Red Land/Black Land

Teaching Ancient Egyptian Archaeology through Digital Game-Based Learning

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ABSTRACT

While digital games are used for health intervention, language training, and science learning, there are few instances of games being used to teach archaeology. This is a missed opportunity, as narratives of exploration and discovery make archaeology well suited to digital games. This article discusses Red Land/Black Land, a prototype Civilization V mod (modification of an existing game) that allows players to explore both the process of cultural change in ancient Egypt and the construction of archaeological knowledge about ancient Egypt. As a case study of scholarly game design, the article explores the project's development. Included is a discussion of play mechanics, the merits and process of modding, and the resources required to build games in academic environments. The article also discusses preliminary efforts to test the game in an undergraduate classroom. Ultimately, the article argues that digital games are powerful tools for communicating archaeology. Instead of falling under the glamour of commercial games, however, scholars should adopt cost effective approaches to game design, looking to mobile play, alternate reality games, modding, and browser based games to realize their vision. The article also argues that the actual process of designing a game is an excellent tool to teach archaeology.

Si bien los juegos digitales se han utilizado como parte de las terapias de rehabilitación, en el prendizaje de idiomas o en la enseñanza de la ciencia, existen muy pocos casos en el que los juegos se han utilizado para la enseñanza de la arqueología. Estos brindan una oportunidad única para ello, ya que las narrativas de exploraciones y de descubrimientos hacen de la arqueología un tema ideal para los juegos digitales. Este artículo discute un prototipo del mod Civilización V, llamado Red Land/Black Land, que permite a los jugadores explorar tanto los procesos de cambio cultural en el antiguo Egipto, como la construcción de conocimiento arqueológico acerca del antiguo Egipto. Siendo éste un estudio de caso sobre el diseño de un juego académico, el artículo explora el desarrollo del proyecto. Incluido en éste, se integra una discusión sobre la mecánica del juego, los méritos y el proceso de modificación o "modding", así como los recursos requeridos para elaborar juegos en medios académicos. Además, el artículo analiza los esfuerzos preliminares que se han hecho para probar el juego en un salon de clases de educación superior. Finalmente, el artículo sustenta que los juegos digitales son herramientas excelentes para la enseñanza de la arqueología. En lugar de caer bajo el encanto de los juegos comerciales, los académicos, no obstante, deberán adoptar estrategias en el diseño de juegos que sean efectivas en términos de sus costos, explorar los juegos móviles, los juegos de realidad alternativa, el "modding" y los juegos de navegador para lograr su objetivo. El artículo también sustenta que el proceso que se ha seguido en el diseño del juego es una excelente herramienta para la enseñanza de la arqueología.

For years, researchers have discussed the educational potential of digital games (Prensky 2005; Squire 2011). It is only relatively recently that these discussions have started to bear fruit in the form of thoughtful, serious game development and published research (Bogost 2007; Gee 2003, 2005; Prensky 2007). While serious games have been used in domains such as health (Baranowski et al. 2008; Göbel et al. 2010; Procci et al. 2013), military (Prasolova-Førland et al. 2013), science and engineering (Mayo 2009; Miller et al. 2011), and language learning (Johnson 2007), there are few instances of games being used to teach cultural heritage. Several noteworthy examples include the Fort Ross Virtual Warehouse Project (Lercari et al. 2013), the Andakatu project (Leite-Velho and Oosterbeek 2009), and ThIATRO: The Immersive Art Training Online (Froschauer et al. 2011).

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There are even fewer examples of games being used to seriously explore and teach archaeological methodology and epistemology. This is puzzling, as given its well-worn narratives of exploration and discovery, archaeology is a domain that is well suited to serious games. This is to say nothing about the actual process of archaeological excavation, which, from the perspective of game design, is tailor-made as a game mechanic.

This is not to say that there are no examples of archaeologically oriented serious games—there are. However, archaeology is very much in the minority compared to other domains that have received attention in the world of serious game design. The archaeology serious games that do exist are usually geared towards younger audiences, and simply do not address the more complex and thought provoking questions that archaeologists ask, such as the nature of complex culture change; the impact of the environment on human populations (and vice versa); and the causes and consequences of social collapse.

There are certainly many instances of mainstream commercial games using archaeology and archaeologists as central themes. This is not particularly surprising, as archaeology and archaeologists are universally recognized in popular culture as being synonymous with adventure, danger, mystery, and exotic locales. The problem is that most of these archaeologically oriented mainstream games play on antiquated stereotypes: 19th century imperialistic European adventurers, unilinear and ethnocentric models of cultural change, and a variety of pseudoarchaeological tropes such as ancient aliens and the Atleantean roots of all ancient states (Watrall 2002, 2003). Narratives of discovery are quite common to scholarly archaeological work, but, as Breger (2008:56) argues, archaeology in mainstream video games has narratives that "follow a relatively unquestioned logic of appropriation" rather than careful excavation or research. Few games, if any, depict archaeology as a complex and deeply interdisciplinary undertaking that studies past and present human activity through the lens of material culture. Fewer still attempt to communicate that the primary goal of archaeology is keenly focused not on description, but on building generalizable theory that explains diachronic human behavior.

