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PBL Methodologies with Embedded Augmented Reality in Higher Maritime Education: Augmented Project Definitions for Chemistry Practices

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Abstract

One essential factor when developing a project based learning (PBL) program is giving the required resources leading the student's learning process. We want our students do their own research and obtain the proposed competences, but reaching this objective require a proper project definition, giving appropriate resources and information access. Small questions are also usually proposed for a better project orientation. On a first stage, we are focusing our efforts on augmented project definitions for chemistry practices (density and viscosity) for higher maritime students. Augmented reality can be used for accessing to virtual materials even when outside the laboratory. These mainly consist on 3D models of objects and devices used for measuring, manipulate or processing, and video contents explaining related concepts and other relevant information. Students can study and manipulate fragile and expensive stuff, like viscometers through their mobile device, and watch video demonstrations with another device when working in small groups, while a third student annotates concepts, ideas and procedures on a virtual shared mental map. Augmented materials will be used in a mobile collaborative environment, so mobile devices like smartphones tablets and iPads are a key factor for a better and a more engaging experience for our students. Visualizing augmented contents on virtually any mobile device will be possible by the use of Junaio as it runs on iOS and Android, so we have decided to use Metaio Creator and export as AREL packages to a Metaio server. At the end of these experiences, we expect to obtain better grading results compared with other learning methods.

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Keywords: Augmented Reality in education; Challenge Based Learning; Real objects mapping; Marine Engineering training.

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1. Introduction

Project Based Learning (PBL) involves an alternative to teacher-leaded practices. It is focused to the application of previously acquired knowledge and can be carried individually or by small groups of students [1]. It can be confused with Problem Based Learning (which uses the same acronym), which is focused to construct knowledge through a real problem [2]. Traditionally lecturer centered learning has been used for applying knowledge in laboratories following a previously structured route. Students just follow the instructions and do not discuss procedures or results by themselves. Bologna process has been an opportunity to introduce student-centered learning in higher education [3], but changing traditional learning processes requires a great effort by professors and students [4], so it is preferable to test it with smaller groups of students and expanding for the following courses. The use of Internet is a key tip when designing a PBL especially when work group is preferred [5], but other technologies like Augmented Reality (AR) can play a relevant role on this learning method. For this purpose we have proposed to change the traditional manuals on chemistry practices with augmented project definition manuals. On these ones, specific instructions to solve the project are not given, but related information is supplied, like access to general procedures, instruments and materials required for measuring or processing.

2. The project definition structure

This manual has to be structured but it should give the students the possibility of freely finding their best solution for the proposed project or experiment. It must clearly define the project to carry out, and also the corresponding main and intermediate objectives (Table 1). In PBL learning, students must have previously acquired the required knowledge, but they will have to apply it on their own for solving the proposed project. For this purpose work-groups of students will be created, and the use of collaborative online tools will be mandatory for an easier communication. The project definition document must give the students access to resources for solving the project, but also additional questions and activities should be proposed for better orientation (Table 2).

Table 1. Objectives for density measurement project for first year undergraduate students

Main objective	Intermediate objectives
Density measurement in laboratory	Variation of density by temperature
	Variation of density by salinity
	Influence of density variation on ship stability
	Variation of oil density
	Influence of density on tanks volume and its commercial operations

Challenge Based Learning (CBL) can be mixed for a better knowledge application (Table 3), so some intermediate challenges are also proposed; students will have to discuss the better solution in their work-group. We think this will reinforce the acquired knowledge by applying it for answering real-world questions. In contrast, this will require a greater effort from students and professors.

Table 2. Example of intermediate activities for density project definition

Intermediate activities
Densimeter scales differences
Temperature & salinity influence on density: Plimsoll disc on ships
Density units conversion

Table 3. Example of intermediate challenges for density project definition

Intermediate challenges
Does change the density of 1 kg of steel if you move living to the Moon?
Was Archimedes true?
Why is so difficult drowning at the Dead Sea?
What's the reason of having the Plimsoll disc on every ship?
How can a ship be sunk without touching it?
What have you heard about a Galileo thermometer?
U-Boot (a WWII German submarine) and water density…

3. Augmented contents

Virtualized 3D models of real instruments for measuring and project development are included as augmented contents. The use of this technology permits every student to manipulate expensive instruments without risks before working with real ones. It also reduces costs, as it is not necessary to provide one instrument to every student. Instruments are modeled using Cheetah 3D software and textures like scales and labels are baked and packaged [6]. Metaio Creator is used to include instrument models and also related multimedia contents [7]. When the design is complete contents are uploaded to a web server for Internet access. A QR code is supplied at the beginning of the document so students can visualize all augmented reality contents trough Junaio with their mobile devices [8]. Instruments are not fully described in the manual. Students will have to learn how to use it by observation of the virtualized models through their own research.

