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Real Object Mapping Technologies Applied to Marine Engineering Learning Process Within a CBL Methodology

Carlos Efrén Mora Luis*, Antonio Manuel González Marrero

Maritime Engineering Department, La Laguna University, Vía Auxiliar Paso Alto, 2, 38001, SC de Tenerife, Spain

Abstract

A proper operation and maintenance of marine systems require give specific instructions and descriptions focused on the parts of any device. This is usually taught by the use of texts and figure descriptions, but the learning process is not as immersive as reality itself. Augmented reality over real objects with mobile devices can change this learning process into a more immersive and engaging experience for the students. This technology permits the use of instructional information like texts, videos and 3D virtual objects even with animations over real elements. This powerful tool lets the student recognize any drawings and real objects in one step, and also any specific operating and/or maintenance instructions can be given. For creating these augmented reality experiences we pretend to use metaio Creator combined with metaio Toolbox. Metaio GmbH firstly released this free app on October 2012 in the Apple App Store. It lets capturing a real object (mapping) in order to easily create augmented realty experiences using real objects as references. On a first instance, we pretend to map objects like valves, pumps and other piping elements, so small groups of students will be able to observe and study this objects through their own mobile devices using a QR code for object recognition. The understanding of every object by every group of students becomes their challenge. First every group will have to discuss every relevant aspect they have discovered: working principles, operating and maintenance. Secondly they should discuss their results with other team members. Finally they will explain what they have learned to their instructor using the same AR technology.

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

* Corresponding author. Tel.: +34-922319000, ext 6245; fax:+34-922319831
E-mail address: carmora@ull.edu.es.

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1. Introduction

The inclusion of higher maritime education studies in the European Space for Higher Education in Spain requires a different pedagogical approach. Students should receive more practices and less theoretical lectures that should substituted by autonomous studying. Traditional educational methodologies commonly used in engineering education during last decades do not fit into this educational system. In fact, some experiences point to problem based learning (PBL) as a better method for obtaining better results and the required skills. Contents delivery should not be lecturer-centered in engineering education and graduates must be easily adaptable and life-long learners for an easier adaptation to technology improvements [1]. Several studies conclude that PBL learning has no negative effects on acquired competences of engineering students [2].

Apple, Inc. introduced Challenge Based Learning concept based on PBL for K12 education [3] but the same strategy can be extrapolated to undergraduate curriculum or even graduated engineers [4]. As a first experience we have introduced CBL in order to test the knowledge and skills acquired by our students. By other hand, the use of technology is a key factor for collaborative learning when creating more engaging experiences; augmented reality can be used combined with other technologies when designing challenges for a specific subject. Other previous experiences have argued better results when using AR for learning standard mechanical elements on a traditional lectures-learning environment [5]. By contrast, we pretend our students to acquire the necessary skills on self-learning experiences, embedded into a CBL experience, using augmented information over real objects with mobile devices.

2. Challenge design

Our design is focused on auxiliary systems used in the maritime industry, and more specifically on valves and piping parts. On a traditional lecture approach this subject is taught by the use of Power Point presentations and the acquired knowledge and skills are assessed by a final examination. Students do not collaborate with others and results are not discussed in class.

Table 1. Skills & Knowledge description

Skills to acquire	Description
Parts identification	Being able to identify real parts in drawings and diagrams.
Overhauling	Being able to repair the device, dismounting and reassembling it under security conditions.
Operation	Being able to properly operate the device under security conditions.

Table 2. Knowledge description

Knowledge to acquire	Description
Working principles	Understanding the physical working principles of the device.
Classification	Being able to classify the device under different criteria.

Challenges have to be designed in order to acquire the proposed competences by the use of technology in a collaborative environment with small groups of students, so firstly a proper identification of skills and knowledge must be carried out. The initial assessment should start with a main idea, which will be followed by a main question. The corresponding challenge solutions must give an answer to this main question and other guiding questions for mapping the learning process. For instance, lecturers became facilitators who propose activities and give access to resources focused on the main idea.

Table 3. Challenge design example

Challenge component	Description
Main idea	Valves in naval industry
Main question	What types of valves are important when assuming my responsibilities as an engineer officer?
Challenge description	What is the best valve for every purpose on-board?
Activities and Resources	Study real valves, manufacturer documentation and related audiovisual information.
Guiding questions	What is the physical working principle of every valve? What types of fluids are valves designed for? What are the differences between the studied valves? How are valves classified by different criteria? What are the main parts of a valve? How are assembled? What are the security advices when manipulating a valve?

Every group of students will have to propose a solution based on their experience. Using collaborative online tools and discussions with other groups in class will do this possible. The final solution will be documented and published by the students. Informal and formal assessment will take place at different stages, so knowledge and skills will be measured for every student.

3. AR experiences design

Based on every challenge, experiences must be designed in order to drive the learning process. AR gives the possibility of combining activities with real objects and resources of information in one place, becoming a more engaging experience. We want our students to compare real objects against formal information, so 3D mapping techniques for object recognition is our preferred option. We have used Metaio Toolbox [6] with an iPad for this purpose. We have also built several precision mappings using markers for every object, but some problems arouse with this mapping technique because some objects were quite dark and low textured. These problems were solved by the use of soft lighting conditions and darker backgrounds. Same conditions should be kept in order to be camera recognizable with the student's devices. Additional markers can also be used in order to have more mapping points, but this technique implies to keep markers on the same position when working with students.

Once the 3D map is finally usable, drawings, multimedia contents, descriptions and buttons to links with more technical information are embedded, so not all members of the group will have to access to the same contents at the same time.

Fig. 1. Precision 3D map building with Toolbox.

After the experience design is complete, AR objects are uploaded to a web server; QR cards will be supplied to every work-group for easily downloading the required data with Junaio with their mobile devices.

4. Session planning

As initially mentioned, lecturers labor is to give the students access to selected contents and orienting their own research. Lecturers will assume the role of specialized instructors or facilitators, advising students on the applicability of their proposed solutions.

Sessions with students will be carried out as follows:

- An object and a QR card will be given to every group of students.
- The instructor, focused on the main question will introduce an initial discussion.
- Challenge will be described. Students will start to review real objects and the corresponding AR contents.
- Guiding questions will be asked and every group will start to find solutions using the information provided and Internet resources. Every group will work into a collaborative environment so all resources and information will be immediately shared within the group members.
- Every group will elaborate digital contents for giving a solution to the challenge. Proposed solutions will be discussed and answered with the rest of the students.

Fig. 2. (a) QR card for Junaio. (b) Valve diagram shown on a smartphone.

5. Conclusions and future work

The inclusion of AR technologies in CBL environments permits to improve collaborative learning as it is able to concentrate all the required information and show it over a real object. We think this way of learning will produce better results as it is a more engaging experience for students and helps to immediately apply the acquired knowledge. We pretend to test these materials with randomly selected groups of students during 2014 to find results to validate our expectations.

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