The result of this state of affairs is that many commercial archaeologically inspired games have high production values, and are often quite entertaining from a gameplay perspective. These games, however, are hardly appropriate for teaching, communicating, or understanding the nature of archaeology or the complex and highly relevant questions that archaeologists are engaged in exploring through their research.

WHY DIGITAL GAMES

Digital games have evolved over the past decade into a critically important cultural and economic medium. In 2012, video (console) games, personal computer (PC) games, and other digital game formats, including digital download full games, digital add-on content, mobile games, and social network games, were a $14.8 billion dollar industry in the U.S. alone. Digital games are also reaching a more diverse demographic than ever before. For instance, women 18 or older represent a significantly greater portion of the game-playing population (31 percent) than boys age 17 or younger (19 percent). Women over 35 comprise the largest demographic playing web and downloadable games, and one fourth of adults age 50 and older played a video game in 2012 (Entertainment Software Association 2013).

The "Serious Games Movement" asserts that digital games can serve many functions beyond just entertainment. Jenkins (2006) argues that thinking of games purely for the purposes of entertainment grossly undersells their potential. Serious games have many other purposes, including, but not limited to, learning, health, advertising, and social change (Sawyer 2002; Prensky 2005.) Serious games are thought to provide "stealth learning," as players focus not on learning but on playing (Shreve 2005). Further, serious games capitalize on the benefit of learning through play, a concept that existed long before the emergence of digital games (Malone 1981; Papert 1998; Piaget 1951). Digital games are also gaining momentum in the teaching and learning community because of the strong evidence of perceptual, cognitive, and social benefits gained from playing games (e.g., Dickson et. al. 2004; Gee 2003, 2005; Johnson 2005; Kierrimuir and McFarlane 2004; Ritterfeld et. al. 2004). Indeed, Gee (2003, 2005) believes that games, commercial or otherwise, are enjoyable because of learning. Games present just the right amount of challenge, support, and feedback, progressively rewarding mastery with new challenges. This experience parallels other known optimal states of happiness, or "flow" (Csikszentmihalyi 1990). The structure of many games also mirrors good pedagogy, offering progressive problem solving and scaffolded learning (Dennen 2004). Van Eck (2006) has shown that digital games embody all phases of Gagne's (1985) Nine Events of Instruction, events that activate processes needed for effective learning.

Heeter (2008) has argued that digital games allow for an optimal level of customization compared to other educational methods because players are often able to modify their unique gameplay experience. User-changeable options may include difficulty levels, settings, goals, and avatar names, actions, and physical characteristics. Since an individual's tastes vary and they tend to hold their own self-interests in highest regard, the ability of an educational game to mold itself to a user's specifications increases their self-interest and, thus, intrinsic motivation. Intrinsic motivation is particularly heightened when the fantasy portrayal in the game depends on the skill being used, and vice versa (Malone 1981).

Digital games also have the ability to place learning in context, rendering that context meaningful and interesting for the player (Heeter 2008). Gee (2007) has argued that information delivered out of the context of both identity and activity is more challenging for learners to absorb and retain. In a social studies classroom, a game, unlike a lecture or reading assignment, can put players inside a foreign land to explore its people, places, and cultures. Through such experiences, games allow players to identify with their characters and actively participate in creating stories, while maintaining a purpose related to personal goals (Gee 2007). This leads to an increase in motivation, learning, and retention because players are better able to understand why a topic is important and how it is relevant to their own lives. Essentially, games harness situated cognition.

It is this general context that served to motivate, inform, and shape the *Red Land/Black Land* project discussed herein.

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PROJECT INTRODUCTION AND ORIGINAL OUTCOMES

Developed at Michigan State University's MATRIX: The Center for Digital Humanities & Social Sciences (matrix.msu.edu) and funded by a National Endowment for the Humanities Digital Humanities Startup Grant, the goal of the Red Land/Black Land project was to create a robust *Civilization V* (http://www.civilization5.com/) mod that explores the period from the Early Predynastic (ca. 4000 B.C.) to the end of the New Kingdom (ca. 1070 B.C.).

In the world of digital games (serious or otherwise), a "mod" is a modification of an existing game so that it functions in a manner not intended by the original designers. Changes in a mod can include new content, functionality, missions, art, levels, music, or game modes. Mods that add new content to the underlying game are often called "partial conversions," while mods that create an entirely new game are referred to as "total conversions." While mods can be developed by the game's original designers, they are most often created by the public. It is important to note that mods are not stand-alone pieces of software. They always require a copy of the original game to be played.

