Panta rhei - interdisciplinary approach improves students achievements and motivation

Daniel DZIOB,

Jagiellonian University Medical College, Department of Biophysics, sw. Lazarza 16, 31-530, Krakow, Poland

Daniel DZIOB

Jagiellonian University, Smoluchowski Institute of Physics, Lojasiewicza 11, 30-348 Krakow, Poland

Edyta WOZNIAK, Ryszard GABRYSZEWSKI

Space Research Centre, Polish Academy of Sciences, Bartycka 18A, 00-716 Warsaw, Poland

Abstract. Students usually describe school science subjects as non-related with real science. However, they still recognize profession of scientist as important. Because nowadays science research become interdisciplinary, natural consequence is introducing interdisciplinary topics into school curricula. To fill this gap, we prepared a teaching module Panta Rhei, which combines elements of many school subjects. The module were implemented in few high school classes, together with specially designed test fulfil by students. During the presentation the results will be discussed together with students and teachers opinions.

1 Motivation

Many students describe the school science experience as repeating a list of inconsequential facts or conclusions without reasoning [1]. Successive researchers have found that a considerable decline in student involvement in science might be a consequence of students' 'disenchantment' with science and/or the division between school science and outside-school experiences [2, 3]. It is well known problem for physics educator, which often put emphasis on every-day life context for teaching issues. However, some studies show that even if students' attitudes towards science as a school subject are not positive, they often recognize the profession of scientist as important and readily participated in activities "become a scientist" [4, 5].

Nowadays in science majority of research topics becomes interdisciplinary and required to involved not only physics knowledge, but also other, like biology or chemistry. Combining knowledge and skills from many science disciplines, even so desirable, usually are not actively existing at school. One of the reason could be lack of interdisciplinary topics, which genuinely force widening knowledge out of single subject e.g. physics. To fill this gap, we prepared an interdisciplinary teaching module, in which students become an astronomer.

2 Intervention

Proposed teaching module combines elements of physics, biology, geography, math, informatics and philosophy. The life motive of the exercise is the use of remote sensing for monitoring of changes in vegetation in various geographical zones during a growing season. It aims to show connections among school subjects and to encourage students to carry out their own scientific study. Following topics are integrated:

- Physics – electromagnetic wave, absorption, reflection and transmission of different wavelength in the contact with the object (leaf), astronomy

- Biology – leaf anatomy, photosynthetic activity, changes in electromagnetic wave reflection as a function of content of pigments and water in the leaf, as well as a state of leaf structure
- Geography – changes in photosynthetic activity of vegetation in different geographic zones all over the world, consequences of Earth's movement along orbit
- Math – basic descriptive statistics
- Informatics – software use, very basic programming
- Philosophy – problem of being, change in nature, Heraclitus of Ephesus' theory

The teaching module is developed in following main steps: theoretical background, implementation, result analysis and result presentation. In theoretical background philosophical introduction is done and correlate with environmental changes. Physics phenomena related to earth observation are discusses together with spectral curves and satellite operations and bands. A Normalised Difference Vegetation Index NDVI is introduced for students. In implementation part students are divided in groups. Each group received a set of 12 MODIS images from different geographical zones, one image per month and calculate NDVI index on each satellite image, collect statistics for selected on the image area, calculate mean value of NDVI index for each time point and construct chart of changes of NDVI during the year. At the end, each group presents its results. All charts are collected and presented together. The differences for each geographical zone is discussed as well as influence of altitude or ocean currents. The connection to Earth's movement along orbit is commented.

In order to verify students gain of knowledge as the effect of the intervention and to find their attitudes towards science and their interdisciplinary a special test was designed The test consists of two parts. In first, students knowledge about discussed issues were tested in a form of a True/False questions, in the second (fulfilled only after the implementation) students opinions about the unit were collected as well as their attitudes toward science in questions expressed in a Likert-like form. Test was fulfilled by students at the beginning of the exercise and at the end of the laboratories. The results of both tests will be shown and discuss during the presentation together with students ant teacher opinions.

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References

[1] Mallya, A., Mensah, F. M., Contento, I. R., Koch, P. A., & Calabrese Barton, A. (2012). Extending science beyond the classroom door: Learning from students' experiences with the choice, control and change (C3) curriculum. Journal of Research in Science Teaching, 49(2), 244–269.
[2] Aikenhead, G. (2006). Science education for everyday life. New York: Teachers' College Press
[3] Brickhouse, N. W. & Potter, J. T. (2001). Young women's scientific identity formation in an urban context. Journal of Research in Science Teaching, 38(8), 965–980.
[4] Osborne, J., & Collins, S. (2001). Pupils' views of the role and value of the science curriculum: A focus-group study. International Journal of Science Education, 23, 441–467.
[5] Osborne, J., & Dillon, J. (2008). Science education in Europe: Critical reflections. London: King's College.