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Elżbieta Rożej-Pabijan

New course on curricula of natural sciences – popularization of scientific knowledge as a tool to link science and public – good practice in higher education

Introduction

At a time when so many decisions are being made on the basis of science, it is becoming increasingly important to inform the public about the issues at stake. The question is: how to do it in a transparent way and give clear and up to date high quality information. This type of skills should be formed from early childhood education. However, particular emphasis on developing the ability to popularize scientific knowledge should be placed on higher education.

The current labor market requires people with the right knowledge, however it should be a standard qualification after higher education. But above all employers are looking for people of high level of soft skills like: communication, creativity, team work and time management. Therefore there is a need to educate students not only with academic specialized courses, but at the same time insert to their education practical workshops supporting soft competences. The course carried out as the part of project 'Animation of Scientific and Science Culture' combine the aspects of scientific knowledge and create the environment to practice soft skills.

The skills and knowledge of graduates should be broader than just preparation for teaching in formal education. The universities, especially pedagogical universities, should be an example that differs from other higher schools and prepare not only to be a teacher but also to be a competent candidate to work in museums, national parks, landscape parks as an educator or animator (Gruszka, 2004).

The study of other authors showed that the public wants to interact with scientists and people are dissatisfied with how little they can be engaged in science (Bensaude-Vincent, 2001; Blum, 2008). Thus, public engagement can play an important role in furthering the research agenda (Paul, 2004), attracting people to science and generating public support. Hence, being creative about public engagement, using alternate forms of communication and different settings, may

help to incentivize researcher involvement, reach broader audiences, and foster public fascination for science (Sayer et al., 2014).

Natural Science Popularization

During the course on the popularization of scientific knowledge at first we tried to determine when we are dealing with popularizing. Part of the students mistakenly assigned many situations of formal education, as popularizing such as: field work in their studies, laboratory exercises. Many students correctly pointed in formal situations related to the activities of natural history museums, science centers and science festivals as the popularization. It is worth mentioning that students perceive as a popularizer an individual with extensive experience in scientific work, often the person with the title of professor. They did not have the conviction that as graduates from the life sciences they can work as a popularizer of science.

Finally students agreed that popularization is a kind of communication between representatives of science and the rest of society. It is an art that requires a wide knowledge of natural science. The effectiveness of the popularization determines both the topic and the choice of means of communication, as well as the way of presentation (Hassana et al., 2009).

Another issue discussed during the classes was the role of the senses in perception of biological content. Forms and techniques of learning depend on personal preferences and the characteristics of the learner (table 1). Skills needed for popularizer of scientific knowledge is to use in popularizing the varied and attractive ways of working that will help customers remember presented content.

In this case of great importance is the adjustment of the working methods to the sensory type of recipients. The sensory type is a very important factor influencing the way we learn. It points out which senses are dominant when learning. There are three basic sensory types:

- auditory learners – people who acquire new information mainly by the sense of hearing,
- visual learners – people who remember what they see,
- kinesthetic learners – people who remember what they experience.

With the characteristics of the different kinds of sensory types come preferences regarding methods of learning.

Auditory learners prefer to listen to themselves or others. They remember best what they hear or talk themselves. They learn in a group or with another person – both asking questions and answering them. During the learning process they need peace, because sounds distract them.

Visual learners prefer to learn by watching, reading, observing or demonstrating. People with this sensory type remember best what they see in the form of graphic materials, eg. text, images, movies, presentations or charts. Visual learners will automatically acquire, transform and remember information printed or drawn. Visual clutter distracts them.

Kinesthetic learners prefer to learn by doing something and by direct involvement in experiments. This sensory type remembers best new content through the involvement in physical activity. They like to touch objects and manipulate them. While studying they need to do frequent breaks for exercise or movement.

Workshop – senses engagement in learning process

Each student identified their sensory type answering quiz questions. Among the students dominated a visual learners or mixed type: a visual and auditory learners. Then a workshop was conducted. The aim of the workshop was to demonstrate how the use of varied methods influence on proper memorization. The task was to remember as many details of the illustration from the book as possible. Three volunteers came out of the class. A teacher presented the illustration to the first volunteer, while the other two did not take part in it. The teacher used illustration but also described it in words, and at the same time performed gestures relating to the location of components in the illustration. The first volunteer repeated once the description. In this case all three senses were involved. Next the first volunteer entered the classroom and described to other students the illustration that was presented to him. The task of the group was to outline this illustration in a notebook. Then the teacher left the classroom to another volunteer and described illustration using only words and gestures. The second volunteer repeated the description. In this situation auditory and kinesthetic sense were involved. Similarly as in the first situation, a second volunteer entered the classroom and described to other students what he remembered. At the same time students performed a second draft in their notebooks. At the end the teacher went out to the third volunteer and showed him the illustration without a comment or gestures. The third volunteer walked into the classroom and described to students what he remembered. Thus the students created a third draft in their notebooks. As an effect of this workshop each student (except three volunteers) had three outlines in their notebooks. The outlines had common features but at the same time they differred noticeably. Confronted with original illustration, the most precise was the description given by the first volunteer. The largest loss of information occurred in the description of the third volunteer, who saw the illustration without any comment.