The *Red Land/Black Land* project has two primary audiences. First, it is intended to be used within the context of an undergraduate archaeology or ancient history class setting as a supplement to traditional learning materials. Second, it is intended to be played by the general public, including the extremely large community of *Civilization* players.

In an effort to address some of the aforementioned shortcomings of existing archaeologically themed games (both mainstream and serious), the project had three primary goals.

The first goal was to create a game-based experience in which players explore cultural change from the Predynastic period (ca. 4500 B.C.) until the end of the New Kingdom (ca. 1070 B.C.). This goal was very much informed by Gee's (2003) assertion that games are best when they allow players to examine process as opposed to fact-based learning. As such, the primary thrust of the *Red Land/Black Land* project was not so much to create a game experience in which players are forced restrictively to play events as archaeologists and Egyptologists believe they happened. Instead, the game focuses on allowing players to explore the process of cultural change within the framework of ancient Egyptian history and archaeology. Players are able to explore why things happened (and why archaeologists and Egyptologists believe they happened that way) as opposed to the facts of what happened (as they are currently understood by archaeologists and Egyptologists)—something that could easily be looked up in a book on ancient Egyptian archaeology (or on Wikipedia, for that matter). An example of this approach comes from the early stage of the game dedicated to the rise of the Egyptian state during the late Predynastic period (ca. 3500–3000 BC). Players take part in a scenario in which the possible factors that led to the unification of the ancient Egyptian state come into play. If, for instance, players reach a point in the gameplay where they control Upper Egypt, would it be in their best interest to conquer Lower Egypt through direct military action, or would they rather attempt to assimilate Lower Egypt through trade, peaceful colonization, and cultural exchange? What are the results (both long-term and short-term) of either strategy?

The second goal of the project was to create a game-based experience in which players are exposed to supplementary in-game content that addresses questions of how scholars build arguments about ancient Egypt in order to explore the construction of historical and archaeological knowledge. Continuing with the previous gameplay example, players are able to use an in-game Archaeological Learning Agent (discussed below) to explore what archaeologists and Egyptologists know about the unification of Upper and Lower Egypt at the end of the Predynastic period. More importantly, players explore the scientific process of archaeology, weighing theories and evidence, assessing the plausibility of conclusions made by archaeologists for themselves.

The final goal, which is hardly inconsequential, was to create a game-based experience that provides an ethical and thoughtful counterpoint to the many mainstream commercial video games that perpetuate pseudo-historical and pseudo-archaeological notions of ancient Egypt.

Ultimately, the game-based learning approach embodied in the project provides a far deeper and more experiential understanding of the subject material than might be gained through other, more traditional means such as textbooks or classroom lectures. *Red Land/Black Land* communicates complex cultural, archaeological, disciplinary, and epistemological concepts in an easily approachable and enjoyable learning experience.

It is very important to note that due to the nature of the grant (intended to produce a proof of concept), the length of the grant (18 months), the amount of the grant ($50,000 in both direct and indirect costs), and the intricate nature of game design, the goal of the project was to produce a pilot prototype that could then be expanded upon with future funding. What is presented here, both the development and the initial testing, amounts to the preliminary phase of a much larger project.

CIVILIZATION V: A PLATFORM FOR DEVELOPMENT

One of the most challenging aspects of serious game development in a scholarly context is the issue of resources and technical experience. Simply put, making games is difficult and quite expensive. The resources available to larger mainstream game companies, or even small commercial developers, are well out of the reach of scholars in most academic environments. As a result, scholarly game projects have to make very thoughtful choices about the platforms they use for their projects. They must conduct a measured assessment of technical, budgetary, and human resources at their disposal and make the best choices that meet the needs of their project. In many ways, the *Red Land/Black Land* project was intended to be one model for extremely low budget scholarly serious game development.

The decision to create a mod for the *Red Land/Black Land* project (as opposed to building the game from the ground up) was driven by many of these resource issues. The choice of *Civiliza-*

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FIGURE 1. Civilization V provides a god-like perspective from which players can control every aspect of a "civilization's" development over long periods of time.

tion V as a platform was driven mostly by the project's desired game mechanics, subject matter, content, and goals.

