Chapter 8
A Design Framework for Educational Exergames

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ABSTRACT

This chapter presents a framework for understanding the elements of educational exergames that combine both cognitive and physical gameplay. The aim of the framework is to provide a foundation to develop engaging and effective educational exergames as well as to provide a blueprint to define reasonable research settings. By using the framework, designers can scrutinize their game designs, either in research or commercial settings, and reveal new ways to optimize learning effects, health effects, and user experience in educational exergames. The chapter describes a case study in which the framework was used to fine-tune an educational exergame called "Yammy Attack." The results showed that the framework was a useful tool to imagine and discover novel design solutions that would not necessarily otherwise emerge. Furthermore, the chapter discusses the usefulness of educational exergames and possibilities to incorporate them into the schools.

INTRODUCTION

The development of new educational methods is necessary to accelerate learning and to reach learner groups that are currently not reached by conventional techniques of learning. The potential use of games in educational settings is huge because a large and growing population is engaged with playing games. However, the popularity of games has also created problems. For example, obesity has become a big problem in many countries recently. According to Gorgu, O'Hare and O'Grady (2009), the reasons for obesity include a high calorie diet and a serious lack of physical activities in the daily lives of children. It has been argued that video games are one of the main reasons for physical inactivity (Vanderwater, Shim & Caplovitz, 2004; Sothern, 2004). Furthermore,

DOI: 10.4018/978-1-4666-3950-8.ch008

physical activity in schools has steadily declined since the 1970s. During this same period, the percentage of overweight children in the US, for example, has more than doubled (Hedley et al. 2004). The emerging exertion game genre tries to have an effect on this by encouraging players to perform physical movements during gameplay.

An adequate amount of physical activity is important for children because

1. Increased physical activity has the potential to improve fitness and decrease obesity, both of which positively impact cognitive functioning and academic achievement (Castelli, Hillman, Buck & Erwing, 2007),
2. Physical activity activates brains for enhanced learning and memory (e.g. Ratey & Hagerman, 2008; Hopkins, Nitecki, & Bucci, 2011), and
3. Good fitness potentially prevents troublesome behavior in schools (Ratey & Hagerman, 2008).

However, currently students spend the majority of their school time sitting in a classroom, which is not an optimal solution from both learning and health perspectives. We should find new ways to introduce good practices regarding the provision of regular physical activity in schools. Thus, this chapter considers exertion games as an alternative learning environment that could be applied on a day-to-day basis in elementary schools.

Although the possibilities that serious games can provide to schools have been recognized, still one of the biggest problems is the inadequate integration of education and game design principles (e.g. Arnab et al, 2011; Kiili, 2005a, Kiili, 2005b). According to Quinn (2005) it is a real challenge to design engagement that integrates with educational effectiveness. The challenge of the proposed approach is even higher, because an exertion dimension has been added to this problem space. A combination such as this, educational exergames, is a new, unstudied branch of research in the era of serious games. In this chapter we propose a design framework for educational exergames. The aim of the framework is to provide foundation to develop engaging and effective educational exergames as well as to provide a blueprint to define reasonable research settings. First we shortly define exergames and consider bodily interaction. After that the initial structure of the design framework is presented and an educational exergame, Yammy Attack, is re-designed with the help of the framework. Finally, the possibilities and challenges that introduction of educational exergames provide for schools are discussed.

EXERGAMES AND BODILY INTERACTION

According to Mueller et al. (2011) exergames are an emerging form of computer games that aim to leverage the advantages of sports and exercise in order to support physical, social, and mental health benefits. An exergame is controlled with an input mechanism that requires a player to invest physical exertion. Exergaming is not a new phenomenon, but in recent years, the development of motion-based controllers has facilitated the advent of the exergame genre (Kiili, Perttula & Tuomi, 2010; Kiili & Merilampi, 2010). Currently, exergames are specifically associated with Nintendo Wii, Kinect and Playstation Move game consoles. Most commonly exergame movements are detected via motion sensors, cameras, pressure sensors or GPS sensors depending on the type of the game.

The Impacts of Exergaming

According to Staiano and Calfert (2011) exergame playing can lead in physical, social, and cognitive developments. Next, the major findings about the impacts of exergaming are shortly reviewed.

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