NATURAL SCIENCE EDUCATION IN THE TIME OF VIRTUAL WORLDS

Dear Readers!

Implementation of ICT to the process of instruction does not mean eliminating real school experiments from school laboratory practice. Real living environment makes us face more and more items of virtual environment, worlds, mediated by infinite possibilities of computer networks. The mediated perception through virtual images has become an important cognitive channel for pupils. Real information from the existing reality is steadily replaced by virtual information.

Is the remote (by computer network mediated) and virtual (by computer simulated) experiment able to meet requirements of the best school laboratory practice?

How to blend an effective and meaningful application of real, indirect and simulative observation, measuring and experimenting according to didactic principles?

Numerous authors (f. e. Hassard, 1999, Lamanauskas, 2003, Bílek and Krumina, 2008, Škoda and Doulík, 2009) dealing with natural science education, rather intuitively tend to simple experiments (which do not require demanding material and technical equipment) to be made in the form of real activities; to remote observations and remote experiments to be used towards updating information and motivation, e.g. in the form of school project and project-oriented instruction; and to virtual experiments to be applied in the interpretation of real experiments (simulators of laboratory activities, predicting and verifying results in experiments) and experiments which cannot be made in schools (dangerous, requiring demanding instruments, unobtainable, etc.). Forming and improving manual skills (measuring by available laboratory instruments, working with laboratory systems, even constructed from common subjects of everyday use, working with safe matters, etc.), which are substantial part of natural science education, cannot be fully replaced by practising through monitor and keyboard. On the other hand it is impossible to avoid indirect observations and working with models and instruments. Researching these fields leads, or not, to proving intuitive estimations, which is important, as well as answering other questions which result from this area of potential assets and threats. It is obvious that nowadays, in the period of creating and applying remote, especially virtual, laboratories and their accessibility also in extra-curricular conditions via Web, there is an increasing demand for new researches (mainly pedagogical and pedagogical-psychological ones) in this field. This means especially researching the effectiveness in application of selected simulative and animating experiments not only by application of traditional pedagogical research methods, like direct and indirect observation, interview or pedagogical experiment. New situation calls for new methods of pedagogical research. Our first experience is oriented to not frequently used methods, like case studies, mind mapping, clustering etc., and as well as to methods from other research fields, e.g. method of eye-tracking applied in management and marketing psychology, sociology rating sheets, communication density or creativity measurement etc. Children's concepts and likely learning styles are of some importance in this process, too.

In our new research project, which started in 2009, the chemistry instruction serves as an example of natural science instruction (Bílek et al., 2009). This subject provides wide space for application of information technologies supporting empirical (observation, measuring, experiment) and theoretical

(modelling, comparing) cognitive methods. The technology development is very fast but as for its influence on learning in various stages of pupil's development in the field of knowledge processing, there are only few applicable principles, rules and natural relations. One of the main objectives is to express the role of modern technical equipment and technology in forming so called visual literacy, current and important part of which the work with computed simulations is. Modern technical equipment plays a contradictory role in this type of learning. On one hand, various processes and technologies of visualisation (mainly of 3-D objects) lead to using software products strengthening spatial skills, if properly used. On the other hand, both TV and computer screens may provide incorrect imaginations and habits, e.g. virtual experience which does not prove exact, but biased, misrepresented or incorrectly formed spatial skills, understanding weights, forces, energies, solidity, as well as emotions and feelings.

In the first part of the mentioned project we obtained a few interesting results motivating us to extend our empirical data survey. During the pilot research pupils (n = 85) worked with real and virtual (simulated) pH-meter. After measurements they were asked to express their opinion on other possibilities of pH measuring with laboratory devices. Pupils working with real devices (manual pH-meters) related their proposals to their practical applications which frequently appear in everyday life. On the contrary, pupils working with virtual devices (Web-applets) were kept fully engaged in this virtual environment. Either situation, i.e. whether they belong to the real or virtual world, influenced their opinion substantially. In case of work in virtual environment their relation to the real environment was restricted by a computer screen and keyboard to a large degree.

Reaching the above mentioned targets in science education is classified to be progress in so called science literacy. Virtual environment supported by ICT is penetrating both human and school life. All kinds of our activities can be supported by technologies. According to Marshall McLuhan (1964) it can be said "...technologies are enhancing our senses..." and they can support our understanding of nature and improving our being. In our opinion, the necessity to research this field, especially in situations where the initial relation to natural science and technical subjects is formed, is currently very topical and desirable (Bílek and Skalická, 2009).

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