Civilization V is the latest version of the extremely popular series of socio-historical turn-based strategy games developed by Firaxis Games (http://www.firaxis.com/) and published by 2K Games (Figure 1). The game features a complex, rule-based system that attempts to simulate historical, cultural, and economic change over large periods of time. As such, it is an excellent platform for the *Red Land/Black Land* project. In addition, and perhaps most importantly, the game has been developed (since very early in the franchise) to allow the public to create their own content in the form of mods or scenarios. The game includes a suite of publicly available development tools with which third-party developers can modify almost all aspects of the game, including the graphics engine and the AI engine. It also includes the rule-based system, thereby allowing a "rewrite" of the aforementioned 19th-century anthropological ideas that are so obvious in the game's architecture and in the game interface itself. In this regard, *Civilization V* does all of the "heavy lifting" (e.g., basic non-player character artificial intelligence, graphics processing, and level editing tools) for the *Red Land/Black Land* project. All modifications in *Civilization V* are accomplished using XML and Lua, both of which are scripting languages with a low barrier to entry and which do not require anywhere near the level of experience that is required with compiled languages such as Java or C++. In addition, mods are self-contained, have a relatively small file size, and are easily distributed (often through robust fan communities or a digital game distribution platform such as Steam); to play, all that is required is a copy of *Civilization V* (which retails for less than $30 and is available on both Mac and PC).

By leveraging an existing commercial game, the project was able to avoid steep development costs and lengthy development time and focus tightly on the project's content, play mechanics, and goals. This is especially important given that the grant from the National Endowment for the Humanities, which funded the project, was quite small and required completion in a relatively short amount of time.

It is worth noting that using *Civilization* is not a particularly new idea. There are quite a few examples of *Civilization* (either modded or un-modded) being used to teach history, political geography, diplomacy, or economics, either in a formal or informal learning environment. One of the most noteworthy examples is the History Game Canada (thehistorygamecanada,com), a public education project aimed at teaching Canadian history using a robust *Civilization III* mod. At the university level, Graham's Year of the Four Emperors *Civilization IV* mod is particularly noteworthy (Graham 2007, 2014).

Until fairly recently, Firaxis Games even maintained a section on its website dedicated to resources (lesson plans, guides, etc.) for teachers interested in using *Civilization* in their classroom.

GAME DESIGN AND DEVELOPMENT

Funded by a National Endowment for the Humanities Digital Humanities Startup Grant, the project was developed over a period of 18 months. Over the course of the project, the design team was composed of at least three individuals: one student programmer, one student designer, and the project director. All

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game design was done collaboratively by the student designer and the project director, with regular input and guidance from the student programmer as to any technical issues, such as limitations of the platform that would impact the project. The student designer was responsible for overseeing day-to-day design tasks. The project was very fortunate in that it was able to hire a Michigan State University Anthropology Ph.D. student, Katy Meyers, who had a particular interest in cultural heritage learning games, to fill the role of designer. The importance of Meyers to this project simply cannot be overstated. While she did not have any previous applied game design experience, her longstanding interest in games and knowledge of archaeology was invaluable.

Due to the unexpected length of the project because of some logistical issues in the early part of the grant, we were not able to employ the same student programmer throughout the development. This issue, which might have caused problems for the continuity of technical development, was mitigated by several key factors. First, MATRIX employs a very robust project management infrastructure. Student programmers who work at MATRIX have all taken at least several programming/computer science classes and receive at least two months of training at MATRIX in common programming methods and best practices. This ensures that all MATRIX student programmers have at least a similar baseline set of skills. The result is that if one leaves, another one can be integrated into the project with minimal complication. This very issue came up early in the project when the student programmer left MATRIX unexpectedly to take an internship at Microsoft. Fortunately, another student programmer was able to join the project and pick up where the previous one left off with a minimum of problems. Second, Meyers' work on the project remained constant. She worked directly with the various student programmers and was able to maintain a clear and continuous design vision.

A living design document was maintained on an internal wiki and updated on a regular basis by everyone involved in the project. TRAC (http://trac.edgewall.org) was used for task management and issue tracking. SVN (http://subversion.apache.org/) was used to maintain version control on all project materials.

SHIFTING PROJECT OUTCOMES

As mentioned previously, one of the project's initial goals was to create a game-based experience in which players explore the process of cultural change from the Early Predynastic period (ca. 4000 B.C.) until the end of the New Kingdom (ca. 1070 B.C.). Unfortunately, it became quite clear early in the project that this goal was simply unfeasible. While *Civilization V*'s architecture facilitated this sort of approach, attempting to accurately quantify and programmatically model all of the cultural, political, environmental, ideological, and economic variables for a period of more than 3000 years in the *Civilization V* engine was herculean in scale and would have been impossible to accomplish given the relatively short time frame and fairly small budget of our grant. The result of this realization was that the project focus shifted, foregrounding the goal of creating an engaging game-based experience in which players explore the construction of archaeological knowledge with in-game content that directly addresses questions of how archaeologists and Egyptologists know what they do about ancient Egypt.

This is not to say that the goal of creating an experience in which players explore the process of cultural change in ancient Egypt was completely abandoned. As will be discussed shortly, the progression of the gameplay remained chronological in nature. It also still focused on major social, political, economic, and historical characteristics and events. However, all of this cultural content was designed in such a way that it specifically supported the goal of communicating the construction of archaeological and Egyptological knowledge.

