

## SPECIAL ISSUE

# Computer game based learning

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### INTRODUCTION

Game studies are being approached from various fields such as media and communication theories (Järvinen, *et. al.* 2002), semiotics (Murray, 1997; Frasca, 1999), literary theories (Aarseth, 1997), sociology (Toasca, 2002; Steinkuehler, 2006), anthropology (Huizinga, 1944), etc. Recently, with the advent of computer games, the Human Computer Interaction (HCI) community has also begun studying games, often with the intention to uncover useful information that informs the design and evaluation of work-based software, including educational software. Following the increasing interest for serious games which was initiated by David Rejeski and Ben Sawyer (Stokes, 2005), computer game-based learning has become one of the most studied domains in the area of computer games. Research in game-based learning emphasises the natural learning process that happens within the game and how this can inform the design of educational games developed explicitly to support the learning of a subject matter.

Until recently, computer games were largely ignored by most educators, as they saw only the negative social consequences of playing games and overlooked the educational opportunity of gaming. This was highly influenced by the media criticism of the use of games in e-learning, exacerbated by the perception that computer games are often mindless, violent, solitary pursuits played by males. In fact, there is almost no doubt that one does learn something from the game while playing it.

Although not many, since the widespread popularity of Pac-Man in the early 1980s, a few

educators started to believe that the “magic” of computer games could apply in the classroom to engage students, making learning more enjoyable (Squire, 2003). A few educators have taken this further by defining elements of game design that might be used to make learning environments more engaging (Bowman, 1982; Malone, 1980).

For instance, Malone (1980) in the paper, *What Makes Things Fun to Learn? Heuristics for Designing Instructional Computer Games*, proposes three main elements that contribute to the fun factor of computer games: challenge, fantasy and curiosity. Gee (2003) describes, in *What Video Games Have to Teach Us About Learning and Literacy*, gaming as a complex social practice where computer game players engage in high order thinking that requires complex cognitive effort. The overarching idea is that children learn to participate in new domains by playing computer games. They learn to make sense of new areas, not only on their own, but also by engaging with their peers, discussing and sharing information.

Another study has been carried out by Squire (2004), as part of his PhD research, to study game-based learning. It is worth mentioning that in his work Squire explains how activity theory could provide an analytical lens to examine learning through computer games. Based on social cultural theories which argue that knowledge cannot be treated as isolated entities extracted from the contexts from which they form, he treats computer games as a tool in the learning activity system.

Through the years game-based learning research has gone through some theoretical as well as technological evolution.

The first generation maintained a narrow focus on learning with the computer game filling players up with knowledge. The first generation perspective corresponds with the early edutainment ideas, which drew largely from the behaviourist learning approach that assumes that learning occurs when a learner repeatedly practices a skill enough times and advocates that learning is based on observable changes in behaviour such as basic paired associations, discriminations, rote memorisation.

The second generation of game-based learning research adopted a cognitivist approach, trying to understand the more complex processes between players and computer games. In the cognitivist approach, the learner becomes the centre of attention. It focuses on preparing the learner to problem solving in ambiguous situations (e.g., heuristic problem solving, personal selection and monitoring of cognitive strategies). Such studies help us understand the mental models that students use to perceive the world and the assumptions they make to support those models. The cognitive approach advocates that the purpose of learning is for an individual to construct his or her own meaning, not just memorise the “right” answers and regurgitate someone else's meaning.

The third generation of game-based learning research focuses on the networked element of games. The game systems now go beyond the player-game interface interaction by also including the socio-cultural elements of game playing. This generation of game-based learning research stresses learning as construction. One of the emphases in this era of game-based learning research is the domain of constructionism (Papert & Harel, 1991). According to this new direction, research has focused on open-ended games, where students design games, engaging in virtual worlds, and playing of other open-ended computer games.

Another emphasis on the third generation of game-based learning is the social context around the gaming experience. One of the most prominent social cultural theories in learning was founded by Vygotsky. He emphasised the importance of socio-cultural aspects of learning, advocating that learning is mediated by cultural tools in which knowledge amasses (Vygotsky, 1930). Learners do not interact with the environment directly; instead the interaction is socially mediated through artefacts, be it signs or tools.