Transformation of scientific knowledge – scientific event from popular science article

The starting material for this part of the course were popular science articles in Polish on amphibians, issued by the Wigry National Park (Krzysztofiak, Krzysztofiak, 2003). These are articles of biological content. When choosing materials, several criteria were taken into account. First, the articles relate to protected species. Second, they are species difficult to observe and students have little contact with them during their studies. Third, the articles were a good example of popularization

of knowledge about amphibians – accessibly written with high quality pictures and graphics (Weiner, 2009). Papers about amphibians were the basis of group work and were also a good example of popularization of scientific knowledge. Articles related to: newts, green frogs, brown frogs and toads, spade foot and salamanders. Layout of the articles was presented in a similar way: introduction defined the general characteristics of the group. Further part of article described the representatives, with details about biology of species. The following is a portion of an article on newts:

„NEWTS *Triturus* are caudate amphibians, which means that both larval and adult forms have a well-developed tail, contrary to ecaudate amphibians, which possess a tail only during the larval stage. There are four species of newts in Poland: crested newt *Trituruscristatus*, smooth newt *Triturus vulgaris*, Carpathian newt *Triturusmontadoni*, and alpine newt *Triturusalpestris*.

Crested newt is present in Europe and Asia Minor; in Poland it is observed mainly on lowlands, and much more seldom in lower parts of mountains. It inhabits larger and deeper water reservoirs as a rule but it can be also seen in ditches, ponds and post-peat reservoirs. During the land period of life, it seeks shelters among shrubbery, under rotten trunks, sometimes in cellars and in earth mounds. In comparison to other newts, during its mating season, it stays in water for a very long time and while on land, it is a significantly stenothermal form.

Smooth newt is present in the central, northern and Eastern Europe and in Asia. It is common on lowlands in Poland while it is quite scarce in mountains. It is not fussy as regards selection of its habitat. During the mating season, it can be seen in various types of water reservoirs while during the land period of life, it can be seen in damp and shaded places, for example under stones, fallen trees, in burrows of minor mammals or in cellars.

Crested newt is the largest among Polish newts; its males reach the length of 15 centimetres while females even up to 18 centimetres. However, the smooth newt is the smallest and the most delicate species – its females reach the length of 10 centimetres while males – 11 centimetres. The fact that males are larger in comparison to females is an extraordinary phenomenon among amphibians.

The dorsal side of the body of both species is covered with dark, round spots located on a grey or olive-green background, while the ventral side of the body is yellow, orange or red, covered with dark spots. The crested newt is characterised by its specific pigmentation of toes – there are transverse red and yellow stripes located alternately while the dewlap is grey and covered with black spots. During the mating season, males develop a so called “crest” on the dorsal part of the body - this is a fold of skin which runs from the head to the tail with a break in the area of lower back (significantly smaller and more delicate crest also appears at the female of a smooth newt).

Crested newt wakes up from hibernation in March – April while the smooth newt wakes up much earlier – in February or at the beginning of March, and then enters water reservoirs, which are still being partially covered with ice. The smooth newt begins its mating activity as the first species of our amphibians - the temperature of water is estimated at 4–8°C then. It happens quite often that the mating season of the smooth newt and the crested newt falls out at the same time and in the same water reservoir. Males of caudate amphibians – contrary to males of ecaudate amphibians – do not have the ability of uttering mating sounds. During creation of a couple, chemical and visual stimuli play the major role. There are glands in the dorsal skin of newts, which produce aromatic substances which are peculiar for the given sex and species and which aim at attracting the partner. The male performs a characteristic dance in front of a female and if she accepts him, he places a spermatophore (that is a cluster of sperm cells), which is then collected by the female with the use of the lips of the cloacae. Then it is not the fertilization that takes place – this process is called insemination. Eggs are fertilized just before their laying. Eggs are laid one by one and then wrapped up into leaves of underwater plants. After approximately two weeks, larvae hatch from these eggs and they measure up to 10 millimetres. Just like in most of our caudate amphibians, the front limbs are the first to appear during the development process; the hind limbs are next to appear. The transformation takes place just after the period of three months and then young newts come out to the land. Newts run a hidden course of life on land. During the day, they seek shelter in damp recesses and they hunt in the evening and at night. They hibernate in rotten, damp trees, under stones, in piles of leaves and often are accompanied by other amphibians. They reach sexual maturity in the third year of their life. Initially, nourishment of newts mainly consists of microscopic animals, then minor crustaceans (daphnia, Cyclops, ostracods), larvae of water insects and larvae and eggs of other amphibians. While on land, they hunt slugs, moths, spiders as well as insects and their larvae. Natural foes of newts include predatory larvae of water insects, predatory fish, other newts, frogs, grass snakes, and wild and domesticated water birds – especially ducks, hedgehogs, weasels and rats.

