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## A STUDENT-DESIGNED, REMOTE-CONTROLLED EXPERIMENT IN CHEMISTRY

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**KEYWORDS:** Distance education, Experiment design, Labwork, Chemistry

### Abstract

*The presented device is a remote-controlled chemistry laboratory. The specificity of the system is the possibility given to the student to design a complex experimental protocol.*

### INTRODUCTION

One of the specificity of the experimental sciences courses (*i.e.* biology, chemistry, physics) is the need for the students to interact with both the domain of real objects and observable things and the domain of ideas (Millar et al. 2002). In distance education, ideas are easily transmitted through classic media. The laboratory work, which specifically deals with the objects and the observable things, has been transposed in distance education following two ways: the use of simulations (de Jong & van Joolingen 1998) and the use of remote-controlled experiment (Cooper et al. 2002). Both of these solutions set out difficulties. Simulations are a representation of the real objects, and, in fact, are driven by theories that belong to the domain of ideas. Remote-controlled experiments do represent the domain of real objects, but they often are a transposition of classroom experiments, in which the function of the student is limited: learners have to execute procedures without being aware of the important choices made by the designer of the protocol (Séré, 2002). This difficulty is enhanced in distance education, by the fact that students don't handle the materials.

Our aim is to present a prototype of a remote-controlled experiment, in which the domains of ideas and real objects are closely connected. In this case, theory is used and questioned in order to understand the practical work. The experimental part is not the first step, but appears once the learners have designed the experiment, which will help them to memorize and understand the procedures (Séré, 2002). In this demonstration, we will focus on the software that students use to design their experiment.

### DESCRIPTION OF THE LEARNING DEVICE

The first experiment that has been chosen for our prototype is the determination of the E124 dye concentration in the grenadine syrup with a spectrophotometric method. The main learning objective is to learn how to design an experiment in order to solve a scientific question.

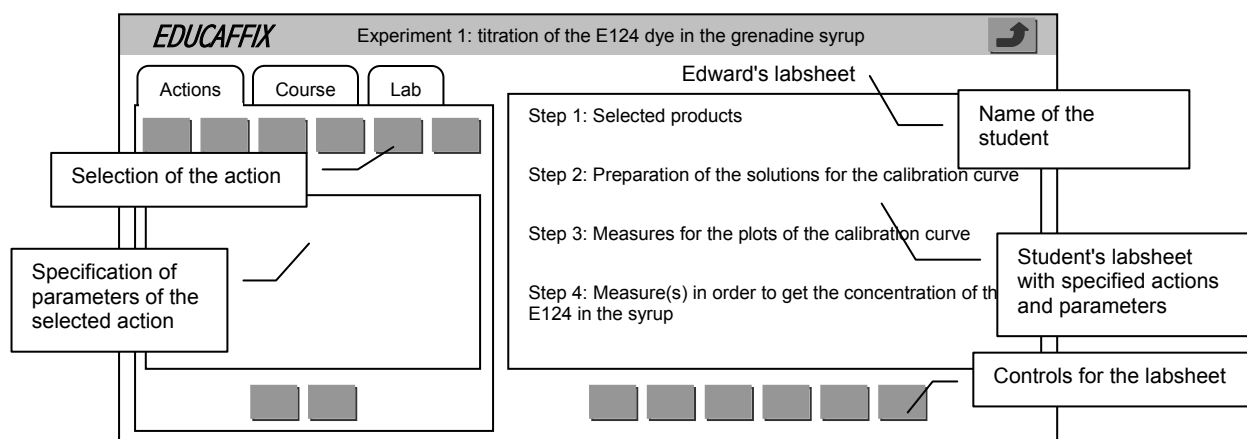
#### Technical description

The presented device, named Educ@ffix.net, performs with a Robotic Sample Processor and a spectrophotometer, both controlled by a server (the lab server). A web server, linked to the lab server, enables the learner to control the system, with data acquisition and video assistance, from any PC connected to Internet.

### Description of the interface used to design the experiment

The protocol, designed by the learner, is a set of ordered actions with defined parameters. It is recorded in the "student's labsheet" in which four steps are previously specified in order to structure the work of the learner (right part of the interface, see the schematic representation below). The actions can be selected and the parameters set in the "Actions" panel. There are eight actions from which the learner can choose for this experiment (e.g. "Dilute a solution", "Acquire a spectrum"...). A correct protocol would comprise 23 actions minimum in the labsheet.

To help the student, the course corresponding to the experiment is available in the "Course" panel, and feedback on the protocol can be obtained from an artificial tutor. When the artificial tutor favorably assesses the protocol, the manipulation takes place and can be viewed by the student in the "Lab" panel.



*Schematic representation of the learner interface used to design the experiment*

### CONCLUSION

This prototype is under analysis in term of knowledge acquisition by the learners. We are testing the ability of last-year college and first-year university students to design the experiment with or without the specific software.

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