In many ways, this shift was liberating. The pressure to create a game that accurately modeled ancient Egyptian culture with a high degree of historical and cultural verisimilitude verged on debilitating. By depreciating this goal, the project was able to creatively leverage the innately 19th-century anthropological theory built into the very fabric of *Civilization V*. The cultural linearity, which would prove problematic if we attempted to create a cultural simulator, was used as a counterfactual foil of sorts to more effectively address the construction and development of archaeological knowledge about ancient Egypt. In addition, it allowed the project to more intensely leverage *Civilization V*'s built-in advisor system in order to construct an Archaeology Learning Agent (discussed below).

GAME MECHANICS

While the goals of the project shifted, the general framework of the game remained chronological. Instead of creating one play experience that lasted from the Predynastic period until the end of the New Kingdom, however, gameplay was broken up into a series of scenarios that could be played in any order. Each scenario featured a clearly defined victory condition and tightly bounded parameters (such as geography, population, and resources), all of which were informed by the specific period in play (Figure 2). It is important to note that the scenarios, and associated win conditions, were somewhat simplistic and one-dimensional, as described below. The simplicity of the win conditions was mostly the result of technical challenges imposed by the game itself. The scenario descriptions were purposefully designed to be simple. As such, they acted as a straw man of sorts, allowing the design of more thoughtful and sophisticated exploration of the ideas in the gameplay that led to a seemingly simple conclusion, a situation in itself that is characteristic of archaeological investigation.

Ultimately, the goal was not to create a completely open-ended play experience that stretched over 3000 years (in-game time), but to create an experience grounded in archaeology and Egyptology that was tightly focused on addressing the project's (revised) primary outcome: creating an experience in which players explored the construction and evolution of archaeological and Egyptological knowledge.

In-game scenarios and associated win-conditions included the following:

Predynastic (Win Condition: Unify Upper and Lower Egypt). The scenario requires the player to build enough of a military force to conquer other chiefdoms, create puppet polities, or gain favor through gifts to become allies. Construction of strong ideology aids in gaining allies, as does the development of writing.

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FIGURE 2. Red Land/Black Land gameplay was broken into a series of chronologically-based scenarios.

Old Kingdom (Win Condition: Construct a Pyramid). This scenario challenges players to gain enough power over other nomarchs (governors) in order to acquire worker units for the pyramid construction project. It also requires a high amount of money and development in the domain of science, so that the player can build a pyramid. The scenario also requires players to initially build a step pyramid and a queen's pyramid. Players also have the option to gain additional influence over nomarchs by conquering, controlling, or winning favor. Happiness must be high in order for workers to continue working on the pyramid construction project. Building temples makes workers happier, as well as shortening the time required to complete the pyramid construction project.

First Intermediate Period (Win Condition: Re-Unify Egypt). This scenario requires players to build up enough of a military to conquer other nomes and to reunify Egypt. Alternatively, players can gain the allegiance of nomarchs through gift-giving. In this scenario, construction of a state ideology and propaganda machine is particularly important.

Middle Kingdom (Win Condition: Expand into Nubia). This scenario requires players to conquer, control, or ally with Nubian polities. In order to accomplish this, the player can construct a series of fortresses along the Nile in southern Upper Egypt and Lower Nubia.

Second Intermediate Period (Win Condition: Reunify Egypt and Expel Hyksos). In this scenario, players must ally with other nomes in order to conquer Avaris, the capital of the Hyksos.

New Kingdom (Win Condition: Expand Influence beyond Traditional Borders). In this scenario, players are challenged to expand political influence beyond the country's traditional borders and gain positive influence or military control with all neighboring countries, including Kush, Turkey (Hittite), Syria/Palestine, and Libya. In order to accomplish this, players need to have a strong military, strong bureaucracy, large amounts of money, and control trade routes.

At the start of each scenario, players are greeted by introductory text that provides cultural and historical context for the gameplay (Figure 3). For instance, in the case of the Second Intermediate Period scenario, players are greeted with the following text:

> The kingdom of Egypt is once again divided. However, unlike in the First Intermediate Period, a foreign power has taken control of Lower Egypt—the Hyksos.
>
> With the end of the Twelfth Dynasty, a lack of successors meant a power struggle over the throne. The inability of Thirteenth Dynasty monarchs to maintain

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FIGURE 3. Introductory text is displayed to the players at the beginning of each scenario in order to provide relevant historical and cultural context.

control led to the division of Upper from Lower Egypt. In Upper Egypt, an independent Fourteenth Dynasty emerges. In Lower Egypt the Fifteenth Dynasty is founded by invaders from Western Asia, the Hyksos. The word Hyksos in Egyptian means "rulers of foreign countries," an apt title for these foreign conquerors. Through Egyptian vassals, the Hyksos have successfully gained control over the Northern parts of the kingdom. Unrest is brewing in Thebes, however, and murmurs of weakness in the Hyksos rulers have begun to spread.

