Chapter 3.6
Building Artificially Intelligent Learning Games

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The biggest thing limiting games in education in my view is the lack of good artificial intelligence to generate good and believable conversations and interactions … We need games with expert systems built into characters and the interactions players can engage in with the environment. We need our best artificial tutoring systems built inside games, as well … Then we will get games where the line between education and entertainment is truly erased. (James Gee, 2003)

ABSTRACT

The idea of digital game-based learning (DGBL) is gaining acceptance among researchers, game designers, educators, parents, and students alike. Building new educational games that meet educational goals without sacrificing what makes games engaging remains largely unrealized, however. If we are to build the next generation of learning games, we must recognize that while digital games might be new, the theory and technologies we need to create DGBL has been evolving in multiple disciplines for the last 30 years. This chapter will describe an approach, based on theories and technologies in education, instructional design, artificial intelligence, and cognitive psychology, that will help us build intelligent learning games (ILGs).

INTRODUCTION

The learning potential of games has been discussed in the popular press and academic journals since at least the mid-60s with the advent of simulation games in the social sciences. Yet games and learning have also always been viewed by many with a healthy dose of skepticism. One of the reasons for this has always been the dichotomization of playversus work, in which play is seen as frivolous entertainment and therefore the opposite of work and learning. This popular belief has begun to change, however, in part thanks to the efforts of scholars and researchers who have studied games and learning and published in the mainstream press (e.g., Gee, 2004; Johnson,

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2005; Prensky, 2000; Reiber, 1996). Some 200 academics interested in developing and using games for learning have attended at the Game Developers Conference each year since 2002, and hundreds of academics are conducting game studies, designing games, and/or finding ways to integrate commercial games into the classroom (Foreman, 2004). This has been in part spurred by the tremendous growth in the games industry, which is currently estimated to be a $10 billion industry (eSchool News, 2005). This, of course, is in turn driven by the growing number of people who are playing games, and they are not all net gen-ers. The Entertainment Software Association (ESA) reports that 75% of heads of household play computer games, and that 62% of game players are over 18 with a mean age of 30. This increase in the game industry and number of games has, most recently, led to an increase in the number of colleges offering game design programs, which will further break down barriers to the acceptance of games and learning.

But even as games become more mainstream and the idea of games as a learning medium gains acceptance, the promise of learning games remains largely unrealized. Although the edutainment industry (initial attempts at learning games) has grown in sales over the years, it has not revolutionized learning nor experienced the explosive growth originally predicted. The combination of the adaptive and tireless nature of computer-based instruction with both entertainment and authentic problem solving should have produced a host of games that teach all learners at their own pace. So where are these games?

One reason for the dearth of these games may be that the dominant paradigms in education and the gaming industry are too different to allow for good synergies. The world of education is focused on providing the best path for learners to get from novice to expert in different domains. Content is thus privileged over experience. The game world, in contrast, is focused on providing a rewarding, interactive experience. Content is secondary to experience and is willingly sacrificed for game play when and where needed. In the cases of edutainment titles, these worlds often clash, with educators developing content (often linear, hierarchical, and instructivist) without regard to experience, and game developers building interactive environments (often non-linear and player-driven) without regard to the content or instruction. It is this culture clash that has led to titles in which game play is interrupted by long bouts of reading and drill and practice, and/or where game play is used as a reward for slogging through such instruction. In these edutainment titles, the game and the content are rarely if ever integrated. Seymour Papert (1998) refers to these as Shavian Reversals, which is a term from genetics indicating an offspring that has inherited the worst characteristics of both parents. As expected, these titles have rarely been financially successful, making game companies leery of anything that smacks of education. Game developers often believe that "whenever you add an instructional designer, they suck the fun out" of the game (Prensky, 2004).

While there has been some progress made through initiatives like the Serious Games initiative, the games-to-teach project at MIT, and the Education Arcade, which focus on games that teach content in the context in which it is demonstrated (e.g., Carnegie Mellon's *HazMat* project, Chris Dede's *River City* project, Education Arcade's *Revolution* history game, and Muzzy Lane's commercial game *The Calm and The Storm*), blending instructional content and games remains a significant challenge for the field.

Part of the reason for this is that the field is too young to have many established research methods and theoretical models for game design, let alone instructional games (e.g., Pearce, 2004; Prensky, 2001; Smith & Mann, 2002). What we need is to establish new models for developing learning games that account for the strengths of both the educational and game worlds. To do this, we must recognize that while games may

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