Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 75 (2015) 49 – 58

Procedia Computer Science

2015 International Conference on Virtual and Augmented Reality in Education

Mobile Augmented Reality in Vocational Education and Training

Jorge Bacca[a,]*, Silvia Baldiris[a], Ramon Fabregat[a], Kinshuk[b], Sabine Graf[b]

[a]*University of Girona, Institute of Informatics and Applications, Av. Lluis Santalo s/n, 17071 Girona (Spain)*
[b]*Athabasca University, School of Computing and Information Systems, 1200, 10011-109 Street, Edmonton, AB T5J-3S8, Canada*

Abstract

In Vocational Education and Training (VET) institutions, teachers face important difficulties in the teaching process due to a wide variety of student's special educational needs as well as student's lack of: the adequate level of basic competence, motivation, concentration, attention, confidence and background knowledge, among other aspects. Regarding the attention to these aspects, many studies have reported positive impact of Augmented Reality (AR) applications in primary, secondary and higher education in terms of student's motivation, learning gains, collaboration, interaction, learning attitudes and enjoyment, among others. However, very little has been done in terms of AR applications in VET as well as their impact on wide variety of student's special educational needs such as learning difficulties. This paper introduces a marker-based mobile AR application named Paint-cAR for supporting the learning process of repairing paint on a car in the context of a vocational education programme of car's maintenance. The application was developed using a methodology for developing mobile AR applications for educational purposes from a collaborative creation process (Co-Creation) and based on the Universal Design for Learning (UDL). A cross-sectional evaluation study was conducted to validate the Paint-cAR application in a real scenario.

Peer-review under responsibility of organizing committee of the 2015 International Conference on Virtual and Augmented Reality in Education (VARE 2015)

Keywords: Augmented Reality; Vocational Education and Training; Motivation; Universal Design for Learning; Special Educational Needs

1. Introduction

Vocational Education and Training (VET) is defined as: "education programmes that are designed for learners to acquire the knowledge, skills and competencies specific to a particular occupation, trade or class of occupations or

* Corresponding author. Tel.:+34-972-41-9519.
E-mail address: jorge.bacca@udg.edu

Peer-review under responsibility of organizing committee of the 2015 International Conference on Virtual and Augmented Reality in Education (VARE 2015)
doi:10.1016/j.procs.2015.12.203

trades" [1]. At this educational level, students are prepared to supply the needs of the labour market in specific occupations. In the Spanish educational system, some examples of VET programmes are: logistics, transport, manufacturing, building, electricity and tourism, among others.

Students that enrol in VET programmes have completed secondary education or at least most of it. After finishing the VET programme they can go to university or to the labour market in order to work in a particular occupation. Some students also enrol in VET programmes many years after finishing secondary education when they need to obtain a certification for a particular occupation. According to the statistics of the Spanish Ministry of Education, Culture and Sport, 68,1% of the students enrolled in VET programmes in 2013 came from secondary education, 1,5% came from special education schools, 13,9% had dropped out of other educational levels and 16,5% enrolled due to other reasons [2].

According to the results of the Survey of Adult Skills conducted by the Organisation for Economic Co-operation and Development (OECD), 3 out of 10 adults in Spain and Italy perform at or below the level 1 (in a scale from 1 to 5) of literacy and numeracy. Besides that, only 1 out of 20 adults is proficient at the highest level of literacy (levels 4 or 5). The report also states that "large proportions of young people leave school with poor skills in literacy, numeracy and problem solving" [3].

As a result, there is a wide variety of students in Higher Education Programmes and VET programmes with different levels of basic competences, backgrounds, needs, interests, motivation, preferences, etc. In particular in VET programmes, teachers have identified student's lack of: motivation, concentration, attention, confidence and background knowledge, among other aspects [4].

Many studies have reported positive impact of Augmented Reality (AR) applications in primary, secondary and higher education in terms of student's motivation, learning gains, collaboration, interaction, learning attitudes and enjoyment, as reported in the literature review conducted by Bacca, Baldiris, Fabregat, Graf, and Kinshuk [5]. However, very little has been done on the benefits of AR applications in VET as well as their impact for addressing a wide variety of student's special educational needs such as learning difficulties [5].

This paper introduces a marker-based mobile AR application named Paint-cAR for supporting the learning process of repairing paint on a car in the context of a VET programme of car's maintenance. A methodology for designing and developing mobile AR applications was also proposed in order to design and develop Paint-cAR application. The methodology brings together students, teachers and software developers in the design and development process taking into account the special needs of the actors in the educational system, teacher's requirements, interests or pedagogical/didactic preferences, as well as diverse students' needs such as knowledge backgrounds, experience, context, learning styles, functional diversity and various students' preferences. Besides that, the Universal Design for Learning (UDL) framework was considered as an inclusive learning approach for addressing student's needs and overcoming any barriers and difficulties in the learning process.

Paint-cAR application was tested with a group of VET students in Spain and the Instructional Materials Motivation Survey (IMMS) [6] instrument was applied to evaluate student's motivation, in particular, attention, relevance, confidence and satisfaction dimensions. The results show that participants were motivated by the use of Paint-cAR application. Although the results are promising in general, confidence and satisfaction dimensions rated higher.

The rest of the paper is organized in 7 sections. The second section describes the related work; the third section describes the methodology proposed for developing the AR application. Then, the design of the Paint-cAR application is described in section four. Fifth section describes a cross-sectional evaluation study, followed by the sixth section discussing the results obtained. Finally seventh section presents the conclusions and future work.

2. Related work

The concept of AR was coined in contexts of maintenance tasks when Caudell and Mizell [7] proposed the head-mounted display for assisting maintenance in the aircraft industry. Since that moment, AR has been extensively used for assisting maintenance and repairing tasks in a wide variety of fields in industry [8]. Besides that, many studies have reported experiences about using AR in educational processes at primary and secondary educational levels as well as at university. However, very little has been done in terms of AR in vocational education institutions as a support for the learning process [5].