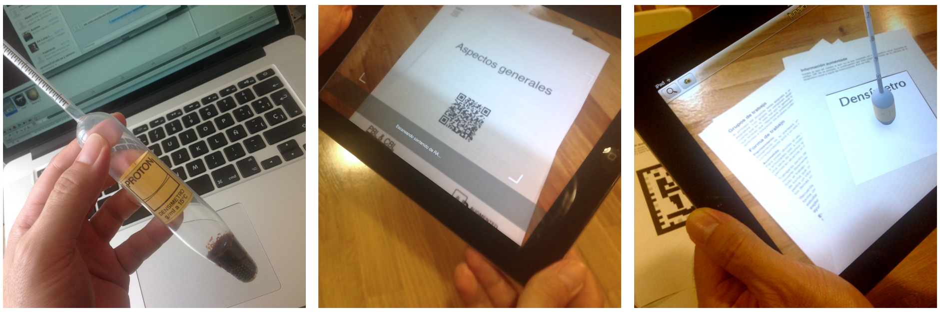

Fig. 1. (a) Instrument modeling. (b) QR scanning. (c) Instrument visualization.

4. Session planning

As initially mentioned, lecturers labor is not to give specific instructions to the students for performing experiments or projects. Students must discuss and apply the previously acquired knowledge, so lecturers became facilitators giving support and advices to the students and access to the required information and instruments.

Sessions with students will be carried out as follows:

- A project manual with the corresponding QR code will be given to all groups of students.
- The facilitator introduces the objectives and students discuss and share ideas focused on the main objective.
- Challenges will be described. Students will start to review information and Internet resources to give reasoned answers and solutions using collaborative tools.
- The students will carry out activities using the best method they consider. They use AR contents to study the instrumentation.
- Every group will elaborate the proposed project or experiment using their own resources and procedures. These will be discussed with the rest of the students and final results will be shared.

5. Conclusions and future work

PBL system requires collaborative environments to share information and the use of Internet is a requirement for knowledge sharing. By the other hand, other technologies like AR permit to start the students' research outside the laboratory. As a result, students become familiar with instruments before working at real environments. We also think that experiences are also more engaging for students and application of knowledge becomes more intuitive. Validation of these arguments will be obtained after testing these experiences and materials with randomly selected groups of students during 2013 and 2014.

References

[1] Mills JE, Treagust DF. Engineering education. Is problem-based or project-based learning the answer? *Australasian Journal of Engineering Education* 2003; **3**: 2-16.

[2] Yusof KM, Aziz AA, Hamid MKA., Hassan MAA, Hassim MH, Hassan SAHS. A. Problem based learning in engineering education: A viable alternative for shaping graduates for the 21st century. In Conference on engineering education, 2004, kuala *lumpur*.

[3] Heitmann G. Challenges of engineering education and curriculum development in the context of the bologna process. *European Journal of Engineering Education* 2005; **30**(4): 447-458.

[4] Valero MG. PBL (piénsatelo bien antes de liarte). *ReVisión* 2012; **5**(2): 11-16.

[5] Watson GH. Problem-based learning and the three Cs of technology. In: Duch, B. J., Groh, S. E., & Allen, D. E., editors. *The power of problem-based learning : A practical "how to" for teaching undergraduate courses in any discipline.* Sterling, Va.: Stylus Pub; 2001, pp. 109-117.

[6] MW3D-Solutions, Cheetah 3D, retrieved July 2013 from http://www.cheetah3d.com

[7] Metaio GmbH, Metaio developer portal (Toolbox), retrieved on June 2013 from http://dev.metaio.com/sdk/toolbox/

[8] Metaio Inc., Junaio, retrieved on June 2013 from http://www.junaio.com