It is upon you, Ahmose I, to found the Eighteenth Dynasty and rid Egypt of this foreign scourge. Once again, our kingdom must be united and the invaders cast out. You will need to gain the support of the other provinces of Egypt, especially those in the South. You must also defeat the Hyksos and drive them out of Egypt. Only then will our kingdom once again be unified.

ARCHAEOLOGY LEARNING AGENTS

Perhaps the most noteworthy aspect of the project is the concept of the in-game Archaeology Learning Agents. Based on *Civilization V*'s existing advisor system, the Archaeology Learning Agents provide contextual archaeological information based

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FIGURE 4. In-game archaeological learning agent content is displayed in a separate pop up window.

on in-game events and player choices. Each of the Archaeology Learning Agents was designed with specific characteristics, motivations, disciplinary background, and perspective on the game's content.

19th-Century Archaeologist: takes a much older disciplinary perspective using evolutionary and economic viewpoints, with a heavier focus on monuments, pottery, and grave goods. The 19th-Century Archaeologist tends to give more advice about grander finds, and clings to older models and approaches, such as cultural evolutionism and diffusion.

21st-Century Anthropological Archaeologist: focuses on modern method and theory, is highly critical of the validity of conclusions without supporting data. The 21st-Century Anthropological Archaeologist is particularly interested in approaches that integrate gender, household, and spatial analysis.

Egyptologist: covers Egyptian history from an epigraphic and historic perspective; focuses more heavily on written sources as the best source of evidence

Graduate Student: covers a number of research perspectives and serves as "jack of all trades."

In order to extend this model and provide additional entertainment and engagement, each of the Archaeological Learning Agents has a detailed biography (which is occasionally shown in the context of the content they deliver):

Gordon Peatree (19th-Century Archaeologist): He attended Cambridge University, and was funded by the Egyptian Discovery Endowment to research Egyptian pottery. His work on ceramic seriation is well known by all Egyptian archaeologists. He is known for several impressive discoveries, including several tombs (from the Second Intermediate Period and the New Kingdom). His seminal publication, *Strangers in the Black Land: The Role of Migration, Diffusion and Foreign Invasion in Ancient Egypt*, focuses primarily on the supposed importance of foreign influence on the rise of ancient Egyptian state. Dr. Peatree tends to focus on stylistic changes in ceramics over time.

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Evie Danielson (21st-Century Anthropological Archaeologist): After receiving both her BA and Ph.D. at the University of Michigan, she began a number of highly successful field seasons excavating Predynastic households throughout Upper Egypt. In recent years, Dr. Danielson has become particularly interested in integrating digital methods in her research. Her most recent publication was titled *Digital Black Lands: Using Technology to Reconstruct Ancient Egypt* and explores the role that 3D scanning plays in the preservation of ancient Egyptian material culture. Dr. Danielson also runs an archaeological field school at the site of Ma'adi in Lower Egypt.

Hazi Wawat (Egyptologist): He received his Ph.D. from Cairo University. He is most famous for his work on epigraphy, specifically New Kingdom ostraca from the site of Deir-el-Medina. In his latest book, *The Stylus is Mightier than the Spade*, he argues that epigraphic sources more accurately reflect the past than archaeological data, which are highly biased because of selective excavation.

Jennifer Herbert (Graduate Student): She is a Ph.D. student in the Department of Anthropology at the American University at Cairo. Her research focuses on mortuary practices in the late Predynastic and early Archaic periods. She received a Master's from the University of St. Andrews, where she did research on disease and work-related pathology on skeletal remains from a worker's cemetery near the Valley of the Kings. She currently works as a research and teaching assistant for Dr. Danielson, attempting to balance her own research with keeping track of the 20 undergraduate field school students.

At key points in the game, the Archaeological Learning Agents appear and provide the player with contextual information about in-game events. An example of this is in the New Kingdom scenario, when players first come in contact with Nubians.

Gordon Peatree: "Similarity in Egyptian and Nubian pottery shows that the Nubians adopted Egyptian styles through contact. There was obviously a lot of cultural diffusion from the Egyptians to the Nubians."

Evie Danielson: "Archaeological evidence from several sites in Lower Nubia shows that Egypt had military and administrative control over Nubian cities, although there is debate whether Egyptians ruled there or if they incorporated Nubians into their elite to be rulers."

Hazi Wawat: "Historic documents from Egypt talk of Amenhotep I's conquest of Nubia: "King Djeserkare, the justified, when he sailed south to Kush, to enlarge the borders." This is clear evidence that the Nubians were conquered and integrated in the Egyptian empire."