The basic form of protection of newts is linked to protection of places of their reproduction. All newts are protected by law".

Based on the popular articles on Polish amphibians, the students prepared events popularizing scientific knowledge on amphibians. Of great importance was the knowledge level of popular scientific articles – they presented detailed content that was new for students.

As a result, students broadened their knowledge of the randomly selected amphibian group. Students usually used only parts of the article to the transformation and popularization. The students worked in six groups, up to six people each. Especially noteworthy are ideas of two groups. As the event popularizing scientific knowledge they proposed:

1. Learning game on topic „Toads, spadefoot and salamander".

The game requires prior preparation of about 50 questions about toads, spadefoot and salamander. The game takes place outside the classroom – in the university hallway. The players stand in a circle. First, they listen to a theoretical introduction to the topic and information about biology of toads, spadefoot and salamander. At the center of the circle stands a person with a plush mascot-frog and blindfolded. This person is throwing mascot to people in a circle. People in the circle are moving clockwise. A person standing in the middle is throwing the mascot. It cannot fall to the ground. If it falls, people in the circle stop and the person closest to the collapsed mascot leaves the circle and cannot take part in the game. Participants of the game want to catch mascot, so do not let it fall to the ground. The person who catches mascot answers to the question about biology of toads, spadefoot or salamanders. The questions are quite detailed and difficult. When the participant gives the wrong answer – they leave the game. Those who correctly answer the question – stay in a circle and take part in the game.

A change of scenery from classroom to university hallway helped to achieve an informal atmosphere of joy and fun. The participants were motivated to act. They were happy to catch 'flying frog' and willingly answered questions. The originators of the game at the end summarized the game. They informed what the correct answers were. They conclude which species caused the most problems and announced who was the winner.

2. Coloring – great crested newt

As one of the elements of a scientific event, a group working on newts prepared a large drawing – 80 cm by 30 cm. The drawing showed a male great crested newt. It was drawn with a black pen and presented the outlines of the animal. Leader of a group described species of newts which occur in Poland and what their characteristics are. He informed that in the rest of the task we will concentrate on great crested newt. He described the biology and morphology of great crested newt. Following elements were needed to the task: two volunteers, magnets, whiteboard, a sheet of paper with the contours of the male great crested newt and crayons.

The aim of the task was to color the great crested newt as described. A nice surprise was that the description was presented in the form of a rhymed poem. Sometimes the poem had the form of puzzles, making it difficult to calibrate the colors. The group watch over the correct implementation of the task. The effect was impressive – a colorful poster presenting the male great crested newt. One of the students took the poster home for his younger brother.

Non-verbal means of communication – self-presentation and body language

Scientific events presented by students were recorded on video and used later in the course. Next topic raised during the classes on the popularization of scientific knowledge was body language and self-presentation. Body language is understood as a kind of non-verbal communication, where thoughts, intentions, or feelings are

expressed by physical behaviours, such as facial expressions, body posture, gestures, eye movement, touch and the use of space (Niedzicki, 2010). Body language, a subset of nonverbal communication, complements verbal communication in social interaction. In fact some researchers conclude that nonverbal communication accounts for the majority of information transmitted during interpersonal interactions (Kurien, 2010). It helps to establish the relationship between two people and regulates interaction.

After introducing the subject, we watched videos from the previous classes. We paid particular attention to the self-presentation and mistakes in self-presentation.

1. Facial expression

Facial expression helps in expressing emotions through the body. Combinations of eyes, eyebrow, lips, nose, and cheek movements help form different moods of an individual (e.g. happy, sad, depressed, angry, etc.) (Kurien, 2010).

The most common mistake made during the students' presentations, was the lack of eye contact with audience. Quite often there were two behaviors. The first – reduced facial expression, which gave the effect of monotony and boredom. Second – excessive stimulation of facial expressions, most often it was a very frequent smiling for no reason.

