Guest editorial

Special issue on education and learning for virtual environments and serious games

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Over the past few decades, there has been huge advances in creative industry applications which grew enormously ranging from console, personal computer, and mobile-based applications. Two of the most significant areas of recent growth include serious games and virtual environments. Serious games can be considered as computer games that have an educational and learning aspect and are not used just for entertainment purposes. Virtual environments have gained tremendous interest through the availability of new hardware and software solutions.

The special issue explores games and virtual worlds in relation to (a) novel technologies, (b) applications, (c) methodologies, theories, and frameworks and (d) evaluation approaches and studies. This special issues is focused on novel research into serious games and virtual environments for the purpose of education and learning and consists of seven articles.

The articles in this special issue are extended and revised versions of the selected best educational papers presented at the 9th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games 2017), 6–8 September, Athens, Greece. VS-Games 2017 that was jointly organised by the National Technical University of Athens (NTUA), Greece, and the Human Computer Interaction Laboratory (HCI Lab), Faculty of Informatics, Masaryk University, Czech Republic and was awarded technical sponsorship by the Institute of Electrical and Electronics Engineers (IEEE).

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The first paper entitled "Can digital games in school improve attention? A study of Brazilian elementary school students" evaluates the effect of digital game routine on attention performance of elementary school students. Thirty students played digital games daily at the beginning of class for 6 weeks, while a group of 41 students had the normal school routine. The students' attention performance was assessed by the D2 test before and after the training period. Findings suggest that the use of digital games in school routine can enhance the cognitive improvement that is already obtained in the normal school routine, creating an enriched environment to stimulate students' cognitive development.

The second paper entitled "Chain of command in autonomous cooperative agents for battles in real-time strategy games" investigates incorporating chain of command in swarm intelligence of honey bees to create groups of ranked co-operative autonomous agents for an RTS game into create and re-enact battle-like simulations. The behaviour of the agents is based on the foraging and defensive behaviours of honey bees, adapted to a human–environment. The chain of command is implemented using a hierarchical decision model. The behaviours of agents are evaluated both mathematically and empirically using an adaptation of anytime universal intelligence test and agent believability metric.

The third paper entitled "VReanimate II: training first aid and reanimation in virtual reality" presents a virtual reality application, which teaches about aspects of first aid in a controlled digital environment. In the first part of this article, related work is described and in the second part, an evaluation of the system is presented, including results concerning its usability and effects on the knowledge gain of different users. A mixed methods study observes a significant improvement in regard to knowledge about correct procedures in emergency situations and could confirm the hypothesis, so that a non-textual and situated design can be helpful for this purpose.

The fourth paper entitled "How to play storytelling games with masterpieces: from art galleries to hybrid board games" explores how to play storytelling games with collections of artworks. First, a generic storytelling game is proposed, and then the results of a user study that investigates the game's affordances in different environments and setups are presented, ranging from large exhibitions at a cultural centre, to a casual home setting. Finally, following a user-centred design approach, preliminary evaluation results of the game prototype using the focus group methodology are provided.

The fifth paper entitled "Adaptive game-based learning in multi-agent educational settings" proposes a novel methodology to model an educational framework able to represent and optimally foster these needs, along with a methodology for nonlinearly adapting networked learning objectives. In addition, the framework is supported with an ontology that enables personalised and contextualised decision-making over learning activities on autonomous devices, enabling their dynamic modularisation during the learning process.

The sixth paper entitled "A model of heritage content to support the design and analysis of video games for history education" investigates issues that are related by a lack of definitions of heritage content in the video game medium. It describes a model that defines how historical information can be presented in a video game at a content level and demonstrate how it can be applied to the analysis of the content

in a commercial historical game. Finally, it proposes a novel methodology based on activity theory to guide the design of serious games, based on pre-defined heritage instructional content.

The seventh and the last paper entitled "An adaptive framework for the creation of exergames for intangible cultural heritage (ICH) education" focuses on the design and development of a novel framework for the rapid design of body-motion-based customizable game-like applications. Three pilot-use cases have been selected: (i) the Latin dance Salsa, (ii) the Greek traditional dance Tsamiko, and (iii) the Walloon (Belgian) traditional dance. Results showed that the use of such a game-like application could be efficient, as positive feedback was obtained.

Prof. Fotis Liarokapis　is an Associate Professor and the director of the Human-Computer Interaction Laboratory at Masaryk University, Faculty of Informatics at Brno, Czech Republic. Before, he was the Director of Interactive Worlds Applied Research Group (iWARG), Faculty of Engineering and Computing at Coventry University and a research fellow at the Serious Games Institute (SGI). He has contributed significant publications in the broad areas of virtual and augmented reality, serious games and braincomputer interfaces. He has organised multiple conferences and workshops and he is the co-founder of VS-Games international conference.

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