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Teaching with Technology: Digital Tools for Archaeological Education

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Abstract

Recent technological advances have greatly altered how scholars record, study, and educate the public about cultural resources. Data can now be instantly recorded, analyzed, and widely shared. Digital tools can help create multimedia, interactive products that have contributed greatly to education and outreach initiatives worldwide.

Both the National Park Service (NPS) and the National Council for Preservation Education (NCPE) are dedicated to studying, preserving, and educating the public about cultural resources. A recent internship project between these two institutions produced online lesson plans that educated students about cultural materials and the various methodologies scholars within archaeology, historic preservation, and additional cultural resource fields use to study them. Several of the lessons included digital technology, specifically 3D artifact models and virtual site tours. Both types of additions allow students to question and interact with featured cultural materials in novel ways. This article will detail these two tools, discuss how they were applied within the NPS/NCPE project, and provide a list of additional factors for others to consider when creating archaeological educational content using digital technology.

Introduction: Digital Technology for Cultural Resource Studies

Digital technology has become an increasingly powerful tool within cultural resource studies and, more specifically, archaeology. A wide variety of tools, such as photogrammetry and laser scanning, are now available that can produce digital models of archaeological materials. Such products, whether a digital copy of an individual artifact or an immersive digital walk of an entire site, are valuable in several ways. Mainly, they enable individuals to engage with cultural materials in ways that have not been possible before, either digitally or manually. This interaction benefits archaeologists and members of the public alike. Hermon (2012) and Sanders (2014) in particular discuss how archaeologists can use digital tools to help preserve sites by creating lasting models of endangered resources. In addition, because of these models, archaeologists are able to ask different questions of artifacts and sites. By digitally manipulating materials, they can then test their hypotheses.

Several studies have noted the impact digital products can have on the public as well. Means (2017) details the reasoning behind, or the “why,” of digital product creation. He especially notes the power of touch, detailing the impact that the ability to hold artifact replicas has upon students. Digital tools also greatly increase inclusive access to cultural materials through distance learning. Kirchen (2011) promotes “virtual

field trips" for young school children that use various media to bring sites to children rather than the reverse. O'Leary (2011), Katz and Halpern (2015), and others provide case studies where digital tours have successfully been applied. The former presents the Philadelphia Museum's *Project Airline* which virtually walks students through the museum exhibits. The latter studied the connection between virtual tours and participant engagement levels, finding that participants became more "immersed" and had a higher positive outlook toward the exhibit overall.

Given these findings, the potential these digital tools have within archaeology should not be underestimated. The following sections will discuss two of these tools, provide a brief technological overview of each, and demonstrate how the developed products can be successfully applied within archaeology education resources.

Digital Tools: Creation and Application

3D Scans and Models

Three-dimensional modeling is becoming more and more popular within archaeology. Modeling can create digital and physical reproductions of artifacts, features, or entire sites. It encompasses three steps: scanning, modeling, and printing. Once these steps are completed, 3D models can become a valuable addition to educational initiatives by enhancing traditional, text-based resources.

Techniques to scan cultural materials range from laser or light scanners to downloadable apps for personal devices. Photogrammetry may also be a useful tool to record complex materials (Boardman and Bryan 2018; Boehler and Marbs 2004). Once an object is scanned or photographed, the collected data are inputted into a selected software. Some applications, like ScanStudio, are built into the scanner itself. Others, such as Sketchup and AutoCAD, must be downloaded separately. These programs transform the scanned data into a digital 3D model, termed a "computer-aided design" (or CAD) file (Figure 1). These files can be stored on the computer or uploaded into open-source websites such as Sketchfab (www.sketchfab.com). In the second case, members of the public need only a URL address to access the digital model on their computers.

After the digital file is created, the model can be printed. Like the scanning equipment, 3D printers vary widely in price. However, libraries and universities across the country are beginning to offer free or reduced-cost scanning services. A variety of different filament options are available, including resin, metal, and plastic. The latter is a

commonly-used filament type, for plastic models are cheap, durable, and easily replaced if lost or broken.

Figure 1: A 3D scan of mug excavated from Fort Frederica National Monument. Small circled numbers indicate interactive annotations. *(Sketchfab)*

Despite its many advantages, 3D modeling may also present challenges. A variety of hardware and software is required to create models, and one must have a computer to access digital files. Depending on the selected equipment, scanning projects may become expensive or take an extended amount of time to complete. In addition, not every object is suitable for 3D scanning: reflective surfaces, thin forms, and complex shapes are often problematic. Current technology limits model printing to solid color material. To obtain identical replicas of original materials, specialized painting skills may be required. Finally, file formatting, metadata, and long-term digital storage also need to be considered (Champion 2018:19.)

