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Acta Geoturistica **V**olume **10** (2019), number **2**, 15-20

Education in disciplines of geoscience by non-traditional methods

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Abstract.

It is very important to deal with education in geoscience and to bring raw materials and mining closer to society. This theme is absent at elementary and secondary schools and students often do not know opportunities to study geoscience discipline at universities. Faculty of Mining, Ecology, Process Control and Geotechnologies of Technical university in Košice has elaborated a lot of projects dealing with this issue. One of the EIT Raw materials KAVA project is Virtual Mine – educational model for Wider Society. Thanks to the project many lectures and activities were organised for children and students at the age of 6 to 19 years. Main goal was to bring geology and knowledge about understanding geological processes of the planet Earth and raw materials closer to young people. A lot of students participated in lectures and workshop and a lot of geological activities were prepared for them.

Keywords: *education, geoscience, Virtual Mine project, elementary school, raw materials*

Introduction

Thinking about the near future, it may sound like a utopia to build a new scientific culture which should begin at school since childhood (Estrella, 2018). According to the education system of many countries of the world, students do not have a chance to be in contact with subject like Geology. This is one of the reasons that students do not follow Geology at undergraduate course or at university (Wickramasooriya, 2018). It is decisive to arouse the interest of Studies in Geosciences at such early age as it is possible. The key institutions are elementary schools. Geoscience education will progress most effectively through extending geoscience learning to all children and educating teachers (King, 2008). A fundamental goal of geoscience education is ensuring that all inhabitants of the planet have knowledge of the natural processes that shape the physical environment, and understand how the actions of humans have an impact on the Earth on local, regional, and global scales (Locke et al., 2012). There are many various projects which are dealing with education of young people in geosciences all over the world. The eminent organization in Europe, which helps educate and gives opportunities to learn students about importance of raw materials is EIT RawMaterials. The mission of the institute is enable sustainable competitiveness of the European minerals, metals and materials sector along the value chain by driving innovation, education and entrepreneurship (https://eitrawmaterials.eu/about-us/vision-mission/). One of the EIT KAVA project is Virtual Mine – educational model for Wider Society.

Virtual Mine project

The main goal of the KAVA project Virtual Mine – educational model for Wider Society was to create a model of education which includes three aspects– interactivity, activity/movement and modern technologies to achieve the most efficient educational process (Molokáč et al., 2017). The educational program was created for five target groups: the local community, business sector, local governments and regional organizations, general public, children and students. The Virtual Mine partners created many non-traditional educational tools. For example, they produced short films and presentations advertising the offer of educational activities regarding mining. The partners also created the comic book „Kobold the Treasures and a history of raw materials in a nutshell“ and devised the game Roboblocks based on playing with Lego blocks (Molokáč et al., 2019). Thanks to Virtual Mine project, a number of events and workshops were organized.

The children are the center of attention in education and nowadays they are accommodating to the age full of modern devices. It was created the 3D image in the form of hologram which represents the miner in mining clothes with mining equipment. Also the PC game „Life without raw materials“ and application of 3D visualization of copper mine were created (https://sites.google.com/view/virtualmine/home).

Virtual Mine – workshops in Slovakia

Museum and geoparks are appropriate places providing the geoscience education for wider society. Faculty of Mining, Ecology, Process control and Geotechnologies of Technical University in Košice as one of the partners of Virtual mine project, has also convenient venues where different types of events take place. We have conducted the lectures and workshops in Geoscience exposition room which is the museum-like place with exposition of rocks, minerals and fossils.

Although the idea of Virtual Mine project implies five target groups, we have focused on young generation – children and students. The project educational program has developed the methods to explain the importance of raw materials in our life to young people and provide them knowledge about mining and geology.

We organized lot of workshops and created various presentations for children and students of elementary and secondary schools. Participated students were not only from Košice but from schools of whole Eastern Slovak Region too. Approximately 1000 participants attended the workshops throughout the project. We prepared more than 30 workshops. We selected three target groups of students based on the age: 6 – 10, 11 – 15, 16 – 19 years old. Then we conceived various activities consisting of entertaining, interactive and gameplay elements that correspond to the level of education. As it is written above, the target group were children and students aged 6 to 19 years – the age corresponding to elementary and secondary school students. The capacity of our event venue allowed us to invite one to three classrooms per day which means to prepare activities for 15 to 60 students.

Every workshop started with the lecture about raw materials, for example: My best friend, the cell phone – Material composition of a mobile phone (Fig. 1), How a cobblestone is formed, What is hidden in the stone, etc.

Fig. 1 Lecture called My best friend, the cell phone – Material composition of a mobile phone (photo: author)

Then the students were divided into groups (as needed) and participated in a specific activity. In following text we provide the list and description of activities:

Make your own mineral bracelet – children strung the mineral beads on the elastic band and made the bracelet. Original raw mineral was also available for children to see difference between original mineral and polished mineral stone beads. Since they could take the handmade product home and show it to parents this activity was one of the most popular among girls, but boys were impressed as well (Fig. 2, 3).

Fig. 2 Mineral bracelet workshop (photo: author)

Fig. 3 Handmade bracelets as the result of the workshop (photo: author)

Gold–panning – we poured water, spilled gravel, pebbles and pieces of pyrite into a big plastic container. Children first listened to the lecture about gold-panning history and gold panning techniques. Then they were trying to find „Fool's gold" by the small circular movements with a gold pan while holding it just below the surface of the water (Fig. 4).

Fig. 4 Gold –panning (photo: author)

Find a mineral – on the basis of 10 photos of different minerals children had to find the real mineral sample placed in 28 glass showcases (1200 pieces of minerals) and write the correct name of a mineral to the prepared table.

