The Use of Digital Technologies in the Science Camp VEBOR

Beáta Brestenská, Jana Cibulková, Petra Ivánková

Abstract

Summer science camps for young people are full of different activities that develop children's motivation, to learn and get enthusiastic about natural science subjects in schools. The main meaning of the camps is to increase interest in science and develop a positive relationship with nature as well as environmental responsibility. One of the ways to implement these activities is to work with digital technologies. During the camp we used measuring equipment that supports the scientific character of the camp and mobile devices like tablets as working tools and a source of information in connection with the Internet.

Key words: science camp, digital technologies, measuring equipment, tablets.

Abstrakt

Letní vědecký tábor pro děti zahrnuje množství rozdílných aktivit, které rozvíjejí motivaci dětí učit se a nadchnout se pro přírodovědné předměty ve školách. Hlavním smysl tábora je zvýšit zájem dětí o vědu a rozvíjet jejich pozitivní vztah k přírodě, tedy environmentální odpovědnost. Jednou z možností implementace těchto aktivit je aktivní práce s digitálními technologiemi. Během realizace tábora jsme používali měřicí zařízení, která podporovala vědecký charakter tábora. Také jsme využívali tablety, které sloužily jako pracovní nástroj a informační zdroj pro připojení na Internet.

Klíčová slova: vědecký tabor, digitální technologie, měřicí přístroje, tablet.

Introduction

In this article, we will prove that science camps are the right place for teaching natural science in nature. It fosters playful and experience-based learning which motivates and supports comprehension of the abstract concepts and scientific processes. Empiricism is the essential condition in order to understand them. For research purposes, the science world makes a frequent use of the most varied technologies and devices, to simulate their work not only in laboratories, but mainly in the field. Therefore, we applied digital technologies (measuring and mobile devices, sensors, digital microscope, etc.) in the science camp too.

1 Digital Technologies and Science Camp

Due to the recent lack of interest of young people in the area of natural science, different projects have been launched to keep increase in their interest. Summer science camps are one of them. Realized activities in the summer camps support the interest and motivation of children and youth in the field of natural science and technology. At the same time, the camps help develop a connection with nature. The International SciCamp project started in 2012 with three main ideas as follows (SciCamp, 2015):

- To create a European network of science camp organizers and allow for sharing of their experience.
- To connect the science camp organizers with local institutions dealing with scientific research.
- To integrate science camps in school systems.

Other goal of the science camps is to navigate young people in their search of roles – scientist and engineer. "A Science Camp is a residential science education program, which offers various activities for young people of 6–20 years of age, aimed at supporting and strengthening (SciCamp, 2015) their science, technology, engineering and math (STEM) skills, and which lasts at least two days with one overnight (usually) within the camp premises." (Sveegaard, 2014).

Science camp target younger audience, they are appropriate to introduce individual scientific fields in a "playful and entertaining way" (Veda nás baví, 2016). Therefore, the activities should be adjusted to the form of experiential teaching. Yet in the 1940s, the German pedagogue Kurt Hahn launched the first experience-based summer school (Hypeš, 2007). One of the most famous experience-based camps is the summer school Lipnice in the Czech Republic, which organizes many courses dedicated to personality development (Prázdninová škola Lipnice, 2016). Its mission is to motivate humans to bravery and creativity.

Digital technologies (DT) are teaching tools used in the (science) education quite frequently. DT are the tools to support the process of learning and teaching, to develop critical thinking and problem solving skills, or to develop the ability to cooperate and communicate. Also DT develop digital skills of students as well as teachers who become digitally literate. DT support the development of science and social competence during the learning process (Kalaš, 2010; Kern, 2008).

In the science camp program we decided to use various types of digital technologies:

1. Measuring equipment
   With the respect to scientific nature of the camp the mission of which is to convey children the science in a fun and informal way. Measuring instruments are proper alternative, resp. they are the tools for getting real science (chemistry) outside the (science or school) laboratory. The advantage of measuring equipment with integrated computer is its mobility and therefore they are suitable for field work, so for science camp too (Prokša et al., 2015). In the science camp we used measuring equipment LabQuest, LabQuest 2 in Figure 1 in the connection with the sensors to measure pH, temperature and conductivity of selected materials.

