Physical chemistry education and learning objects (PChemLO): A technological implementation to foster inquiry-based learning and diminish gender differences at higher education

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Physical Chemistry Education and learning objects (PChemLO): A technological implementation to foster inquiry-based learning and diminish gender differences at higher education

Murat Kahveci, Ph.D.

Associate Professor of Chemistry Education
Canakkale Onsekiz Mart University
Faculty of Education, Canakkale 17100, Turkey
mkahveci@comu.edu.tr

Abstract

PChemLO project (Kahveci, 2012) is a collaborative project between the Divisions of Chemistry Education and Physical Chemistry at Canakkale Onsekiz Mart University in Turkey. The main objectives of the project are to develop learning objects that are based on inquiry-based teaching principles and investigate student attitudes and motivation to utilize these learning objects. The project investigates male and female students' affective dimensions in using the online materials (i.e. learning objects) to learn advanced chemistry topics such as physical chemistry. By the implementation of technology into the inquiry-based science education as the teaching strategy may diminish the gender differences on learning science contents and using technology for learning. In this poster, the method to develop and implement learning objects in a physical chemistry course will be presented. In addition, benefits and disadvantages of using such systems with the gender differences perspective will be presented from relevant literature.

Reference

Kahveci, M. (2012). *Physical chemistry education and learning objects (PChemLO): Implementation and development of the materials based on inquiry-based approaches at higher education* (No. 2011/132). Çanakkale: Bilimsel Araştırma Projeleri, Çanakkale Onsekiz Mart Üniversitesi. Retrieved from http://chemed.comu.edu.tr

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Murat Kahveci, Ph.D.
Department of Secondary Schools Science and Mathematics Education
Canakkale Onsekiz Mart University, Canakkale, Turkey 17100
mkahveci@comu.edu.tr

http://chemed.comu.edu.tr

PChemLO project is a collaborative project between the Divisions of Chemistry Education and Physical Chemistry at Canakkale Onsekiz Mart University in Turkey. The main objectives of the project are to develop learning objects that are based on inquiry-based teaching principles and investigate student attitudes and motivation to utilize these learning objects. The project investigates male and female students' affective dimensions in using the online materials (i.e. learning objects) to learn advanced chemistry topics such as physical chemistry. By the implementation of technology into the inquiry-based science education as the teaching strategy may diminish the gender differences on learning science contents and using technology for learning. In this poster, the method to develop and implement learning objects in a physical chemistry course will be presented. In addition, benefits and disadvantages of using such systems with the gender differences perspective will be presented from relevant literature.

About the PChemLO Project

As research and development project, the PChemLO project is planned to be a collaborative project between the Departments of Secondary Schools Science and Mathematics Education, Chemistry Education Division, and the Department of Chemistry at Canakkale Onsekiz Mart University. The project focuses on inquiry-based science education (IBSE) at undergraduate level and aims at:

1. developing supplementary course materials that are based on IBSE approaches,
2. developing learning objects for Physical Chemistry topics,
3. investigating misconceptions on selected Physical Chemistry topics,
4. reviewing the relevant literature on learning objects' development and implementation, and
5. investigating the impact of learning objects in relation to student conceptions on chemistry education.

Project Duration: 18 months (February 2012—August 2013)

Keywords: inquiry-based science education, learning objects, misconceptions, physical chemistry education, educational technology, affective dimensions in chemistry education, gender difference in learning chemistry

Funding Agency: Internal (Canakkale Onsekiz Mart University)

Scope

This paper presents the technical procedures for developing *learning objects,* which are aligned with inquiry-based science education strategies, and their deployment to student interface in a classroom setting. Secondly, relaying on the relevant literature, it is hypothesized that

"Using learning objects in teaching physical chemistry topics will diminish gender difference in classroom at undergraduate level."

Context

The project focuses on the third year undergraduate students whose major is chemistry. The content of the application is relevant to the first and second semester of physical chemistry courses.

The instructional medium is both face to face classroom teaching. In addition, for the research implementation online learning tools are used with those of whom are voluntarily willing to participate.

Theoretical Framework

Inquiry-Based Science Education (IBSE). Science education reforms in Turkey and the relevant European Union fundings in Europe in general are based on the wide spread use of IBSE across the nation and Europe. IBSE engages students in:

1. authentic learning activities,
2. experimental activities,
3. self-regulatory learning sequences, and
4. argumentation with peers.

Learning Objects (LOs). LOs are able to exploit various educational technologies, including those based on the Web and on virtual learning environments. Originating from Object Oriented programming philosophy, LOs are designed so that they could be re-used in a variety of circumstances; thus, they operate in multi-platform environments.

