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A Virtual Reality Application to Attract Young Talents to Manufacturing

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Abstract

This study applies an innovative introduction of a learning framework to secondary education, using Virtual Reality (VR) aiming to attract young talent to Manufacturing. To achieve that, the developed approach exposes young students to the concepts of Manufacturing, by using an immersive VR simulation of a manual assembly task in a CAVE. The procedure is defined by a pedagogical framework that describes the learning process. Structured questionnaires for before, after intervention, and long term evaluation are used to monitor the interest and awareness of the participants. The method employs game-based learning and enhances it by combining it with VR simulations using immersive setups.

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1. Introduction

Nowadays, despite the high levels of unemployment, many employers, particularly in Manufacturing, are struggling to find the talent they need. For example, in the U.S. jobs in Manufacturing grown by 4.3% from 2010 to 2013; however, analysts say that this growth in Manufacturing is being held back by a skills gap [1]. In Europe, Manufacturing accounts for more than 28% of the GDP, even in today's economic recession [2]. Taking into account the importance of Manufacturing as wealth generating activity for a nation, the promotion of excellence will become a strategic target in the years to come [3]. Manufacturing education, as identified by Manufuture [4][3], will comprise a major driver towards that direction.

However, teaching and training have not kept pace with the advances in technology and skills' shortages are reported to have had a negative effect on innovation performance [5]. As an example of the efforts to address this matter, tertiary education institutions across Europe are trying to introduce their students to Industrial Manufacturing early in the learning process targeting to provide a close-to professional experience to them. To achieve that, they often use Virtual reality simulations of complex procedures. However such practices are very rare in secondary education.

Typically a simulation is defined as a model of a real world environment, usually with the facility for the user to interact with the environment [6]. Simulations are popular with constructivists for two reasons. Firstly, simulations provide realistic context in which learners can explore and experiment, with these explorations allowing the learner to construct their own mental model of the environment. Secondly, the interactivity inherent in simulations allows learners to see immediate results as they create models or try out their theories about the concepts modelled [7].

At the same time, there has been much interest in the potential of VR applications for learning and teaching in recent years. They are popular with young people—a recent survey carried out for Futurelab showed that 79% of 737 children aged 5 to 15 played computer games at home alone 'at least a few times a week' [8]. Serious games, and VR delivery mechanisms in general also tend to be used occasionally in formal education and there are examples, where games used with sufficient support are shown to be motivational and an aid to learning high level or complex skills [9][10]. Despite the theoretical and

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empirical evidence for the potential of educational games, there is still some reluctance among teachers towards their broader adoption and use in educational practice; a reason for that could be that applications built - in in educational games are usually black boxes and not tangible for teachers [11]. From a learning perspective, another reason is mainly because games teach practical skills such as collaboration and problem solving, while the education system focuses on more specific structure of knowledge assets. When they are applied, in most cases, the selected games are chosen because they can be seen to inspire the students towards a domain, or there is a direct link to the curriculum. The latter is more likely if the game can provide appropriate assessment and the overall pedagogical design fits into existing lesson structures [12].

A pedagogical design refers to any systematic choice and use of procedures, methods, prescriptions, and devices in order to bring about effective, efficient, and productive learning, as described in [13].

Game-based learning is focused on achieving the particular objectives of given educational content through game play. In more detail, players' attempts to solve problems are maintained throughout the learning session. In game-based learning where the students both study and play, learning strategies and gaming strategies become identical entities seen from different perspectives. Learning strategies and gaming strategies adopted to achieve problem solving strategies in game-based learning may be the primary factor behind the high achievements in both learning and gaming. This implies that higher scores in learning and gaming require better problem solving abilities, which require, in turn, well-chosen strategies for both learning and gaming [14]. All the above can lead to the realization that these practices supported by a pedagogical frame, can become more applicable to classroom level and it is necessary apart from identifying the appropriate games and applications that meet their learning objectives, to also examine ways that the learning process can be assessed.

2. Integration of Manufacturing Concepts to Secondary Education Through Monitored Intervention

2.1. Learning Framework and Learning Assessment

This paper proposes a procedure in the form of an intervention, which aims to familiarize secondary education students to the concepts of Manufacturing and potentially promote a career in the field. The developed method involves the contact of secondary students with manufacturing operations in an immersive Virtual Environment (VE) adjusted to fit the needs and educational level of the specific target group. Bringing together the worlds of Virtual Reality simulation of Manufacturing processes and game-based learning, the developed method takes advantage of the potential of both concepts to effectively achieve maximum knowledge acquisition by the young stakeholders (Fig. 1).

To monitor the resulted impact of the method on the stakeholders, a set of research questions was selected. These research questions focus on the students' interest and awareness towards Manufacturing as a learning domain, and a potential career as a Manufacturing engineer. The research questions used for the purposes of this paper are described in the next section. To answer to these research questions, pedagogically acceptable, well-established monitoring mechanisms are employed to monitor the knowledge and interest of the stakeholders before, after the intervention and in the long term.

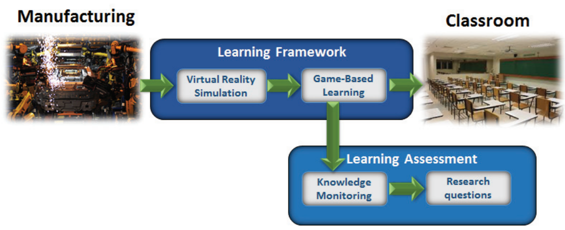

Fig. 1. Learning framework of the developed method

2.2. Design of the Learning Process

To achieve the goals that were described above, the experimental design (Fig. 2) is divided in four distinct and consecutive stages: the Pre-Intervention stage, the Main Intervention stage, the Post-Intervention stage and the Long-term Intervention stage. In more detail, during the Pre-Intervention stage the aim is to trace both the initial level of awareness and interest of the stakeholders concerning Manufacturing. The next stage is the Main Intervention where each stakeholder engages with an appropriate for its age Pedagogical Scenario. Moving on to the Post-Intervention stage we are tracing once more the levels of awareness and interest for Manufacturing and we compare them to those of the Pre-Intervention stage to see the short-term effect of the Main Intervention. Moreover, at the same stage we are also interested in checking the usability of the delivery mechanisms used at the Main Intervention. Finally, at the Post-post Intervention stage we are interested in the long-term effect of the Main Intervention on awareness and interest for Manufacturing.

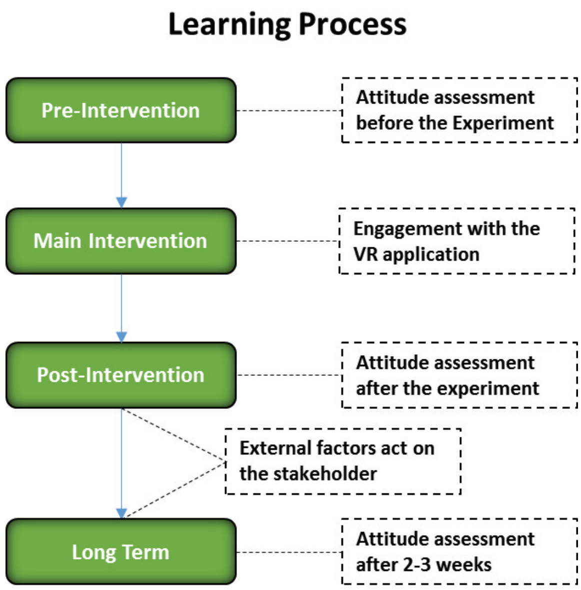

Fig. 2. Design of the Learning Process