

Chapter 22

Balancing Fun and Learning in a Serious Game Design

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ABSTRACT

This article presents the underlying philosophy of Sustain City, an educational serious game system that engages students, particularly prospective and beginning science and engineering students, in a series of engineering design challenges. Various strategies implemented in Sustain City for achieving a balance of fun and learning are discussed, including narrative-learning synthesis, supplementing the player's actions with feedback, and the development of a sufficient guidance system. The evaluation of Sustain City deployment is also presented. The assessment confirms the values of the serious games in promoting students' interests and learning in STEM fields.

INTRODUCTION

A number of recent reports (Computing Research Association, 2005) make it clear that the United States is losing ground on key indicators of innovation and progress because of its deteriorating performance in teaching math and science. Unfortunately, difficulty with early concepts in mathematics and sciences can dissuade students from pursuing further education in Science, Technology, Engineering, and Math (STEM) fields (Lantz, 2009). Student frustration is commonly to blame for poor performance, but the wide range of

learning styles and varying degrees of proficiency between students make it difficult for classic teaching methods to be universally effective. Even in modest class sizes, curriculum requirements and short class times do not allow instructors to provide individualized instruction. Additionally, such a system often emphasizes rote memorization that stifles students who are naturally adept at science and serves as a barrier to those who may still succeed if granted extra help. Although steps have been taken to enhance school systems in STEM areas, improvement would require new equipment and training that may be beyond the

skill set of current teachers. In fact, less invasive ways to augment current school systems must be considered to be able to make wide-spread changes feasible.

Video games have, since the 90s, become a mainstream form of entertainment and a multi-billion dollar industry. With improving hardware and software, development and availability of games have become inexpensive and accessible (Mayo, 2009). The success of video games is largely attributed to their ability to synthesize elements of environment and story with simulations that can provide real-time visualized responses. Video games are fun and embody real world situations in which players explore, learn and solve problems (Barab et al., 2009). The consideration of games in education is made evident by recent and growing development in “serious games,” defined by design that takes into account “(i) serious aspects that determine the pedagogical objectives such as the transmission and/or acquisition of knowledge, know-how, or information; (ii) and fun aspects which focus on the motivation and the management of end users’ frustration.” (Hocine and Gouaich, 2011). Taking advantage of the tremendous revolution that interactive technologies have brought to consumers, “serious games” offer a number of strong learning-enhancement capabilities, allowing for the realization of virtual worlds that can adapt to and assist students in ways that the typical classroom environment cannot (Torrente et al., 2011). In standard textbook-driven lecturing and study, visual or hands-on learners are left to find their own ways of perceiving the ever more complex concepts as they wade through a course. Currently, even hands-on approaches to learning, such as lab experiments, are limited by budgetary and safety constraints. Virtual environments allow infinite potential for scientific exploration, offering scenarios that are simply impossible in reality. Vivid examples can be found in many domains, such as science and engineering discovery (Barab et al., 2009; Mott et al., 2006; Sandford et al.,

2006), military training (Smith, 2009; Zielke et al., 2009) and healthcare training (Hoffman, 2006; Wattanasoontorn et al., 2012). A comprehensive review of the current development as well as social and technical barriers to its mass implementation is documented in (Freitas, 2010; Sandford et al., 2006; Ulicsak, 2010).

Serious game design has room for extensive growth which can be informed by recent changes in curricula as well as trends in academia. Echoing general concerns with the current state of our school systems, many educational groups have begun advocating curricular changes for STEM subjects. In a report created by the President’s Council of Advisors on Science and Technology (PCAST), the blame for poor retention rates is split between high performing and low performing students. Higher performing students cite “uninspiring” introductory courses as a factor in choosing different majors while lower performing students struggle with mathematics due to insufficient assistance (President’s Council of Advisors on Science and Technology, 2012). Issues such as student interests and instructional feedback should be considered when developing any STEM serious game. While the educational value of games has long been recognized, there is significant resistance to their adoption in formal education. One problem is the amount of instructional time that must be devoted to training and practice to allow games to have a significant effect on student learning. There is a tendency for serious games to develop an all-inclusive learning system that largely leaves the instructors without the flexibility needed to create their own curriculum. As indicated in (Wilson, 2009; Arnab et al., 2012), considerable benefit would be gained from aligning games with standards and curricula. Although serious games may be powerful tools, they should not be considered as a form of self-contained teaching. A truly effective solution relies on an instructor for focus and guidance (Egenfeldt-Nielsen, 2010). The best practices

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