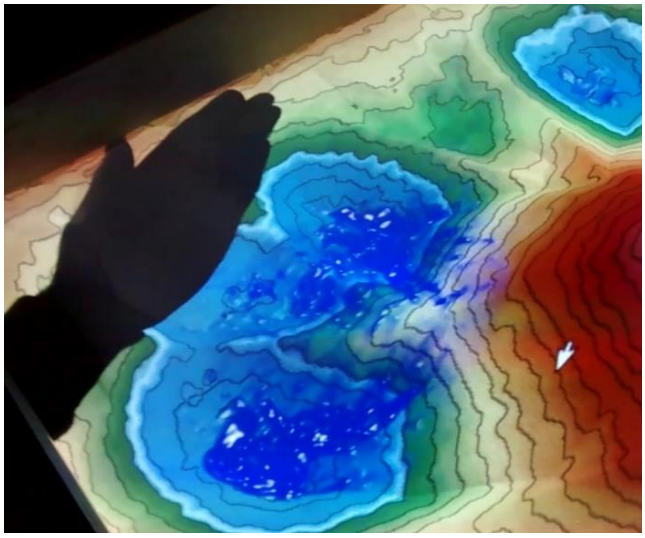

Figure 41. Water simulation in the AR Sandbox.

The main idea of the creators is to develop 3D visualization application which will be exhibited in museums in order to teach the main concepts of geology, hydrogeology and geography, using the augmented reality to explain some of the terms in these science disciplines. But in addition from cartographic point of view it is also a good way to teach students how to read topographic maps. Last but not least, it is an incredible tool for disaster simulations which offers countless scenarios of emergency cases not only for floods but even for forest fires.

Augmented reality sandbox in the Laboratory of Cartography in UACEG

The AR Sandbox is constructed for the first time in Bulgaria in the Laboratory of Cartography in UACEG. Instructions for the elaboration of the stand and the box are not available on the site of Oliver Kreylos except the proportions between the main integral parts of the system. Nevertheless, for this particular construction Kreylos's sandbox is used for prototype but this time it is made from wood (Figure 7). It does not matter what materials the system is made of. There are also many geometrical decisions. The only thing that must be kept is the distances between the projector, the sensor and the sandbox in order the virtual relief to be projected properly over the box.

Figure 42. The prototype in the Laboratory of Cartography, UACEG.

The volume of the sandbox is 0, 2 m^3 and it contains 175 kilos sand which is specially chosen to be with high reflection characteristics. It is white quartz sand with no chemical admixtures as it has to be safe for use from children and students. The software used to drive the closed loop of computer, projector and sensor is developed for the free operational system Linux and it is based on open-source code.

To provide accurate projection of the isolines and the hypsometric coloring over the sand landscapes in the sandbox, calibration is needed. This stage is required for properly working AR Sandbox. The calibration process presents the registration of the center of a white disc which is placed consecutively in twelve positions in the sandbox, required and pointed from the software. The white disc must be placed in one point on high and one on low elevation referred form the average sand level. This stage can continue until the necessary accuracy of the projection is fulfilled. In this case the RPM is 1.76 mm. The calibration process (Figure 8) must be repeated periodically because the AR Sandbox construction is very sensitive to external influence.

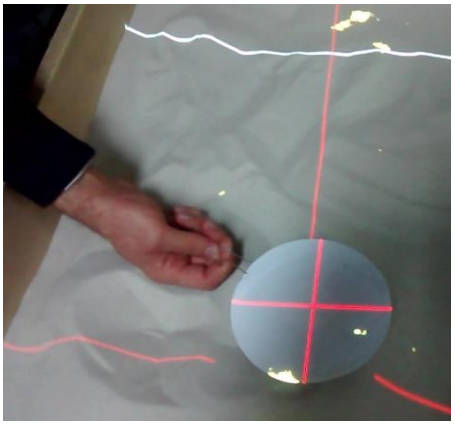

Figure 43. The calibration process of the AR Sandbox.

Interest from students and experts

Since the AR Sandbox has been constructed in the Laboratory of Cartography, students, surveyors and cartographers have shown a great interest in it. The demonstration of its work often raises questions and discussions about the future use of the system. Sharing ideas and experience with foreign researchers and colleagues, help us to expand the horizons for further development and future improvements. At this moment the work over the Augmented Reality Sandbox is focused on giving proposals how to be included in educational disaster programs for children training.

