

A 3D Serious City Building Game on Waste Disposal

Stefania Cuccurullo, Department of Management and Information Technology, University of Salerno, Salerno, Italy

Rita Francese, Department of Management and Information Technology, University of Salerno, Salerno, Italy

Ignazio Passero, Department of Management and Information Technology, University of Salerno, Salerno, Italy

Genoveffa Tortora, Department of Management and Information Technology, University of Salerno, Salerno, Italy

ABSTRACT

The environmental priority requires structural interventions that will be effective in the long period only if they are accompanied by modifications of behaviors, orientations and beliefs, specially investing in the new generations. This paper presents a 3D Virtual World serious game named Pappi World, designed according to pedagogical theories and to the Italian Environmental Ministry guidelines. This game aims at helping children to learn how to dispose waste and to understand that waste can become a relevant resource when correctly managed. The game proposes individual and collaborative activities and exploits the city evolution mechanism proper of city-building games to involve the students. Pappi World is also evaluated 1) considering the learning efficacy and the student perceptions and 2) collecting the teachers opinions related to the game usability, fun, engagement, mechanism and metaphor adequateness as well as expected learning outcomes. Also the student perceptions on the game were collected. With regards to learning effectiveness, the empirical evaluation revealed a significant difference between pre-game and post-game knowledge. Students reported they were engaged and had fun playing Pappi World. Teachers expressed a positive opinion on the game adoption and its effectiveness, also providing useful suggestions to improve it.

Keywords: City-Building Game, E-Learning, Serious Game, Virtual Worlds, Waste Disposal

1. INTRODUCTION

Nowadays, there is a strong need of enforcing environmental education in order to empower all citizens to adopt environmentally sustainable lifestyles. Often there is a gap between people's

growing environmental awareness and their lack of behaviour change. Getting people to take correct environmental actions would require some forms of motivation. Thus, there is the need of planning strategies and designing tools for environmental communication that effec-

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tively lead to changes in the citizen behaviour. In order to be successful, these activities have to involve the youngest citizens by activating formative and didactic actions. The best way to capture the attention of this kind of learners is to adopt an edutainment approach: a serious game proposes an enjoyable experience while training and educating users (McFarlane, Sparrowhawk & Heald, 2002). Indeed, in addition to cognitive outcomes, gaming environments can provide affective outcomes (beliefs or attitudes) that can positively influence the citizen actions (Garris, Ahlers & Driskell, 2002). In any case, the computer game should be aligned with the national curricula (Law, Kickmeier-Rust, Albert & Holzinger, 2008) and designed considering pedagogical foundations (Kebritchi & Hirumi, 2008).

This paper describes a serious game proposed in the TIE project funded by the Campania Region (Italy) aiming at presenting and experimenting the main concepts related to waste collection and garbage recycle in the context of primary school education. Learning is inducted through a City-Building Game approach, based on the sustainable growing of the imaginary Pappi World. The setting of the game is an ad-hoc developed 3D virtual environment which proposes specific educative games based on collecting and separating garbage.

The game promotes the concept that garbage is a resource useful for the student city growth. The environment also supports collaboration and competition to better involve the students to use it over time and to stimulate behaviour changes thanks to the perception of the recycling attitude of the others. The game has been evaluated during a class laboratory activity considering both the students' improvements and their satisfaction. Also the teachers' perceptions have been collected.

This paper is organized as follows: Section 2 discusses related work considering previous researches concerning City-Building Games and the learning support offered by Virtual Worlds; Section 3 describes the pedagogical issues related to material recycling and the

environmental curriculum guidelines proposed by the Italian Environmental and Instruction Ministries; Section 4 presents the goals of the TIE project, which include the development of the Pappi World game; Pappi World objectives and structure are described in Section 5; the learning activities proposed by the game are detailed in Section 6; Section 7 presents the evaluation involving both students and teachers; the results are interpreted and explained in Section 8; finally, Section 9 concludes and discusses future work.

2. RELATED WORK

It is common opinion that games can be a useful and attractive learning method (Boyle, Connolly & Hainey, 2011; Prensky, 2003; Wrzesien & Raya, 2010). There is a growing interest in games-based learning (GBL), where games are explicitly designed for educational purposes (Prensky, 2003).

Serious games and GBL are sometimes considered synonymous, even though the former have the wider objective of supporting training and behavioral change not only in the education sector, but also in different areas, such as business, industry, healthcare and marketing (Wrzesien & Raya, 2010). One of the advantages of adopting GBL is that the game activities are near to the modern psychological and educational theories on effective learning (Boyle et al., 2011). Indeed, they suggest that the most effective learning is reached when the learning experience is active, experiential, situated, problem-based and provides immediate feedback (Boyle et al., 2011). The didactic model adopted in a game-based learning approach is a learner-centered model that puts the learner into a more active role, shifting from the learning-by listening to the learning-by-doing approach. In addition, the game should appropriately embed feature knowledge and skill acquisition mechanisms that should be integrated in a meaningful and homogeneous way (Bellotti, Berta, Gloria & Primavera, 2009).

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