A Framework for Structuring Learning Assessment in a Massively Multiplayer Online Educational Game: Experiment Centered Design

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ABSTRACT

Educational games offer an opportunity to engage and inspire students to take interest in science, technology, engineering, and mathematical (STEM) subjects. Unobtrusive learning assessment techniques coupled with machine learning algorithms can be utilized to record students’ in-game actions and formulate a model of the students’ knowledge without interrupting the students’ play. This paper introduces “Experiment Centered Assessment Design” (XCD), a framework for structuring a learning assessment feedback loop. XCD builds on the “Evidence Centered Assessment Design” (ECD) approach, which uses tasks to elicit evidence about students and their learning. XCD defines every task as an experiment in the scientific method, where an experiment maps a test of factors to observable outcomes. This XCD framework was applied to prototype quests in a massively multiplayer online (MMO) educational game. Future work would build upon the XCD framework and use machine learning techniques to provide feedback to students, teachers, and researchers.

Keywords: Educational Games, Evidence Centered Assessment Design (ECD), Experiment Centered Assessment Design (XCD), Learning Assessment, Massively Multiplayer Online Role Playing Game (MMORPG)

INTRODUCTION

Open-world games like massively multiplayer online role playing games (MMORPGs) encourage exploration and experimentation. In these environments, learning is situated in problem spaces that involve hypothesizing, probing, observing, reflecting, and recycling these steps (Gee, 2003). The open-world allows players the freedom to move and act freely within the game environment, instead of following predefined paths and action sequences (Blizzard Entertainment Inc., 2012). While research has documented how such games can be used...
to engage and inspire students to take interest in science, technology, engineering, and mathematical (STEM) subjects (Steinkuehler & Duncan, 2008), the field is beginning to explore how they can be used for assessment. The extended capabilities provided in MMORPGs allow for a new, innovative approach to assessment. Unlike traditional assessments, which rely on students providing itemized feedback, assessment through MMORPGs can be captured in-situ, during game play. In this paper, we will describe how unobtrusive learning assessment techniques coupled with machine learning algorithms can be utilized to record a student’s in-game actions and formulate a model of the student’s knowledge without interrupting the student’s game play. We introduce “Experiment Centered Assessment Design” (XCD), a framework for structuring a learning assessment feedback loop. XCD builds on the “Evidence Centered Assessment Design” (ECD) approach (Mislevy & Haertel, 2006), which uses tasks to elicit evidence about a student and his learning. XCD defines every task as an experiment in the scientific method, where an experiment maps a test of factors to observable outcomes. This XCD framework was applied to prototype quests in an educational MMORPG, The Radix Endeavor, being developed at The Education Arcade at the Massachusetts Institute of Technology. The game is set on a mysterious cluster of islands. The people of these islands live in a time reminiscent of the Middle Ages, when science and technology were limited. Furthermore, the government suppresses the population’s ability to practice science in order to maintain control over them. Players are recruited to a secret society that finds scientific discoveries to undermine and overthrow the oppressive regime (Klopfer, 2011).

The learning goal of The Radix Endeavor, or Radix for short, is to engage high school students in learning mathematics and biology. Students assume different character roles that determine the curriculum of quests their character will need to complete. The structure of the open-world MMORPG offers players two important freedoms. First, a sandbox RPG gives players the freedom to explore the game world. Players have quests in various locations on the island, but players are not limited in where they go, what equipment to use, or what tasks to complete. Second, massively multiplayer online games foster open communication between players. Players are encouraged to share advice on solitary missions, and compelled to communicate with each other during multiplayer quests (Klopfer, 2011).

Radix also aims to use learning assessment to offer feedback to students while the game is played. MMORPGs have a multitude of information to convey about a player’s status, abilities, location, equipment, enemies, and achievements. All of this information informs the player about his character and progress, and can be presented in a variety of interfaces. These interfaces allow a player to witness and analyze his position in the game and empowers players to make informed choices on the most effective path to success.

Even with efficient interfaces, however, a player may still become stuck. The ability to detect when a player is stuck allows the game to offer advice as needed or when it is most applicable. When a player has become stuck, the game should gradually assist the player in reaching his goal. By trusting and respecting a
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