Jennifer Herbert: "Evidence about the Nubians is strongly biased because the records we have are mainly Egyptian in origin. In the past Nubians were characterized as frontier barbarians, savage primitives overly decadent, or completely Egyptian. The point is that scholarly opinion about the Nubians has changed drastically over time."

The Archaeology Learning Agents were purposefully designed to be general archetypes. Their role is to embody different intellectual, theoretical, and disciplinary perspectives. During the initial design phases of the project, there was significant thought about the obviously simplistic and essentialist nature of the characters that had been created. In their simplicity, did the Archaeology Learning Agents actually run the risk of encouraging players to think of archaeologists and Egyptologists as one dimensional? Ultimately, the decision was made not to add significant depth to the Archaeology Learning Agents. They needed to embody, express, and very clearly communicate a wide variety of disciplinary and epistemological trends in the history of archaeology (and Egyptian archaeology), and could not do so effectively if they were overly detailed. Their simplicity is mitigated in key ways. There are several instances in the game where the Archaeology Learning Agents are actually reflective and thoughtful about their comments. In one specific instance, Evie Danielson and Hazi Wawat comment on the differing nature of archaeology within an Egyptological context (Wawat's perspective) and an anthropological context (Danielson's perspective). While their in-game "comments" are limited to how and where they appear in the game's interface, they do add some much-needed depth to the representations of archaeology, archaeologists, and the study of ancient Egypt.

IN-GAME CONTEXTUAL LEARNING CONTENT

In addition to the content delivered by the various in-game Archaeological Learning Agents, players are provided information about sites, and the associated archaeological research that has been carried out at the site, through a system of contextual pop-ups. For instance, in the Middle Kingdom scenario, when players locate the site of Hawara, they are provided with the following information:

> Hawara is located in Upper Egypt, and contains the pyramid complex of 12th Dynasty king Amenemhat III and Princess Neferuptah. It also contains a cemetery that dates from the Late Middle Kingdom to the Roman period. The funerary complex of Amenemhat III is the most elaborate and extensive of the Middle Kingdom, and is strongly influenced by Old Kingdom funerary complexes. The complex consists of a mud-brick pyramid with an outer casing of limestone. Within the pyramid there were a number of innovations such as sliding portcullises to block off corridors, and a different floor plan to increase protection. While the tomb of the princess was badly damaged, the burial chamber (including her sarcophagus) below ground remained intact and undisturbed.
>
> Excavations at the site were primarily done by Flinders Petrie in 1888. The site was highly damaged by stone robbing, and descriptions of the pyramid from Roman historians weren't enough to reconstruct it. While Petrie was able to recover a number of Old Kingdom papyri and 146 portraits from Roman coffins, little was recovered from the Middle Kingdom portion of the site. The tomb of Neferuptah was excavated in 1956 by Farang and Iskander. They were able to recover the princesses's sarcophagus and funerary equipment, although it had been damaged by ground water.

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GAME DESIGN AS EDUCATION AND CAPACITY BUILDING

One of the unanticipated side effects of the project is that it served as an opportunity to build technical capacity among student domain experts and domain knowledge in student programmers. On one hand, the project programmers were exposed to ancient Egyptian archaeology and history. In fact, one of the tasks that the student programmers were required to undertake was to read Kathryn Bard's *Introduction to the Archaeology of Ancient Egypt* (2007). This provided them with at least a rudimentary contextual understanding of the game design decisions that were being made and which they were required to implement.

On the other hand, Meyers, the student designer, had the opportunity to learn the fundamentals of game design, skills which will undoubtedly serve her well as she continues to have a committed scholarly interest in serious games and meaningful play for cultural heritage learning, outreach, and engagement.

In much of the serious games literature, the emphasis is on the transformational nature of playing a game. However, archaeological knowledge is often transmitted though hands-on, experiential learning (field schools, lab classes, etc.). As such, leveraging the aspect of game development involving "building as a way of knowing," a concept that has become popular in the Digital Humanities, might prove to be quite powerful within the domain of archaeological teaching and learning.

Even at this small scale, the project was important because it served as a vehicle to build both technical capacity and domain knowledge among students who otherwise might not have acquired such knowledge.

It is worth noting that this idea of learning through game development has gained traction in other domains. Particularly relevant to this discussion is the work of Uricchio (2011), who explicitly ties game development with various historiographic approaches.

TESTING, DEPLOYMENT, AND DISTRIBUTION

The game materials were subjected to formative evaluation from both internal sources (the members of the project) and external sources (members of the advisory board). In addition, once the game had reached a stage at which it was playable, it was regularly subjected to internal play-testing. The results of both formative evaluation and play-testing were iteratively cycled into the game's design and development.

