Collaborative Experiments in Distance Science Education

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Abstract
Real experiments play a central role in the teaching of physics, biology, chemistry and other natural sciences. The majority of e-learning courses feature real experiments presented through digital video demonstrations or simulations (Ong, Mannan, 2004). The disadvantage of such presentations is that most students tend to become passive learners, thus missing individual or group activities normally required for experiments conducted in the real-world environment. In such cases, the learning process is generally not supported by interaction between actual media and individuals who work together preparing and conducting such experiments.

There are no simple, uniform solutions for realizing the interactive science experiment in distance education. However, a number of software products support an individual or, increasingly, collaborative accomplishment of the experiment's goals. This can be achieved by conducting natural and virtual science experiments. It is also possible to carry out remote experiments or experiment simulations. Particularly noteworthy are the solutions employed in interactive screen experiments and 3D experiments.

An Interactive Screen Experiment (ISE) is based on real research action. ISEs are exact photographic images of real experiments, recorded using interactive multimedia technology (Kirstein, 1999). Such material is then presented as a web-based teaching application, which can be used in an individual learning process or recently by learning groups. Students can remotely interact with the course material to study the contents of the experiment. They can also interact with each other using synchronous or asynchronous communication tools.

The paper presents tests involving ISE implementation in collaborative learning. In this case, experiments are conducted together. It needs to be noted that this process involves a high level of students’ activity, enabling them to exchange their opinions regarding the experiments, as well as perform and finalise them in cooperation (Figure 1).

Another possible realization of cooperative experiments involves activities in the 3D space. Existing solutions provide environments simulating the operation of physical laws (Meger, 2008). A solution being developed currently aims to provide a similar environment, at the same time enabling cooperation in distance experiments. The basic concept of this project is to build a 3D experimental environment where students could design and conduct various tests, observe components from different points of view, move them around and connect them together. Each component in this environment would have functions identical with those of real-world devices.

In this environment, participants could move devices and observe experiments from multiple points of view (Fig. 2), have a close look at the equipment and observe what happens during the experiment. Students and teachers would get the oppor-
tunity to choose components and connect them in order to prepare an experimental arrangement.

**Figure 1.** An experiment can be performed by a group of students collaborating online. It involves individuals carrying out the experiments, communicating by means of synchronous communication tools and observing results on screen.

**Figure 2:** The experiment can be observed from different points of view

The presented educational environment can be used for presenting other science-related concepts and problems apart from physical experiments, such as chemical processes. Observation with a microscope, for instance, involves both physics and biology, while the application of Newtonian laws and gravitational field is relevant for many technical sciences. The development of a 3D experimental environment would therefore be of great importance in science education at large.

**References**


**Keywords**

e-learning, distance education, science education, distance experiments, collaborative experiments.
Biography

Zbigniew Meger is a graduate of the University of Gdansk (Poland), received his PhD degree from the Humboldt University of Berlin (Germany) and currently holds the position of a dean at the University of Social Sciences in Lodz (Poland). He is interested in distance education and applications of computer and social networks, especially uses of various experiments in teaching physics, chemistry and biology.

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