Figure 1
Selected measuring equipment in the science camp

- Mobile devices
  Mobile devices include tablets, smartphones with various attachments which are assimilated to the Slovak school environment through the national program OPIS – Operational Program Informatization of Society (Government Office of the Slovak Republic, 2013). Since 2013, the OPIS has supported national projects focused on digitalization of the education system, for example Digiškola (Digiškola, 2016) and Škola na dotyk (Škola na dotyk, 2016). For the needs of the camp, we used tablets (connected to the Internet) with the Android operating system and Windows tablets (Figure 2) primarily as the source of the information and its processing.

Figure 2
Selected mobile devices in the science camp

- Digital microscope
  Digital microscope is a very interesting digital technology which can be used for observation of subjects during camp activities and for direct visualization on the chosen display area (computer, interactive whiteboard, screen). Flaškár et al. (2010) consider this tool as the excellent way to use digital technologies in biology.
- Other technologies
  For astronomy activities, we used a digital telescope and a classic astronomy telescope to compare their properties. We also used notebooks and printers for technical and administrative needs of the science camp.

2 General Background of Research

During the first year children dealt with topics such as astronomy, orientation in the field, water, biochemistry and green chemistry. Topics were designed according to ISCED 2 of selected subjects – biology, chemistry and geography. Prepared activities followed the content of the mentioned subjects in 5th grade, for example themes: Earth in geography, water in chemistry, or life in forest and work with microscope in biology. With the support of sponsors and university grants, it was possible to try interesting digital technologies which added a completely new dimension to the event.

The Science Camp VEBOR took place in the recreation center Smolenice Záruby, tailored to the individual activities such as field trip to the city Smolenice, the cave Driny and the beekeeping Včelco. All activities were carried out through experiential learning.

2.1 Activities with the Use of Digital Technologies

During the science camp we realized activities with the use of selected digital technologies displayed in Table 1.

Table 1
The design of activities with selected digital technologies

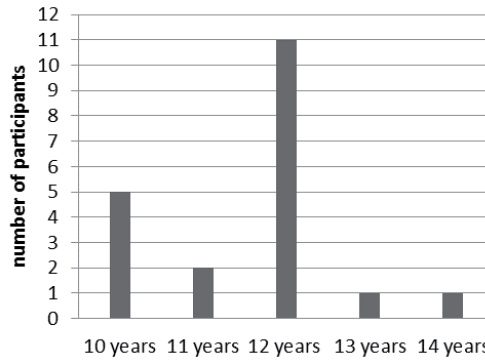
The name	Science	The goals of activities	Digital technologies
Session with an astronomer	Astronomy, geography	To be able to find, define and name visible elements of solar system (stars, planets), based on the work with a digital telescope, sky map and led by the guidance of an expert.	Digital telescope
Herbalist	Biology, botany	To collect plants during a walk in the forest and to name them using an atlas of plants by their characteristics. To prepare parts of plants (leaf, stem, plant cell) for observation of the anatomy and physiology of plant organs and cells.	Digital microscope
Hidden water treasure	Microworld	To observe samples from prepared hay infusion through digital microscope – the presence of living organisms. To study biotic properties of water.	Digital microscope
The secret of water	General chemistry,	To solve prepared problems, based on factors affecting the properties of water in daily life with the use of tablets and measuring equipment.	Measuring equipment, mobile devices – tablets

The implemented activities were conducted mostly in group work. At the beginning of the camp, the children were divided in 4 groups or scientific teams in order to encourage children to communicate and collaborate both in separated groups as well as among groups.

2.2 Sample of Research

The Science Camp VEBOR was designed for children aged from 10 to 14 years. The number of participants was 20 including 11 girls and 9 boys. The children are pupils of lower secondary schools: 5th–9th grades. The largest number of children was of 12 years of age which means that dominating were pupils of the 6th and 7th grades in primary schools, as displayed in Graph 1.

Graph 1
The age of participants



2.3 Data Collection Methods

At the beginning of the science camp a knowledge-based quiz from different subjects (chemistry, biology, physics, geography) was used to determine the level of the children's knowledge. Quiz tasks were based on real-life problem solving.

Initial interviews were also carried out with each child individually. The structured interviews were used to capture data about the participants' relationship to nature and natural sciences.

Final structured interviews focused on impressions and opinions of the children on the science camp, its realization and camp activities.

3 Results and Discussion

The initial interviews reflect the way the children's perception of science as such and their ideas of scientists, their mission in the world of science ("A person who is fascinated by the world around us. Therefore, they are trying to understand the world around us and teaching others, even if it does not make sense."). In the second part of the initial interviews, the children expressed the reasons and their motivation to participate in the Science Camp VEBOR. Interesting answers to the question were: "Because I enjoy science.", "I like observing.", "I was on other science camps.", "I like physics and chemistry. I wanted to learn something new about these subjects."