AUGMENTED REALITY SANDBOX IN EDUCATIONAL DISASTER RESPONSE PROGRAMS FOR CHILDREN AND STUDENTS

This research aims to define the role of the AR Sandbox in educational programs and its special place in the children trainings for disaster response. The use of AR Sandbox is just a part of the bigger aim to create an Educational Disaster Centre [29]. This simulation system will improve the theory lessons and the training activities for some disaster cases and especially floods.

In future it is planned to include in the preparation processes of the educational activities not only disaster management specialists and cartographers but also teachers, pedagogues and even psychologists. There is no doubt that the activities with the Sandbox must be conformable to children's age and this is the reason to be distinguished four children age groups and extra one for the university students as follows:

- Group I - Age 4 – 6 – Preschool
- Group II - Age 7 – 10 – Primary school
- Group III - Age 11 – 13 – Secondary school
- Group IV - Age 14 – 18 – High school
- University students

These groups are defined by several criteria such as cognitive development, interests and acquired knowledge, etc. and for easy organization in future it is conformed to the structure of the official Bulgarian educational system.

In order to explain the disasters via AR Sandbox, five thematic and interconnected modules are planned. The learning material is divided to Relief (1), Hydrology (2), Disaster events (3), Disasters & Ecology (4) and Introduction to Augmented reality (0) (Figure 9). The first two: Relief and Hydrology, explain basics geological and hydrological terms which lay the foundation for further presentation and explanations in the Disaster events stage. The Disasters & Ecology module is included to demonstrate that the human impact can be also a severe agent of such emergencies. Most of the activities in the first two modules are based on the Facilitation Guide for "Shaping Watershed" exhibition, however the big idea there is to present the water as critical resource on the Earth focusing on water distribution [30]. As it has been already said in this case the simulation system will be used for disaster response training which lays on the same basic conceptions of geology and hydrology. On Figure 10 are presented the future activities which are distinguished according to the modules and the age of the children. To catch the interest of the age group IV and the group of the university students the module ***Introduction to Augmented reality*** will be included. It will be focused on what is AR, how the Sandbox works, and will give the opportunity to students and scholars to ask questions and to share ideas for future system improvement.

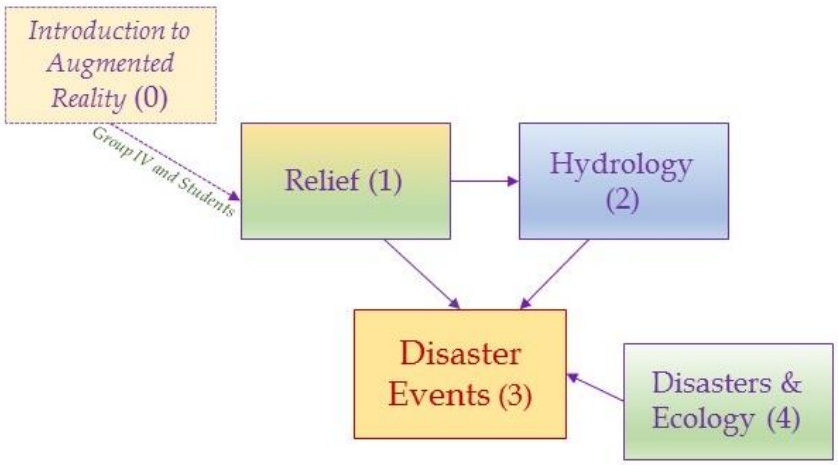

Figure 44. Connection between the planned modules.

Module I: Relief - Theory and Activities

There is a purpose for this module to come first among all four. Without understanding the concept of relief the task to explain events such as floods, drought and fires will not be just difficult but impossible. *What is relief* must be the first lesson learned from the children. One of the most difficult tasks for them is to understand relief on a 2D map and to visualize it over the real surroundings. To improve their orientation in the environment a comparison between the representation of the relief on topographic map and on the AR sandbox is proposed. This will also include the explanations of terms such as **elevation**, **contours** and **hypsometric coloring** which are also visualized over the sand. Topics such as *Where the relief is steep and where is flat?* will be discussed. Presenting the landforms is another subject which will be touched. This part of the training will include shaping different **landforms** in the sand based on prepared in advance examples from real topographic maps. In order to understand the concept of relief, the experience with the AR Sandbox will be enriched with other fun activities and even with easy mathematical calculations (Figure 10).

Module II: Hydrology - Theory and Activities

Together with the Relief, the Hydrology module explains how the water flows through the landforms on the Earth. Discussions will be made over the important issues such as what is the presumable path of the water or where it will be accumulated in case of rain. This is possible thanks to the AR Sandbox and the opportunity to create virtual rain. The rain goes through the landforms according to mathematical equations driven by the software in order to represent accurately its behavior in the environment. The watershed term will be explained to the children and demonstration of how the surface drain after precipitation will be made via the Sandbox's Drain function. The audience also have the chance to create their own watersheds and water bodies in the sand filling them with virtual rain.