## CONTRIBUTIONS

In this issue, we offer six articles on game-based

learning from various areas and different contexts.

Stephan Lukosch and Till Schümmer explored the web-based learning platform known as CURE that supports different collaborative learning scenarios. Their main purpose was to help students prepare oral-exam in peer-based groups by offering a design space with various online learning gadgets. With the flow theory as proposed by Csikszentmihalyi (1990), they discussed the possibility of the design space to provide enjoyable learning situation. Then they implemented two learning gadgets integrated into the CURE platform to demonstrate the practicality of such environment for preparing exam collaboratively in an enjoyable way.

The article by Karin Danielsson and Charlotte Wiberg reports on the methods and theories for learner-designed educational computer games through participatory design. Their results showed that the contributions and feedbacks from the students are important in designing such games through four aspects: target group, game content, aesthetics and experience. They claimed that student participation during the development process helps capture the student's expectation and support the usage. In this article, they also presented the actual development of a game for Swedish parliament and BBC which involved commercial design teams.

In her paper, Lori L. Scarlatos described how tangible user interfaces were used in mathematic games. Working in line with the argument that physical involvement with learning materials can enhance the understanding and retention of difficult concepts, she demonstrated how students worked together in a physical environment that was supported by the underlying computer system in learning mathematics. This paper also discusses pedagogical principles and an approach to designing computer games with tangible technologies with some examples of mathematic games developed.

Megan Miller and Volker Hegelheimer in the paper attempts to tackle an interesting area, namely computer aided language learning (CALL) targeting English as second language (ESL) learners. They adapted a commercially successful game to enhance vocabulary learning through supporting materials. In their study, two groups of adult learners were tested using the modified games and it was found that there was a statistically significant increase in vocabulary acquisition for the group using the game with mandatory supplemental materials. They concluded that it is crucial to structure tasks and support learning when computer games are used for learning.

Ahmed BinSubaih, Steve Maddock and Daniela Romano propose game-based learning to educate traffic accident investigators through “learning by

doing” in which learners feel safe in exploring different cases without real consequences. The article presents the development of the game with an existing game engine and the evaluation of the game. 56 policemen participated in the study in which they were required to investigate a virtual road accident scenario. The experiment revealed that there was a significant improvement in the performance in both novice and experienced policemen.

The last article presents a study on examining the support of the development of formal reasoning skills with informal knowledge used in computer game playing. Brian K Smith, Priya Sharma and Paula Hooper conducted an investigation on fantasy sport game in which players create ideal sport teams and compete to achieve better athletes’ statistical performance as such a game involves mathematical concepts and decision making. The analysis revealed that certain knowledge required to play the fantasy sport game can be made explicit in the interaction between players through the discussion board.

## THE FUTURE

Through the encouraging submissions we received, we have found out that future research on game-based learning could focus on at least four aspects.

### *Fun through challenge, fantasy and curiosity:*

The most obvious benefit education might reap from video game design is probably the fun factor. The word “school” which originally means leisure has now acquired precisely the opposite sense of systematic work and training. In order to bring back the leisure element in education, the game design heuristic of motivation might be useful.

### *Intrinsic motivation learning*

Second, learning happens mostly intrinsically and naturally in computer games. Unlike formal education where students are learning for an external motivation such as a good mark, the player in games is learning for the sake of playing the game. Perhaps examining the learning theories underlying video games would cast some light in this issue

### *Constructionist learning*

Apart from these, new learning theories often observed in game playing activity. Constructionist learning for example has permeated many newer games. These games let players construct the whole civilisation, cities and etc. These kinds of learning might be beneficial in formal education as well as Papert has been proposing and promoting

constructionist spirit in the classroom.

### *Social cultural learning*

Another theory, social cultural learning also applies in games, particularly massively multiplayer online role playing games (MMORPG). Instead of working alone on the same project, learning activity can derive some design principles from MMOG where players are engaged a communal object and divided in different roles.

With the increasing interests from both academia and industry, the future of computer-based learning certainly looks bright. This issue hopefully gives the reader some overview of the current development and research stage.

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