Find a fossil – it is the same activity like „Find a mineral" but children are looking for the specific fossils placed in the glass showcases.

Observing rocks/minerals under a microscope – children were amazed by the beauty of rocks under the polarizing microscope or the beautiful magnified crystal under binocular microscope.

Make your picture of ancient world – all participating children had to color the sketch of animal and plant fossils and then stuck it on the already prepared artwork. They had to recognize whether the fossil lived in the sea/ocean or on the land. Finally, children took the picture with them as a reminder of the event (Fig. 5, 6).

Fig. 5 Making of picture by drawing fossils (photo: author)

Fig. 6 Result of the activity "Make your picture of ancient world" (photo: author)

Geocaching – we hid the treasure on the special place in the area of Technical university. Students were looking for it by the use of GPS devices and on the basis of given hints. The treasure were small pieces of polished minerals enclosed in a small box.

Geoquizzes for grammar school students – students in groups had to compete and solve quizzes in the fastest and the most correct way. Every group got 3 worksheets: 1. Write the correct name of the different parts of a volcano into a frame, 2. Locate some of the world's most famous volcanoes on a map using their latitude and longitude coordinates, 3. Write the correct name of the landform into a frame.

Mineralogical memory card game – the object of this mineral themed memory game was to turn over pairs of matching cards and distinguish one mineral from another. We used picture memory card game but also memory game with the real minerals hidden under the small boxes.

Make a crown and become a princess – we prepared paper royal crown templates and participating female pupils had to cut, colored, and decorated them with gem stickers (Fig. 7, 8). Children learnt that gem stones are the pieces of minerals which were cut and polished and used for jewelry and royal crown too.

Fig. 7 Making of princess crown (photo: author)

Fig. 8 Children`s joy at the end of the workshop (photo: author)

Cinderella – we printed the pictures of minerals and put plenty of small polished minerals into a box. Students had to assort them and pair the piece of mineral with the correct picture (Fig. 9).

Fig. 9 Activity "Cinderella" (photo: author)

Planet Earth– children got sketch of the planet Earth. They used glue and then they poured the colored sand on the sticky paper parts - the blue colored sand for the ocean, green for the land and brown for the mountains.

What did you like? – it used to be a last activity of the whole workshop. Every student could choose one of the most beautiful or interesting mineral or fossil from showcases in Geoscience exposition and they drew it on the paper. The students were supposed to write (on the other side of the paper) what they liked and which information they remembered from the lecture or whole workshop.

Discussion

Nowadays, it is well known that the method of teaching based on active learning gives better results when compared to a traditional lecture-based course (Carneiro and Goncalves, 2010).

We prepared 13 various activities for the students. Each of them were tailor-made for children of different ages. Each activity was aimed at the geological theme and raw materials. The main goal was to provide children and students with the knowledge about our planet, rocks, minerals, ancient world of fossils, etc., because these topics are missing in the teaching synopsis of elementary and secondary schools or they are only marginally taught. In Table 1 we compiled a summary of the activities that we prepared for our visitors. Every workshop had a special idea of bringing some part of geosciences closer to the general public. Some activities were suitable for every age group of children and some only for the littlest children or only for teenagers. We were able to evaluate the satisfaction of students with the activities and general impression of the workshop on the basis of questionnaire survey which children had completed at the end of the workshop. In the evaluation we used the marks 1, 2, 3 where 1 expresses perfect impression and amazing experience of workshop, 2 is for good, interesting experience but not so strong impression of workshop and 3 expresses not very interesting and a little bit boring experience.

Activity	Suitable for children aged			Evaluation
	6 - 10	11 - 15	16 - 19	
Make your own mineral bracelet	✓	✓	✓	1
Gold - panning	✓	✓	✓	1
Find a mineral	x	✓	✓	2
Find a fossil	x	✓	✓	2
Observing rocks/minerals under a microscope	✓	✓	✓	2
Make your picture of ancient world	✓	x	x	1
Geocaching	x	✓	✓	1
Geoquizzes	x	✓	✓	2
Mineralogical memory card game	✓	✓	✓	2
Make a crown and become a princess	✓	x	x	2
Cinderella	✓	✓	✓	1
Planet Earth	✓	x	x	2
What did you like?	✓	✓	✓	2
Mineralogical exposition tour	✓	✓	✓	3
The lecture	✓	✓	✓	3

Table 1. Summary of workshop activities and their evaluation

We can state the following findings: When the workshop comprised only of the lecture or mineralogical exposition tour, it was boring and not very interesting for children. The participating students liked more than 50 percent of activities and approximately 40 percent of activities were considered amazing and left a great impression on the children. The most popular activities for children were one of those, which allowed them to create some handmade products and could take home their own souvenir or piece of work.

Conclusion

The teaching and learning process which consists of fun activities, unusual lectures, interactivity, workshops, educational games and others, is more memorable and interesting for children. As a positive feedback from children and their teachers serves not only the satisfactory answers of the questionnaire survey but also the fact they return repeatedly and recommend the workshops to others. It represents a considerable achievement and success for us. The goal of these activities is not only bring the geoscience disciplines closer to young people but also show that raw materials are used in our daily life and we can't imagine living without them. For the education in geoscience disciplines it is still long way to go to become more attractive for children and youth, but we are sure that this kind of promotion is of great importance.

Acknowledgments

This publication is the result of the implementation of the project Virtual Mine as a modeling tool for Wider Society Learning, EIT/RAW MATERIALS/SGA2017/1 supported by EIT.

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