Chapter 53
Using Reason Racer to Support Argumentation in Middle School Science Instruction

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ABSTRACT

With secondary students reporting that they are not attracted to science, technology, engineering, or mathematics (STEM) disciplines, educators are turning to games as one strategy to engage students. The goal of integrating games into science learning is to create an excitement difficult to achieve with typical instruction. This chapter reviews games in education, particularly in STEM. Recognizing that teachers often lack the time to integrate role-playing games, the use of casual games is suggested. Casual games are easy to learn and simple to play, and incorporate game features designed to compel students to repeated play. The Reason Racer game addresses the difficult skill of scientific argumentation in a casual, competitive game. Evaluated with more than 700 students, those who played the game at least 10 times during science instruction over 6-weeks improved in every aspect of argumentation, and reported an increase in confidence and motivation to engage in science, compared to those who did not play the game. Readers are walked through the game and the resources in the Teacher Portal.

INTRODUCTION

This chapter has several purposes related both to the use of games to support teaching and learning and the challenge of teaching middle school students the very difficult skill of scientific argumentation. The first part of the chapter provides an overview of the use of games in education, particularly in science, technology, engineering, and mathematics (STEM) education, and a discussion of casual game features that are specifically designed to engage students and can impact learning. The second part of the chapter provides a synopsis of the science practice of ar-

DOI: 10.4018/978-1-4666-9624-2.ch053

gumentation and the effectiveness of the *Reason Racer* game in engaging students in this difficult skill. The remainder of the chapter focuses on the features of the multiplayer *Reason Racer* game and an explanation of how to use the game and the accompanying Teacher Dashboard to support scientific argumentation teaching and learning.

As with any innovation, there are issues, problems, and tentative solutions. These are presented as challenges, not caveats. Our hope is that educators and researchers will include casual games as one of many resources available to support science instruction. Games, such as *Reason Racer,* can be both as engaging as any arcade-style game yet challenge middle school students in the higher order skill of scientific argumentation.

THE INSTRUCTIONAL USE OF GAMES

Games in Education

Teachers have been using games to engage students in learning long before the advent of technology-based games, understanding that games have the potential to excite students while engaging them in content, a condition optimal for learning (Blanchard & Cheska, 1985; Klopfer, 2008; Lepper & Cordova, 1992; Malone & Lepper, 1987). Early work with technology and computers recognized that features of computer-based games could increase student engagement and opportunities to practice skills, particularly for struggling learners. Early research and development of games included, for example, the MathKeys games (Xin, 1999) developed by the Minnesota Educational Computing Company (MECC) and the Arcademic Skillbuilder games (Chaffin, 1982; Chaffin, Maxwell, & Thompson, 1982) from the Developmental Learning Materials (DLM) Company. These games incorporated features such as moving images, user-control, rapid play, and immediate feedback to engage students. These games, however, were single-player and installed on a unique computer, which limited the scope of play. They do, however, provide an early demonstration of the power of technology-based games to engage students and build basic mathematical skills. Subsequent online games have evolved since this early development and can now be multiplayer and engage students in more complex skills.

Research on the effect of technology-based games has consistently shown positive results regarding motivation, persistence, curiosity, attention, and attitude toward learning (Shin, Sutherland, Norris, & Soloway, 2012), that students can have significantly higher cognitive gains when working with games when compared to receiving traditional instruction (Vogel et al., 2006), and that games promote learning and/or reduce instructional time across multiple disciplines and ages (Van Eck, 2006).

For an experience to be considered a game it will usually include goals, rules, challenges, and interaction (Crawford, 2003). Some suggest that games also require competition and quantifiable outcomes (Salen & Zimmerman, 2004) as well as the possibility for error and failure (Squire, 2006). There are many different types of educational game genres, usually defined by the type of game-action rather than the content of the game (Apperley, 2006). Prensky (2005) points out the need to deliver educational content using differing game genres and mechanics because, as he suggests, different types of content and learning require different pedagogical approaches. All game genres, recognizing that games have to contain essential engaging elements, should be considered when selecting a game to support learning a specific skill or knowledge (De Byl & Brand, 2011).

There are several different types of game formats that have shown promise in education (Dickey, 2007; Shin, Sutherland, Norris, & Soloway, 2012; Vogel et al., 2006). de Freitas (2006) demonstrated the wide array of game types that