Virtual laboratory activities in basic biochemistry

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Abstract

In 2009, the Creation Group of Educational Objects in Biochemistry (GCOEB) started to organize virtually practical-laboratory activities in basic Biochemistry for undergraduate students of Pharmacy Course. This occurred through presentation type files (power point) with detailed photos of technical procedures, reagents, equipment and possible results, all associated with challenging questions. These activities are being gradually transformed into virtual versions of the Flash program, mixing photos, cartoons and proposed interactivities. These simulations aim to help the students in the consolidation of the theoretical and practical biochemical knowledge. We believe that these pedagogic tools support the learning of Biochemistry, increase the scientific curiosity, stimulate the presence in the laboratory and never replace it. (www.ufrgs.br/gcoeb/)

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1. Introduction

In 2009, some teachers, postgraduate and undergraduate students from the Biochemistry Department of Instituto de Ciências Básicas da Saúde, Universidade Federal do Rio Grande do Sul, constituted the Creation Group of Educational Objects in Biochemistry or, in Portuguese, Grupo de Criação de Objetos Educacionais em Bioquímica (GCOEB). Its activities started when UFRGS-Pharmacy Faculty had its subjects organization modified in 2008. The subject named Biochemistry I was also included in this change. It was transferred from the 4th to 3rd semester and had its class number reduced from 9 to 8 hours, but 2 lab hours were maintained. So, in

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the first semester of 2009, both subjects, the Old and the New Biochemistry I, were performed simultaneously. In other words, the number of students was doublet. Then, how could we teach our practical classes, if the laboratory had only place for the half?

To maintain the teaching of basic practical Biochemistry concepts we decided to offer different tools to the students. The classical Biochemistry laboratory could be interchanged weekly with the informatics laboratory. Using this strategy, we believed that the students could learn and construct their own knowledge as usual (Eichler and Del Pino, 2006; Behar, 2009).

2. Practice simulation using power-point files

To organize the virtual classes we built up power-point files aiming to simulate lab activities by using pictures, identifying phrases and technical questions. All power-point files started with the information of page number inside the Biochemistry protocol book and finished with the suggestion to the students to make the report of the simulation results (Salbego and Trindade, 2008). Fig 1 is a file example: Ascending chromatography on paper of amino acids.

In the same way, other simulation practices were created: Protein properties, Protein and Inorganic Phosphate determination in biological samples, Carbohydrate detections, Glucose determination in plasma obtained from fed rats and from rats submitted to a 24-hour fast, Glycogen obtaining from liver and muscle of fed rats and from rats submitted to a 24-hour fast, and enzymes evaluations (pirophosphatase, succinate dehydrogenase and lactate dehydrogenase).

![Ascending chromatography on paper of amino acids](image)

2. Practice simulation using graphic interface-Flash 8.

In a new stage, we decided to make an improvement in our virtual material adding more interactions to them. Therefore, we again planned the several contents, selected them, edited images and developed them in the graphic interface-Flash8 (Macromedia, 2005; Shupe, 2010). Associated with this development it can be seen: pictures, interactive animated cartoons and challenging questions. These characteristics were introduced in the
same virtual object of the Fig.1, but now it is in Flash. In Fig.2, a challenging question is shown: it is suggested to the student that he is supposed to be in the lab, starting the simulation of ascending chromatography. He is challenged to select the group of equipment needed at the first step of the technique. These groups of equipment are assembled in different sets. If the student clicks on Fig 2a, a message will appear indicating that the answer is correct but, if the student clicks on Fig 2b, a message will appear indicating that the answer is wrong. A sentence appears with both messages explaining that to start the chromatography process, first, it is necessary to transfer solvent mixture into the tank for its saturation (www.bdc.ib.unicamp.br/bdc/visualizarMaterial.php?idMaterial=1136).

Fig. 2. Interactive animated cartoons in flash-file of “Ascending chromatography on paper of amino acids”.
a) Chromatographic tank and erlenmayer with solvent mixture. b) Material used in the experiment: whatman paper, ruler, pencil, standards, sample, glass capillaries and spray bottle

In order to give an upgrade to our learning objects, a scene menu and illustrative films were added to “Determination of serum lactate dehydrogenase (LDH) activity” flash file. This scene is composed of different sets that show the animated reaction, the LDH isoenzyme structures and cell localizations, the metabolic relations, pathologies related to LDH, the method principle of LDH determination and its simulation (Fig.3) (www.bdc.ib.unicamp.br/bdc/visualizarMaterial.php?idMaterial=1165).

Fig. 3. Scene menu in flash-file of “Determination of serum lactate dehydrogenase (LDH) activity”
To make our learning objects more user-friendly, we have introduced some link buttons in the introduction section. We also have inserted multiple information into different interactive sets and some technical and interpretative exercises. These improvements can be seen in “Glucose determination in plasma from fed rats and from rats submitted to 24-hour fast” flash file. Link buttons determine the opening of windows in which the chemical reaction is shown explaining the method principle (Fig.4). In another screen, standards and samples are identified; the absorbance measurement and the standard curve plotting are also animated (www.ufrgs.br/gcoeb/dosagemglicemia/).

Fig. 4. Interactive animated cartoons in flash-file of “Glucose determination in plasma from fed rats and from rats submitted to 24-hour fast”.

Another stage of our learning objects development occurred when the simulation actions were added through a challenging logic programming. Help buttons, messages of error and of simulation end steps were added. In this way, the learning object “Casein isoelectric point determination” was much more interactive (Fig.5) (www.ufrgs.br/gcoeb/PontoisoletricoDaCaseina/PontoisoletricoDaCaseina.swf).

Fig. 5. Interactive animated cartoons in flash-file of “Casein isoelectric point determination”. a) several flaps identifying different simulation steps b) table showing the different volumes of reagent to be pipetted; c) micropipette with the possibility to adjust the volume to be transferred from reagent bottles to test tubes.
3. Evaluation of the learning object: “Ascending chromatography on paper of amino acids”.

This learning object evaluation was performed by the students of Biochemistry 1 (Pharmacy-UFRGS) of the second semester/2009 (Zanatta et al., 2009) and the first and second semesters/2010/2011. Fig. 6 shows that, in general, the students evaluated the LO design and functionality positively, since most of them answered as excellent the questioned aspects. Others LO had similar evaluations for the navigation program, display format and help in learning. (data not shown).

![Fig.6. LO evaluation: “Ascending chromatography on paper of amino acids” evaluation.](image)
a) Questions  b) Answer percentage

10. Conclusions

In conclusion, we agree with de Jong et al. (2013) that these pedagogic tools (www.ufrgs.br/geoeb/) support the Biochemistry learning, the increase of the scientific curiosity and the stimulation of the students’ presence in the lab, but they never replace it.

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12. References