However, it is the author's opinion that these difficulties are outweighed by the opportunities 3D modeling offers, especially when applied to cultural resource education. The primary benefit to utilizing 3D models is that they allow students and other members of the public to interact with cultural materials. The traditional "Do Not Touch" museum signs are reversed to read "Please Touch." Individuals are able to explore the model replicas while the original artifacts, features, and sites remain safely preserved. As a previous study suggests, such interactive experiences may help

"participants increase their reasoning process and become more interested in cultural content" (Katz and Halpern 2015:776). As part of this former "reasoning," students and archaeologists alike are able to test their hypotheses about an object's form and function within the past (Hermon 2012, Sanders 2014). Overall, members of the public may form deeper connections with historical events and narratives by holding a piece, albeit a replica, of the past in their hands. The model may lack certain qualities of the original artifact, such as its weight or texture, but in the author's experience, these discrepancies do not lessen visitors' enthusiasm of being able to touch and engage with objects and their narratives.

In addition, incorporating digital models vastly increases distance learning opportunities. Members of the public can access digital models directly from their computers rather than traveling to sites. If they choose, they may also print individual models at their own home or local library, or receive them through the mail. As a note, if a small fee is applied, models may increase not only public outreach but project revenue as well.

In summary, 3D models expand accessibility to cultural resources. Individuals are given the chance to engage with materials that they might never have been able to access otherwise. This situation is especially true for persons with disabilities. In their World Report on Disability, the World Health Organization estimated that 15% of the world's population lives with some form of disability as defined by the presence of bodily impairments, activity limitations, and/or participation restrictions (World Health Organization and World Bank 2011:4, 53). Three-dimensional models provide these individuals, especially those who are visually impaired or mobility challenged, with opportunities to view or "read" objects that are commonly inaccessible for them (Bieber and Rae 2013, Denard 2009, Means 2017).

Virtual Tours

Another opportunity for archaeology lesson plans to employ digital technology is through virtual tours. Depending on the required data resolution level, techniques for creating virtual tours include laser and light scanning, photogrammetry, 360-degree cameras, and smartphone apps such as Autodesk's 123D Catch. Some of these tools are able to acquire and process data into mesh clouds, while others require additional software (Hanke and Grussenmeyer 2002; Mason 2017). These materials range in price, yet low cost equipment has proven effective for cultural resource initiatives. Koutsoudis and his colleagues (2007), for example, were able to create a detailed scan and interactive model of the ancient Greek city Xanthi using only low-cost digital tools.

Such virtual tours offer similar benefits as 3D models for cultural resource education. Tours are especially valuable distance learning tools. Similar to Kirchen's concept of virtual field trips, tours allow students to "take an educational journey" to explore sites without needing to leave their classrooms (Kirchen 2011:22). Kirchen also notes the benefits of such virtual explorations. Field trips to sites may be problematic due to required staff, time, or funds. In addition, some sites may not be accessible at all, especially for students with disabilities. Virtual tours remedy these problems: in situations where "children cannot go to the location, teachers can bring the location to the children" (Kirchen 2011:24).

Tours may also act as a supplement to actual site visits. Contrary to expectations, a 2011 study by O'Leary (2011) found that members of the public are actually more encouraged to travel to the physical locations after taking a virtual tour. After all, "watching a movie trailer doesn't make you not want to see the movie" (O'Leary 2011, 246). Educators may elect to show the virtual tour before or after a field trip to increase students' understanding of the site materials and narratives. As an added advantage, such site "previews" help individuals with disabilities reduce their anxiety levels (Germann, Broida, and Broida 2003:53).

Case Study: NPS/NCPE Project

Project Goals

> *The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.*

In accordance with the mission statement above, the National Park Service (NPS) partners with National Council for Preservation Education (NCPE) to offer students and recent graduates in cultural resource fields internship opportunities with ongoing projects. In summer of 2018, the author and another NCPE intern were placed with the NPS Archaeology Program Washington Support Office in Washington, D.C. Their main project involved creating lesson plans for NPS websites that applied archaeology as an interdisciplinary teaching tool. The lessons would include case studies from National Park Service sites, and incorporate the recently-popular tools of 3D modeling and virtual site tours when available.