3.1 Overview of Activities with the Use of Digital Technologies

The design and realization of suggested activities that were actually carried out are slightly different. As a result of unexpected changes, we had to adjust the activities to the actual circumstances in the field. In the following part, individual activities with the implementation of digital technologies will be described.

3.1.1 Session with an Astronomer

Star observation with the use of a telescope is a fascinating experience, which enchanted all the camp participants. However, the observation was preceded by a proper preparation. Starting with Wi-Fi network connected tablets, they read about our solar system, found out information about planets – their constitution, characteristics (color, size, shape, etc.) and the position of the Earth in the universe in Figure 3. Afterwards, they had to prepare their own posters in Figure 4.

Figures 3 and 4
Our solar system

Before the observation of the night sky, they played a group game, the purpose of which was to collect all parts of a paper telescope as fast as possible in Figure 5. The goal of this game was to introduce the children to basic construction of a classic telescope.

Figure 5
The construction of a classic telescope

The night sky observation was led by a professional from the Department of Astronomy, Physics of the Earth and Meteorology of Comenius University in Bratislava. Working in an unknown field requires a due preparation; the astrologer arrived in the afternoon to check the most suitable location for the sky observation. He brought one classic telescope and one digital telescope to show the advantages and disadvantages of both. When the professional had chosen the right location for observation, he had to take into consideration the limited conditions for electricity connection and cabling which are necessary for the use of the digital telescope. Nevertheless, this is the only disadvantage of the digital telescope in comparison with the classic one. The digital telescope allowed the children to see space objects under the same weather conditions much better compared to the classic telescope.

The children were excited and enthusiastic about the astronomer's explanations, they patiently watched stars, star clusters, planets Saturn and Mars, moons of Mars, etc. in Figure 6. On the digital telescope, it was possible to set the codes of the position of individual objects so that the telescope found them itself without any further help from the astronomer, which accelerated the whole observation and saved the astrologer a lot of time.

Figure 6
The night sky observation

3.1.2 Hidden Water Treasure

The original idea was to research biotic properties of different samples of local water resources. Unfortunately, the local brook dried up so we focused our attention on the artificially prepared hay infusion and observation of the organisms living in this type of water. We turned the preparation of hay infusion into a fun activity for the children. Even though we had to wait three days before we could actually use it. To complete this activity, we used work sheets randomly hidden in the close area of the camp premises. Children received a map leading to the worksheets after they had participated in a running game in Figures 7, 8.

Figures 7, 8
The running game and the preparation of hay infusion

For the purposes of observation we equipped the children with two types of microscopes – the classic one and the digital one. The children could see that working with the digital microscope is more effective in Figure 9. While the classic microscope could be used only by one person looking through the eye-piece. The digital microscope allowed us to connect it with a data projector, so we were able to zoom in objects and view them on a huge screen, and they could be seen by everyone. As the digital microscope allowed an experienced person to guide the observation and explain the step-by-step process at once to all, it saved some time, plus it offered space for open discussion of all the camp participants in Figure10.

Figures 9, 10
The observation with a digital microscope and open discussion

3.1.3 The Secret of Water

The goal of this activity had to be modified from investigating abiotic properties of collected water samples from the neighborhood to solving problems using prepared worksheets. Topics of the problems were based on the daily life:

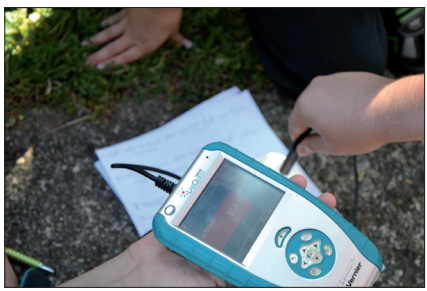
- the impact of detergents on pH of water,
- the impact of fertilizer on pH of water,
- the impact of water hardness on conductivity.

The children explored problems from the position of scientists, better said scientific teams because science is team work, by which we incorporated the elements of inquiry-based learning during the camp. They applied the measuring equipment and mobile devices – tablets for their solution.

The children were more skilled when working with tablets connected to the Internet for searching, collecting and processing the necessary information because they use tablets in everyday life and the schools participating in national projects implement tablets in lessons in Figure 11.

