

Chapter 2

The Use of Computer Games in Education: A Review of the Literature

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ABSTRACT

Games-based learning has captured the interest of educationalists as it is perceived as a potentially highly motivating approach for learning in a diverse number of areas. Despite this, there is a dearth of empirical evidence in the GBL literature, and confusion as to where games-based learning fits in relation to games, simulations, and serious games. This chapter will present a review of the current state of the GBL empirical literature, but will particularly focus on the fields of software engineering, Information Systems, and computer science. This chapter will also take into account the advantages and disadvantages that have to be considered when selecting a GBL approach.

INTRODUCTION

This chapter will discuss the definition of ‘Games-Based Learning’ (GBL) and its associated terms and will suggest a position for GBL in terms of its relation to games and simulations. A brief

review of the use of some computer games in education will then be performed to show the diversity of the use of GBL outside of computer science. The chapter will then review the use of computer games in computing education and will summarise the empirical evidence associated with the relevant games. Finally there will be a brief discussion on the advantages and disadvantages of games-based learning.

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WHAT IS GAMES-BASED LEARNING?

This section will provide a definition of Games-Based Learning and some of the cognate terms surrounding it in the literature such as: games, simulations, computer games, simulation games, computer simulations, computer simulation games and serious games. Taking these definitions and distinctions into account, a diagram will be produced to illustrate the position of GBL to situate these terms within the literature.

The term “game” covers a very wide range of activities but, as Juul (2003) and others (e.g. Crawford, 2003) have observed, it is difficult to define in terms of necessary and sufficient features, and there is no real consensus on shared terms and their definitions. Several definitions of games have been proposed. For example, Dempsey, Haynes, Lucassen and Casey (2002) define a game as “... a set of activities involving one or more players. It has goals, constraints, payoffs, and consequences. A game is rule-guided and artificial in some respects. Finally, a game involves some aspect of competition, even if that competition is with oneself.” Grendler (1996, pp. 523) defines games as “consisting of rules that describe allowable player moves, game constraints and privileges (such as ways of earning extra turns) and penalties for illegal (non permissible) actions. Further the rules may be imaginative in that they need not relate to real world-events.” On the other hand, Caillois (1961) defines a game as “an activity that is voluntary and enjoyable, separate from the real world, uncertain, unproductive (in that the activity does not produce any goods of external value), and governed by rules.” The main characteristics of games are that they are voluntary, and typically enjoyable, physical or mental activities; they involve goals and ways of achieving these goals usually through “moves” or actions within the game that can be subject to constraints or rules; they are in some way separate from real life. Games can be played singly, in pairs

or in teams. Smed and Hakonen (2003) define a computer game as “a game that is carried out with the help of a computer program.”

The term “simulation” generally refers to a representation of a real system, an abstract system, an environment or a process that is electronically generated. Crookall and Saunders (1989) view a simulation as a representation of a real world system that may focus on a specific aspect of reality. Thavikulwat (1999) defines the term “simulation” as “a replicable representation of a process. The representation can be phenotypical or genotypical. If phenotypical, it is a reflection of the process; if genotypical, it is a subset. Thus, a phenotypical representation of employment would have participants employ fictitious persons; a genotypical representation would have them employ each other. Computer animation might make the phenotypical representation realistic, but it cannot make it real. Genotypical representation, however, is real.”

The term “computer simulation” has many definitions. Pritsker (1979) compiled an inventory and found twenty-one different definitions. In the largest possible sense, McLeod (1986) defines a computer simulation as “the use of computers to model things” whereas Laurillard (2002) defines it as an “artefact that embodies some model of an aspect of the real world, allows the user to make inputs to the model, runs the model and displays the results.”

There is both a distinction and an overlap associated with the terms “simulation” and “game”, which gives rise to the terms “simulation game” and “computer simulation game.” Heinich, Molenda, Russell and Smoldino (1996) provide the following distinction between a game and a simulation: “a game is an activity in which participants follow prescribed rules that differ from those of real life as they strive to attain a challenging goal. The distinction between play and reality is what makes games entertaining... A simulation is an abstraction or simplification of some real-life situation or process. In simulations, participants

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