Ideally, this strategy would accomplish two goals. First, students would learn more about the methodologies archaeologists, historic preservationists, and other specialists utilize to analyze, interpret, and preserve cultural materials. Second, because these lessons would be designed to align with nation-wide Common Core standards, educators could use lesson themes to reinforce topics that students were already learning in their classrooms. These tools enable students to interact with digital copies of featured archaeological materials, such as artifacts curated in collections or landscapes off-limits to visitors. Such experiential learning may help to increase students' understanding of lesson topics and provide them with a more enjoyable educational experience.

NPS Resources

The National Park Service uses two broad approaches to teach members of the public about cultural resources. During "on-site learning," park visitors can listen to Ranger talks, tour sites, or take part in participatory programs such as public archaeology days (Figure 2). NPS also creates online "distance learning" resources. These materials include lesson plans hosted on open-access individual park pages, the Teaching with Historic Places (TwHP) website (www.nps.gov/subjects/teachingwithhistoricplaces), and the Educators page (www.nps.gov/teachers). Rather than having to travel to a physical site, students, educators, and other members of the public require only an Internet connection to access and learn about cultural resources. Together, the materials on these three sites cover a wide variety of archaeological topics, ranging from lithic analysis to modern conservation efforts.

This project focused on creating material for the Educators page. This website is designed with a key word search function. Individuals select or enter a word or phrase, such as "historic preservation," "conservation," or "archaeology," to retrieve lesson plans from all over the United States and its territories. Each lesson states one or more "essential questions." These are the main concepts or problems that the lesson materials will address, and their answer is the final "take-away" for students. Additional required metadata include "essential questions" which NPS defines as main concepts that the lesson plan addresses, which Common Core and state educational standards the lesson meets, background information for teachers on the selected topic, and an outlined procedure for teachers to follow when conducting the lesson. However, unlike the Teaching with Historic Places website that requires lessons to align with one of many listed themes, the lessons on the Education Portal may address any individual topic. In addition, also unlike TwHP, there is no pre-defined organizational template requiring a set number of maps, documents, and images. In many cases, having such

a template may be helpful when designing lessons. However, in this case, the added flexibility allowed each lesson to be creatively tailored around the featured cultural materials, 3D models, and virtual site tours.

Figure 2: Public Archaeology Day at San Antonio Missions National Historical Park. *(National Park Service, San Antonio Missions National Historical Park, available at https://www.nps.gov/media/multimedia-search.htm)*

When designing this project, staff had to first identify concepts students would learn, then structure a lesson plan to teach these topics. In other words, staff produced both the aforementioned “essential” questions and the answers to them. In some cases, staff at the selected sites already had specific topics in mind that aligned with their existing educational resources. In other cases, project staff attempted to fill information gaps in existing educational resources by discovering hitherto-unaddressed concepts and designing new curriculum around them.

This project produced fourteen lesson plans that cover a wide grade range, from early elementary to upper high school (Figure 3). Each lesson consists of a set of readings and activities or discussion questions that use archaeology to address specific academic subjects. Within the metadata section, all lessons are tagged with key words. To access these lessons, teachers enter one of these search terms within the

Educators page. They then can read the background information, review the lesson procedure, and download the various materials for students.

Lesson Plan	NPS Site	Theme	Time Period	Feature	Common Core Standards
Archaeology at Ellis Island: Uncovering Immigrants' Experiences*	Ellis Island (NY)	Immigrant history	19th-20th century	Virtual site tour	L.6-8.4, RI.6-8.1, RI.6-8.7, RST.6-8.9, W.6-8.2, W.6-8.2.B, W.6-8.3, W.6-8.3.a
Archaeology at Fort Frederica	Fort Frederica (GA)	Colonial history	18th century	3D models	L.8.4, L.8.4.a, RH.6-8.1, RH.6-8.2, RH.6-8.4, RH.6-8.7, RH.6-8.10, RST.6-8.1, RST.6-8.2, RST.6-8.4, RST.6-8.7, RST.6-8.9, RST.6-8.10, SL.8.1
Atomic Elements and Archaeology: Tracing Ancient Resource Access and Trade Routes Using XRF	Yellowstone National Park (ID/MT/WY)	XRF; Native American history	11,000 BCE to present		RI.6-8.4, RI.6-8.7, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7
Crashing the Gates series on Ann Axtell Morris, Florence Hawley Ellis, and Bertha Dutton	Aztec Ruins National Monument (NM); Chaco Culture National Historical Park (NM); Canyon de Chelly National Monument (AZ); Mesa Verde National Park (CO)	Women's history	20th century		RH.6-8.1, RH.6-8.3, RH.6-8.4, RH.6-8.7, RI.6.7

