Digitally-empowered learning: teaching archaeology through virtual reality and game-based learning

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INTRODUCTION

Archaeology has an inherent physical component and deals largely with three-dimensional objects, making it challenging to present in a traditional classroom. Like many natural sciences, a critical component of archaeology is field work. But field experience is not an option for most students.

- Participation requires travel, time, financial, or logistical resources not available to many students
- Burden is greatest on low-income, minority, and non-traditional students
- Many sites or field schools inaccessible for students with limited mobility

With little exposure to archaeological research, fewer students are entering archaeology, particularly minority students (Smith, 2004; Wilson, 2015).

These challenges are well met by virtual reality (VR), which creates a simulated three-dimensional environment where a user can interact in a real and physical way, thereby transforming data analysis into a sensory and cognitive experience.

PROJECT GOALS

Creation of an immersive, interactive, room-scale VR archaeological site that will:

1) Teach methods & principles that are challenging to present in a traditional classroom using sensory and cognitive immersion and game-based learning;

2) Allow wider access to a field science that has previously been limited to select students.

INNOVATION & CLASSROOM INTEGRATION

- HTC Vive VR platform: wireless headset, 2 hand controllers, and two base stations
  - User’s hands and head are tracked in 3-dimensions
  - User has freedom of movement within a 4x4 meter space
- VR environments developed using Unreal Engine 4, an open source gaming engine
- 2 virtually simulated archaeological sites:
  - Learning site: Carson Mounds, Mississippi
    - Site created using Lidar, photographic, and field data
    - Archaeologically accurate, including site- and time-specific objects
    - Teach field methods, basic concepts
  - Game site: Fictional abandoned mining cave (figs. 1, 2)
    - Archaeological concepts embedded in game narrative
    - In-game challenges let students solve successively more abstract problems rather than accumulate and memorize facts
    - Game tasks develop ability to test theories empirically, i.e. develop a scientific approach to problem solving
- Game-based, VR module set into archaeology curriculum for undergraduate students with the following learning objectives:
  - Teach the physical methods of archaeological excavation by providing a virtual setting and tools to allow any student to actively engage in field work;
  - Teach archaeological concepts using a scientific approach to problem solving by couching them within a role-playing game.

Fig. 2. View of VR prototype cave site as seen in virtual reality. Hanging grid system in the middle of the image indicates where a student can dig.

Fig. 1. Left: Student using Vive headset and hand controllers in VR cave site. Right: Student view of VR cave site with shovel (far right) excavating in hanging grid.