Chapter LXXIII
The Future of Digital Game-Based Learning

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ABSTRACT

This chapter discusses the potential future of games for learning through the lens of current advantages of real-world education that are thus far lacking in educational games. It focuses on four main facets of the real-world educational experience: adapting content to an individual student, the rigorous evaluation of educational media, the ease of modification of educational games, and the application of games to new domains and teaching techniques. The chapter then suggests how we as designers and developers can make strides towards incorporating these lacking elements into how we build and use educational games. The author hopes that this discussion can be used to foster discussion about where the field could be and should be going in the near future.

INTRODUCTION

Here we are at the edge of the frontier. The serious games movement has gained momentum by leaps and bounds in the past decade. The Serious Games Initiative has helped foster a community of academics and industry designers interested in combining game design with educational techniques to create digital game-based learning experiences. New school curriculums have been funded by the MacArthur Foundation that focus heavily on employing games for learning (Barab et al., in press; Chaplin, 2007). We are coming into our own as a community as games for learning gain slow acceptance from funding agencies, the education community, and the general public. As we learn more about how to build educational games that are well designed, we should also reflect on the current state of affairs and ask ourselves, "What is missing?" or more specifically, "What aspects of proven real-world educational experiences are we currently lacking in educational games?" Once we come to some answers to this question, we then finally need to ask, "What can we do about it in the future to maximize the potential of games as a medium for learning?"

The first aspect of real-world education missing in educational games thus far is *individualized adaptation* to focus a digital game-based learning experience on a particular student's needs. Students in a traditional classroom have varied learning styles that require different teaching techniques for them to effectively comprehend the material (Felder & Silverman, 1988; Riding & Sadler-Smith, 1997) (e.g., presenting a physics lesson in lecture by giving the formula and examples, then going into the lab and letting students physically play around with the principles covered). Educational games are typically not designed to attack a learning problem in this kind of multi-dimensional model. They are instead designed as a typical entertainment game is, aiming for a single design for a rough population of users (e.g., 10th -12th graders).

In an ideal learning situation, students get their individual needs met in small classrooms or one-on-one teaching or tutoring sessions. Students perform significantly better when given this kind of attention compared to general classroom learning alone (Bloom, 1984; Cohen, Kulik, & Kulik, 1982). The educational games community has started to look at how intelligent tutoring system (ITS) technology, which provides some of the positive results of real-life human tutoring, can be employed to monitor student aptitude in a game and select material to address learning needs (Gomez-Martin, Gomez-Martin, & Gonzalez-Calero, 2004; Johnson, Vilhjálmsson, & Marsella, 2005; Van Eck, in press). The defining feature of an ITS is that it carefully oversees a learner's work on problems to provide needed guidance and content selection. An ITS models the actions and interventions of a human tutor, which is the most effective means of instruction (Bloom, 1984). ITSs identify the need for instructional interventions by comparing a model of expert performance with a model of the learner's performance (Koedinger, Anderson, Hadley, & Mark, 1997). ITSs traditionally employ a *model trace*, which is a fine-grained cognitive model designed to identify what strategies a student is employing to solve a problem. When the student is having trouble arriving at the correct answer, the systems can use the model trace to identify specifically what is wrong with the strategy being employed and what is the student proficiency in the various topics being taught and select content to address student deficiencies in that content.

We as researchers have taken the initial steps to identify the need of individualized teaching in games and a usable technology that can help address that need. Games have already employed intelligent tutoring systems to teach such topics as language (Johnson et al., 2005), computer programming (Gomez-Martin et al., 2004), and interpersonal and intercultural skills (Lane, Core, Gomboc, Karnavat, & Rosenberg, 2007). However, is the traditional ITS model of providing individualized guidance and selecting content as far as we can go? Educational games can expose the student to educational content in both a declarative manner (i.e., presenting text or graphics that communicate some learning concept), as ITS systems typically do, and a procedural manner (i.e., through the act of employing game mechanics to change the game world in some meaningful way). There is a rich future in exploring how we can take advantage of adapting both the declarative and procedural content of games to provide a game experience that is tailored to an individual's needs along a series of dimensions, not just the typical ITS adaptation of declarative content.

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