PChemLO's Stand Point. LOs could be effectively used for teaching advanced chemistry topics such as physical chemistry while maintaining the four dimensions of IBSE at higher education.

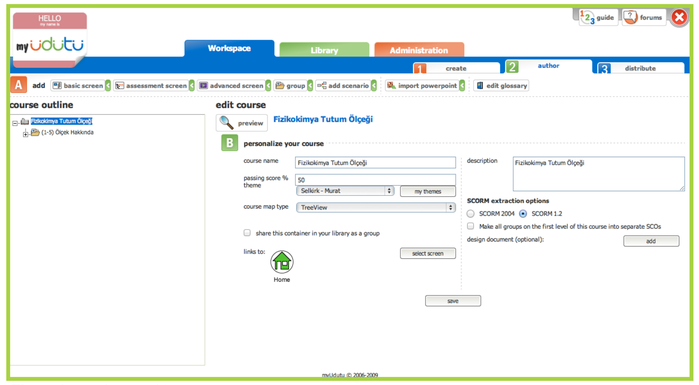

Figure 1. myudutu working space.

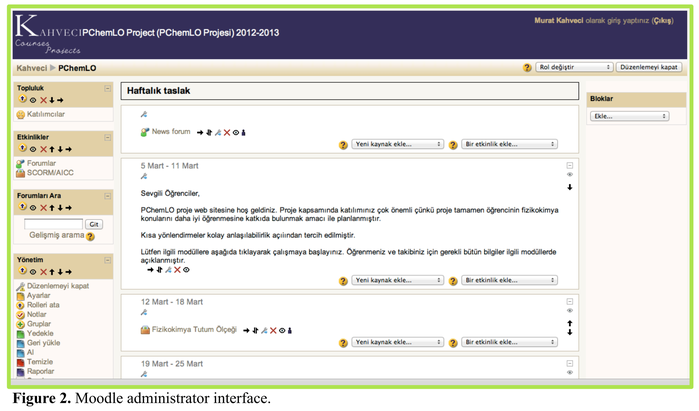

Figure 2. Moodle administrator interface.

Figure 3. Lime Survey data collection management interface.

Development and Deployment

The development of LOs are done by "myudutu," available online (myudutu, 2012) (Figure 1). Many logistic styles for content presentation sequence are available. Also, there are numerous options available for interactive feedback systems, audio, video and image presentation formats, and content evaluation options. Thus; each and every learner, depending on the design and richness of the content presentation, is have different learning pathways, unique completion times, and more detailed personal self-study materials.

While there are other export types, PChemLO project uses the SCORM 1.2 package as it is supported by Moodle (Moodle, 2012) learning management system (LMS) (Figure 2). Students get the content specifically as guided by the instructor through Moodle interface. Learners respond the questions automatically generated by the system; the system evaluates individual responses and then prepares the next content for the learner. Very ideal platform for practice and drill, student assessment, and directive self-study.

Overall student impressions are collected by an online survey system (Figure 3) (Lime, 2012)

Discussion

This paper briefly discusses the *learning objects (LOs)* package development and its deployment on a learning management system. LOs are very flexible in terms of its development and usability. As freely to very low cost of their development by the utilization of online tools such as by *myudutu,* its use should be widely implemented at the level of undergraduate chemistry courses.

By the nature of LOs, the content developed could be extremely suitable for self-studying. However, it should not be limited to self-study only. So, when LOs are developed there should be such activities as peer discussions to foster inquiry-based science education. Conceptual understandings, or *deficiencies in conceptual understandings* could be realized and cured through personal communications.

Research in chemistry education (see Barnea & Dori (1999), for example) shows that the use of computerized systems tends to be in favor of female students in the case of gain measures after an intervention. In addition, other affective based studies on chemistry learning and attitudes to use educational technology for learning in general (see Kahveci (2010, 2011) for example) reports that female students are as good and eager as their counterparts. The implication could suggest that existing gender gap (that is in the favor of male students in recent reports such as *Rocard Report* (2007)) in science technology, engineering and mathematics related fields could be reduced by more personalized and inquiry-based learning environments. LOs seem to have high value in this respect.

Future Research

The hypothesis: "*Using learning objects in teaching physical chemistry topics will diminish gender difference in classroom at undergraduate level*" will be validated for further studies in the PChemLO project.

More in depth data are necessary to provide stronger arguments about the acceptance of the above hypothesis. The data should reflect the information about the affective dimensions of learners such as *beliefs, self-perception, motivation, interest,* and *attitudes.*

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