Module III: Disaster events - Theory and Activities

Once the main terms from geology, geomorphology and hydrology are briefly explained, it is time to continue with the essential: the disaster training activities. It has already been said that AR Sandbox is a convenient tool for presenting multiple kinds of disasters, especially for simulations of floods. This is the reason the proposed activities to be focused on this type of emergency. The virtual rain plays a special role in Module III because it can visually explain the term heavy rain. While controlling the intensity of the precipitation, the sandbox turns into a field where different types of flood can be demonstrated e.g. flash floods or riverine floods. To enhance the realism, a requisite consisting small houses and a dam wall is used. These scale models help to obtain close to reality flood or dam failure cases in a settlement and give the opportunity various situations to be played. This activity is important part of Module III. The reason is that Bulgaria suffers from incidents which are quite often a result of the combination of heavy rain and bad infrastructure. The activities here include some demonstrations of floods, dam failure and discussions which will help children to understand the nature of the these events and will incite them to take better decisions in order to save their own or others' life in case of such disaster. In order to give answers to questions like *Where is the safest place?* in such emergencies, a simple 3D maze is built and will be used as a game for age Group I, II and III. The starting point is the flooded home or school and the final is the highest point of the sandbox or in other words the highest place in the settlement. Special discussions with Group IV will be focused on urban planning. The students will make proposals where to place a settlement or where to build a house in order to find the safest place complying with the relief and the flood potential.

Module IV: Disasters & Ecology

Module IV has one aim: to raise the children awareness of pollution and its connection with the disaster events. They must be acquainted with the fact that although the natural disasters are unstoppable and under the control of Mother Nature, the human acts can also be threads. For example sometimes the consequences by the heavy rain can be enhanced by the lack of infrastructure maintenance and the accumulation of human waste in the riverbeds. In this Module the activities are connected with demonstration of what happens when a riverbed is polluted in case of heavy rain. The children will have the opportunity to put "waste" into a river and to see how the flooded area raise in real time.

Module: Introduction to Augmented reality for Group IV and university students

The last module is additional and specially included for the youth audience. It is presumable that scholars from Group IV and university students will be interested in the technical issues around the AR Sandbox. This is the reason to be

Module	Activity	Age Group
Relief	Comparison between the relief on 2D map and the projected over the sand	II, III, IV
	Calculation of elevation between two points	II, III, IV
	What is steep relief and what is flat?	II, III, IV
	Shaping landforms in the sand from topographic map	II, III
Hydrology	Making virtual rain and demonstrations of flash floods	I, II, III, IV
	Predicting water path	II, III, IV
	Defining and making own *Watershed*	II, III, IV
	Making own water bodies	I, II, III
Disaster Events	Making virtual heavy rain and demonstration of flash flood	I, II, III, IV
	Demonstration of riverine flood	I, II, III, IV
	Demonstration of dam failure	I, II, III, IV
	Where is the safest place in the settlement?	I, II, III, IV
	A 3D maze game – evacuation in case of flood	I, II, III
	Discussion over urban planning	IV
Disaster & Ecology	Flood demonstration in case of riverbed pollution	I, II, III, IV
Introduction to AR	Discussions over AR, AR Sandbox and future improvements	IV and University students

Figure 45. Planned activities with the AR Sandbox, according to the module and the children's age.

made brief explanations of what Augmented Reality is, how it works and have they ever met before it in life. The working principle of the AR Sandbox will be presented and discussions over the future use will be made. Fresh ideas and proposals for improvement of the system will be gladly taken.

CONCLUSIONS AND FUTURE WORK

The technology nowadays is developing very fast so children of today and the future will be growing up and changing with it. Although the Augmented Reality is invented in the last years of the 20th century it is still meant to be a

technology of the future. Exactly this potential of AR is the reason for exploring ways to be included in the new educational programs and activities. In this case was presented just one of the many opportunities through which this innovation can become part of the modern lessons in school. The Augmented Reality Sandbox is an example that the AR is a great tool for presenting specific information to children. Although the work done in this direction with the AR Sandbox is just in the beginning, we are glad of the wide interest shown by experts and students. The listed activities are just one of the many included in the proposal for Educational Disaster Centre which will be developed in detail with the help of teachers and psychologists. After that the future work will be focused on pilot tests with children. In the near future improvements on the hardware and the software of the AR Sandbox system are not planned but we hope that in the process of work some ideas for development will come up and will be fulfilled.

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