Then the children used the measuring equipment and the sensors Vernier or Windows tablets and sensors Pasco to measure pH, temperature, conductivity according to the nature of prepared problems in Figures 12, 13. The work with the measuring equipment was new and interesting experience for the little scientists. The children saw the process of collecting data directly in the displays of the measuring equipment which helped them to understand the observed process better.

Figures 11–13
The solving of prepared problems with the measuring equipment

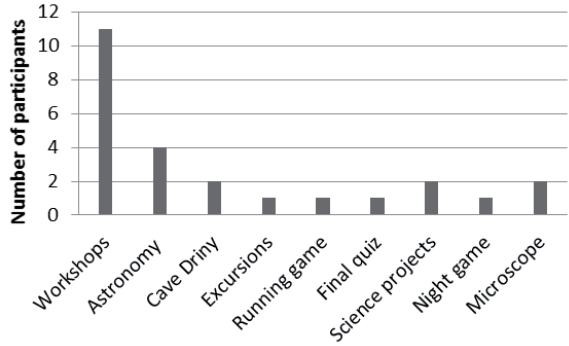


After research work and scientific activities they focused on creating a poster and a follow-up presentation in Figures 14, 15. Through visualization of the obtained data, scientific teams were able to easily process and record the data in the form of graphs and tables on the poster.

Figures 14, 15
Creation and presentation of a poster

The final interview referes mainly to the time spent at the science camp and gives feedback to the organizers of the science camp. Based on the responses of children it can be said that the the Science Camp VEBOR is an interesting, meaningful and fun way how to spend free time. The prepared activities fulfilled the pre-defined goals to get attention of the children and direct it for active learning of new knowledge. Popular activities in the science camp VEBOR are displayed in Graph 2. The most popular activity was workshops focused on biochemistry (carbohydrates and lipids) and biopolymers (bioplastic from starch). The workshops covered of four topics: 1. Honey and beekeeping, 2. How to make soap?, 3. How to make bioplastic?, 4. Dancing. They included not only scientific experiments but also discussion with a beekeeper and a physical activity too. The second most interesting part of the program was space observation and discussion with astronomy experts. Attractiveness of the astronomy topic was supported by the use of a digital telescope. Another favorite activity at the Science Camp VEBOR was scientific projects, it was necessary to work with measuring devices and the observation of selected objects through a digital microscope.

Graph 2
Popular activities in the science camp VEBOR



At the end of the final interviews, some of the children expressed interest in the integration of technology as a future topic of the program of the Science Camp VEBOR ("Maybe some information technology – IT. How IT works.").

4 Conclusions

The trend of the present days is to popularize science and technology among young people. One way is the realization of science camps for children and youth. In the science-related camp Vebor, the use of digital technology not only shows the real work of scientists, but introduces children to the use of laboratory technology too. The science camp fully leads to the personal development of children in all directions of STEM (science, technology, engineering and math). We believe that the science camp in cooperation with digital technologies, as a type of informal and experiential education, is a suitable way of learning about the world and learning from experience.

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Authors of Figures:
Figure 1. Selected measuring equipment in the science camp. Author: Cibulková, J. 2016.
Figure 2. Selected mobile devices in the science camp. Author: Cibulková, J. 2016.
Figure 3. Our solar system 1. Author: Ivánková, P. 2016.
Figure 4. Our solar system 2. Author: Ivánková, P. 2016.
Figure 5. The construction of classic telescope. Author: Ivánková, P. 2016.
Figure 6. The night sky observation. Author: Ivánková, P. 2016.
Figure 7. The running game. Author: Cibulková, J. 2016.
Figure 8. The preparation of hay infusion. Author: Ivánková, P. 2016.
Figure 9. The observation with the digital microscope and open discussion 1. Author: Cibulková, J. 2016.
Figure 10. The observation with the digital microscope and open discussion 2. Author: Cibulková, J. 2016.
Figure 11. The solving of prepared problems with the measuring equipment 1. Author: Ivánková, P. 2016.
Figure 12. The solving of prepared problems with the measuring equipment 2. Author: Ivánková, P. 2016.
Figure 13. The solving of prepared problems with the measuring equipment 3. Author: Ivánková, P. 2016.
Figure 14. Creation and presentation of a poster 1. Author: Ivánková, P. 2016.
Figure 15. Creation and presentation of a poster 2. Author: Ivánková, P. 2016.

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