The game was play-tested as supplementary material in the author's archaeology of ancient Egypt class taught at Michigan State University. The game was introduced to students at the beginning of the semester, and those interested in participating in testing were provided the necessary game files. The test group played the scenario that roughly aligned with the content being covered in class at the time. After they had played through the scenario, they were prompted to write a short blog post on the course website reflecting on their gameplay experience. While students were strongly encouraged to provide unstructured feedback, they were guided by several specific questions about the content, specific gameplay elements, and the overall gameplay model.

It is important to note that the preliminary nature of the project simply did not allow for extensive in-class play-testing. We did not have the time or resources to carry out more extensive testing. In addition, given that the game was a preliminary pilot, more robust testing would have been premature. In addition, the original grant that funded the project did not include any in-class testing beyond what is described here.

Unfortunately, the in-class test that was carried out was not without its issues:

1. Only a small number of students (n = 4) already owned a copy of *Civilization V*. We were able to provide two more copies of the game to interested students. Despite this, the final test group was quite small (n = 6).

2. Given that the mod (even after the end of the granting period) was very basic in nature, the students frequently encountered technical issues. While the identification of bugs was incredibly beneficial to the development team, it meant that student's experience was limited, and often frustrating.

The results of the in-class test, while limited, were interesting. Despite technical challenges, those students who did use the game during class enjoyed the experience. While they felt that the interactive and entertaining nature of the game enhanced their learning experience, they did not believe that it was a replacement for other learning materials, such as lectures or readings. While students were especially appreciative of the character-driven approach of the Archaeology Learning Agents, several expressed interest in seeing more "character types." One student in particular felt that the game would benefit from having Archaeology Learning Agents with specific methodological, material, or analytical expertise (i.e., lithic analyst, ceramic specialist, etc.). More generally, students appreciated the idea of game-based learning within an archaeology course, or any university course, for that matter.

Given the pilot nature of the project and the aforementioned issues, the value of the in-class play-test is clearly limited. It is our plan that future phases of the project will include robust in-class testing in multiple courses and across multiple departments.

While not accomplished during the period of the grant, all of the source files for the project will be made available on GitHub in the near future. The idea in this regard is that development can be continued by anyone in the academic game design community or the thriving *Civilization* mod community. In addition, other academic game developers who are interested in *Civilization V* as a development platform can use the *Red Land/Black Land* source files to advance their project more quickly or to avoid mistakes.

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CONCLUSIONS AND FUTURE DIRECTIONS

We began this project with the belief that games could play a central and powerful role in a formal or informal teaching and learning ecosystem. This belief was particularly fierce in the context of archaeology, a domain that, as mentioned previously, lends itself quite easily to such game-friendly themes and design models as exploration and discovery.

The challenges of game design, either within the domain of archaeology or within a more general scholarly context, are quite high. We were fortunate in that MATRIX has significant resources for project management and development. However, many other institutions do not have similar resources. The result is that game design projects might be out of reach for many scholars at this point.

Modding an established commercial game is a solution to many of these issues. There is no doubt that within the context of the work described herein, *Civilization V* served as a relatively accessible platform for game development, especially given the *Red Land/Black Land* project focus. However, there are still significant challenges. Even if the mod is made available for free, players might still have to buy the game itself to run the mod. In addition, required system specifications for the computer on which the game is played might prove to be a barrier for broad use and adoption. How could a game be used in a formal learning environment if students simply do not have computers that meet the minimum system requirements?

This is not to say that we feel scholarly game design is impracticable given issues of technology, quite the opposite. We feel that scholarly game projects need to be mindful of the implications of choosing one platform over another, especially in regards to audience and accessibility. Scholars should also be wary of falling under the glamour of mainstream, big-budget commercial games. The budgets and resources involved in these games are far out of our reach. Instead, scholars interested in game design projects should adopt a flexible approach to game-based learning and meaningful play. Avenues such as mobile play, alternate reality games, modding (such as described in this article), and browser based games (developed in HTML5, for instance) might prove to be both more attainable from a resource standpoint and equally, or perhaps more, engaging.

Scholars also need to consider the issue of available human resources. Quite simply, creating a digital game is not easy. Game design is a multi-disciplinary undertaking requiring designers, artists, and programmers working collaboratively to realize the vision for the game. It is quite rare for games to be single-authored projects. Even if one chooses a simpler development environment with a lower barrier to entry, one still might not have the necessary human resources (artist, programmer, etc.) to build the game.

We do feel very strongly that the scholarly game design process can serve as an excellent teaching tool. In the context of this project, one could easily imagine game design assignments using *Civilization V* in an archaeology class. So, instead of the finished game being the primary platform for outreach and engagement, the process of designing the game becomes the vehicle for teaching students about archaeology, archaeologists, and the human past.

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Data Availability Statement

All source files for the prototype version of the mod have been released under an open source software license (GPL v 2.0) and are available for download from GitHub at https://github.com/msu-matrix/redlandblackland

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