2. Body postures

Sitting or standing postures also indicate one's emotions. A person sitting till the back of their chair, leans forward with their head nodding along with the discussion implies that he/she is open, relaxed and generally ready to listen. On the other hand, a person who has his/her legs and arms crossed with the foot kicking slightly implies that they are feeling impatient and emotionally detached from the discussion.

Most often repeated unwanted body postures, indicated a lack of confidence. During the course different variants of closed position occurred. Students often crossed their arms and legs or hide themselves behind their notebook.

3. The use of space

Some of the events designed by the students engaged in a natural way to move in the classroom. But it also happened that during the presentation students stood motionless in one place and did not move around the room. This kind of behavior the students explained that they do not feel comfortable performing in public.

Summary

This article demonstrates how to implement a number of issues related to the popularization of scientific knowledge. It is one of the courses that have been implemented under the project "Animation of scientific and science culture" during biology and the environment protection studies. Examples and proposals described in the article should be treated as guidance in the planning of this kind of courses.

Students of biology and environmental protection were confronted with new situations during this course, that have demonstrated their creativity. Classes with the popularization of scientific knowledge were not only an opportunity to give the workshop of culture animator. It is also a platform for communication between students and between teacher and students (Sayer et al., 2014). Classes with the popularization of scientific knowledge have provided students with new knowledge and skills. For these reasons, it should be taken into consideration to introduce such a course permanently to a higher education program. This type of activities are also an opportunity for students to learn about their own strengths and weaknesses and to improve their soft skills. These classes helped the course participants to see what are their capabilities and, what is even more important – motivated them to work on themselves.

References

Hassana A., Osmanb K., Pudin S., 2009, *The adults non-formal environmental education (EE): A Scenario in Sabah, Malaysia*, Procedia Social and Behavioral Sciences, 1, 2306–2311.

Bensaude-Vincent B., 2001, *A genealogy of the increasing gap between science and the public,* Public Understanding of Science, 10, 99–113.

Blum N., 2008, *Environmental education in Costa Rica: Building a framework for sustainable development?* International Journal of Educational Development, 28, 348–358.

Gruszka B. (ed.), 2004, *Medializacja nauki*, Fundacja na Rzecz Nauki Polskiej, Wyd. Fundacji Dyskusje o Nauce, Warszawa.

Janowicz M., 2008, *Introwersja i ekstrawersja w procesie nauczania,* [in:] *Dydaktyka w naukach ekonomicznych*, T. Kiziukiewicz (ed.), Akademia Rolnicza, Szczecin, 50.

Krzysztofiak A., Krzysztofiak L., 2003, *Płazy i gady*, Wyd. Wigierski Park Narodowy.

Kurien, D. N. (March 1, 2010), *Body Language: Silent Communicator at the Workplace,* IUP Journal of Soft Skills, 4(1/2), 29–36.

Niedzicki W., 2010, *Sztuka prezentacji w nauce, polityce, biznesie*, Wyd. Poltext.

Paul D., 2004, *Spreading chaos – The Role of Popularizations in the diffusion of scientific ideas*, WRITTEN COMMUNICATION, 21(1), 32–68.

Sayer E.J., Featherstone H.C., Gosling W.D., the BES Roadies, 2014, *Sex & Bugs & Rock 'n Roll – getting creative about public engagement*, Trends in Ecology & Evolution February 2014, 29(2).

Weiner J., 2009, *Technika pisania i prezentowania przyrodniczych prac naukowych*, Wyd. PWN.

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Abstract

The popularization of science is one of the most important skills that should be formed in higher education in natural sciences. In Poland only humanistic studies in the field of journalism provide preparation in transforming knowledge and presenting it to laic audience. Curricula of biological or environmental protection studies offer no course related to science popularization. This gap is partly covered by educational offer of pedagogical universities; however, they prepare future teachers to work in formal education with recipients within a certain age range. But there is still a gap in educational offer of higher education in natural sciences. Graduates often have biological knowledge but do not have the key skills needed in the labor market – concerning self-presentation, mediation and attractive presentation of scientific knowledge. Here is an example of two courses carried out as the part of the scientific project "Animation of scientific and science culture". The project was performed in academic year 2014–2015 at the Pedagogical University of Cracow. The course was dedicated to popularization of scientific knowledge. The article discusses the substantive scope of the course and methods used to work with students.

Key words: culture animation, natural sciences, popularization, soft competences

Dr Elżbieta Rożej-Pabijan

Institute of Biology, Faculty of Geography and Biology
Pedagogical University of Cracow
e-mail: elarozej@vp.pl