The Results of Formatively Evaluating an Augmented Reality Curriculum Based on Modified Design Principles

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ABSTRACT
This paper describes the results of a formative analysis of a redesigned Augmented Reality (AR) curriculum. The curriculum, Gray Anatomy, was designed based on lessons learned from the design and implementation process of a previous AR curriculum, Alien Contact! The positive and negative impacts of these modifications were evaluated through a qualitative analysis of gameplay and interview videos taken during two implementations of Gray Anatomy. Results are generally positive, showing that the modifications served their intended purpose; however, there were unintended consequences of these changes that warrant additional inspection.

Keywords: Augmented Reality, Curriculum Design, Educational Technology, Global Positioning System, Handheld Computers, Instructional Technology

INTRODUCTION
In the inaugural issue of the International Journal of Gaming and Computer-Mediated Simulations (IJGCMS), O’Shea, Mitchell, Johnston, and Dede (2009) described the lessons they had learned from the conceptualization, development, creation and implementation of an Augmented Reality (AR) curriculum. This article is intended as a follow-up to that work to explore the efficacy of changes that O’Shea et al. made to their AR curriculum design process and products based on those learned lessons. A more detailed description of the curriculum is provided in that earlier article than the summary presented here.

BACKGROUND
The Committee on Information Technology Literacy discussed the idea of fluency with information technology (a concept they called “FITness”), and stated that it was a “process of lifelong learning in which individuals continu...
ally apply what they know to adapt to change and acquire more knowledge to be more effective at applying information technology to their work and personal lives” (National Research Council, 1999, p. 2). Further, they go on to identify three areas of knowledge that will assist a person in his or her quest for FITness:

- **Contemporary skills**, the ability to use today’s computer applications, enable people to apply information technology immediately. In the present labor market, skills are an essential component of job readiness. Most importantly, skills provide a store of practical experience on which to build new competence.

- **Foundational concepts**, the basic principles and ideas of computers, networks, and information, underpin the technology. Concepts explain the how and why of information technology, and they give insight into its opportunities and limitations. Concepts are the raw material for understanding new information technology as it evolves.

- **Intellectual capabilities**, the ability to apply information technology in complex and sustained situations, encapsulate higher-level thinking in the context of information technology. Capabilities empower people to manipulate the medium to their advantage and to handle unintended and unexpected problems when they arise. The intellectual capabilities foster more abstract thinking about information and its manipulation (pp. 2-3).

Herbert S. Lin, who was the director for the study upon which the National Research Council’s report was founded, reiterated and emphasized many of the report’s most important elements in a chapter written for Technology Everywhere: A Campus Agenda for Educating and Managing Workers in the Digital Age (Lin, 2002). Among the items that Lin discussed was the emphasis that the report placed on project-based approaches as a means to achieve FITness.

Klopfer (2008) is not hopeful that schools as they are currently designed can meet this need. He states that “(w)hile schools do a reasonable job of preparing students in the ‘hard skills’ (math, literacy, geography), they are not adequately preparing them in the ‘soft skills’ (problem solving, communication, working in groups, and so on)” (p. 6). However, Klopfer does seem to see a ray of sunshine through this negative prognosis, in “(a)s much as IT has created a complex intellectual landscape that can only be navigated with a new set of skills, it has also provided the means to learn that navigation process, and at the same time make advances in the educational system that have been slow to come.” Of course, given that Klopfer’s book is entitled “Augmented Learning: Research and Design of Mobile Educational Games,” it is easy to determine what type of IT he envisions playing a key role in this process.

Augmented Reality has been defined as “games played in the real world with the support of digital devices (PDAs, cellphones) that create a fictional layer on top of the real world context” (Squire & Jan, 2007, p. 6). Simply put, this would ask the participant to utilize some technological medium, whether a PDA, cell phone or a tablet computer (e.g. iPad), as an interface through which they interact with the world around them. Augmented Reality, in educational settings, involves overlaying virtual information on a physical world to provide engaging, narrative-based educational experiences for students. In the AR games that have been developed so far, the students assume roles within the simulation and work their way through a series of integrated academic challenges (either in groups or individually) in order to complete the scenario – in other words, to complete the game. The technology associated with AR has changed very rapidly. For example, the curricula designed in this paper utilized handheld computers that were GPS enabled in order to present a map of the physical location to each student including their relative position on that map. More recently, software developers have focused on using smartphone technology as a “view-finder” through which the world can be viewed – with digital data overlaid on top of that view.
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