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Colloquium

Cognitive assessment of game-based learning

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Introduction

Game-based learning is an untapped resource that may provide benefits for many educational and therapeutic applications. However, Wartella (2002) noted that as children grow older, they prefer not to play games that are educational by design; opting for action/adventure and role-playing games. She also states that although many researches suggest that cognitive skills are increased through the use of computer games, there is very little solid research to back this claim. Yet Pillay (2003) found that recreational games do facilitate learning, and to a greater extent than educational ones. He suggested that the gameplayers reasoned more effectively and employed anticipatory thinking. He reinforced Ko's (2002) findings, suggesting that the students were able to learn by gaining inferences from the games' design. But when and how does this game-based learning take place?

Many suggest that learning takes place within the game, yet Garris, Ahlers and Driskell (2002) suggest a different model, with learning only taking place after reflection and debriefing. However, there has been little done to produce a framework for game-based learning that is based on validated assessments. A literature search shows that many researchers disagree on the supposed benefits of learning from computer games. For example, Pillay, Brownlee and Wilss (1999) noted that learning is related to mental visualisation of solutions to problems, and they state that playing computer games enhances this cognitive process. They observed a high level of multitasking ability by the player and the use of a metacognitive approach, and contend that computer games do enhance some cognitive skills. However, Antonietti and Mellone (2003) state that literature claiming the use of technology on its own increases the cognitive abilities of the user, is not in fact justified. Yet Kasvi (2000) found, in his study of computer games, that it is the game itself that promotes the learning. Curtis and Lawson (2002) found that increasing the complexity of the game increased the cognitive load on the player, and it is this that improves cognitive abilities needed for learning to occur.

Project goals

The aim of this research is to ascertain how the playing of commercial computer games enhances the quality of learning and to what degree this is achieved by the student. Subsidiary questions will focus on the specific aspects of commercial computer games (design, genre, environment, etc) and if they can be reliably mapped onto skills needed to enhance the quality of learning. Also included will be if the playing of commercial computer games arrest the decline in the cognitive process resulting from learning impairments, such as late effects suffered by teenage cancer survivors.

For this research, a conceptual framework will be developed to show how and when game-based learning takes place. Commercial computer games will be reviewed and tested to ascertain which games and which aspects of these games are shown to enhance the learning process. The conditions under which the games are played, and the environment created, will also be considered as a factor for improving the quality of this learning.

Jerome Bruner (1966) lists multitasking as but one of the cognitive tasks that is required to improve learning, yet Jean Piaget (Flavell, 1985) suggests that cognitive development only occurs after a certain age is reached and the brain has matured. However, all learning theorists agree that cognitive abilities are necessary for learning to occur, but can the quality of this learning be increased through the use of computer games, or is it the immersive environment in which the learning takes place that increases cognitive abilities? The software product *Synwin* was successfully used to show that multitasking ability is improved through playing computer games, but only with games that create an immersive environment (Kearney, 2006).

Project outcomes

A software assessment programme will be created to include several cognitive tests, and will be subsequently validated to test the abilities that have been identified, through academic research, as being necessary for the development of learning and necessary to enhance the quality of such. Each test will be designed using theories developed from game-based learning research. For example, asking a participant to sequence numbers or rotate shapes as quickly as possible provides neither motivation nor challenge to do so. However, add a *Tetris*-like simulation or a game-like interface where the participant becomes a player and the task must be completed to attain a visual goal, then the assessment will become a true representation of the participant's abilities.

The resulting framework from this research will be applied to existing computer games to show their potential to improve the quality of learning. The framework can be used for the design of learning games and application of games in a game-based learning environment. Commercial computer games will also be assessed and rated using a labelling system developed to display the potential education value of the game.

Summary
The research for this study will result in a validated framework of how game-based learning occurs and suggested applications of how it can be applied. Computerised assessment tools will be created and used to validate the resulting framework. The research has been approved for doctoral study at Deakin University, with supervisors Professor Russell Tytler and Dr Paul Nicholson.

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