Frederick Douglass, the Educator of Anacostia: "Once you learn to read, you will be forever free"	Frederick Douglass National Historic Site (DC)	Frederick Douglass	20th century	3D models	RH.6-8.2, RH.6-8.6, RH.6-8.7, RH.6-8.9
Neither Cold Nor A Harbor: A Civil War Soldier's Experiences at the Battle of Cold Harbor	Richmond National Battlefield Park (VA)	Civil War history	1864	3D models	RH.6-8.7, RH.6-8.9, RI.6.4, SL.6-8.1.D
Nickels to Dollars: Maggie L. Walker's Quest for African-American Economic Empowerment	Maggie L. Walker National Historic Site (VA)	Maggie L. Walker	20th century	3D models	RH.6-8.1, RH.6-8.2, RH.6-8.3, RH.6-8.4, RH.6-8.7, RH.6-8.8, RH.6-8.9
Plants, Pollen, and People: Archaeology and Pollen Analysis	Did not include a site case study	Pollen analysis	Unspecified		RI.6.-8.4, RI.6-8.7, RST.9-10.1, RST.9-10.3, RST.9-10.4, RST.9-10.7
Seeing into the Ground: Archaeology and Magnetometry	Knife River Indian Villages (ND)	Magnetometry; Native American history	1500 CE-present		RI.6-8.4, RI.6-8.7, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7
Telling the Stories of Pu'uhonua o Honaunau	Pu'uhonua o Honaunau National Historical Park (HI)	Native Hawaiian history	17th century-present	Virtual site tour	L.5.4, RF.5.4, RF.5.4.a, RF.5.4.b, RF.5.4.c, RI.5.1, RI.5.2, RI.5.3, RI.5.4, RI.5.7, RL.5.1, RL.5.4, SL.5.1, W.5.9
What Did They Eat?: Archaeology and Animal Bones	Cane River Creole National Historical Park (LA)	Faunal analysis; African-American history	19th-20th century		RI.6-8.4, RI.6-8.7, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7

*Virtual tour available at https://www.nps.gov/hdp/exhibits.htm#nps. Lesson plan not yet available online.

Figure 3: Lesson plans produced during the National Park Service and National Council for Preservation project.

Lesson Example #1: 3D Models and Cold Harbor Battlefield

Prior to the beginning of this project, NPS staff had already initiated four 3D scanning initiatives. Sites included the Maggie L. Walker National Historic Site, the Frederick Douglass National Historic Site, Fort Frederica National Monument, and the Cold Harbor Battlefield within Richmond National Battlefield Park. Staff at either the University of Florida or the Virtual Curation Laboratory at Virginia Commonwealth University scanned NPS artifacts. They then uploaded the digital models to the open-source Sketchfab website. While most of these models are available as digital versions only, some can be downloaded and printed as physical, 3D replicas.

A primary task at the beginning of this project was to find the best strategies to incorporate these digital and printed (if available) models into the new lesson plans. The main challenge in doing so was that there was not a clear precedent to follow. Most of the existing NPS lesson plans on cultural resources were created several years if not decades ago. Therefore, very few of them addressed modern technological tools used within cultural resource studies, such as digital mapping or chemical analysis, let alone 3D modeling. In addition, there was no official NPS guidance or technical manual on how to incorporate 3D models into educational curriculum. This was simply due to the fact that this kind of undertaking is so new. Therefore, existing NPS cultural resource curriculum and outside 3D scanning projects became the principal sources of instruction and inspiration.

Over the course of the project, several methods were developed to incorporate digital resources into lesson plans. An essential task was matching each site's available resources, such as quantity and identifications of scanned materials, and the desired educational message. Some sites, such as Cold Harbor battlefield, had a limited number of scanned artifacts and already emphasized certain time periods or narratives within their existing curriculum. Other sites, such as Fort Frederica National Monument, had a large collection of available scanned artifacts but these were not used to emphasize larger themes. In all of these cases, the flexible Educators page template became an asset, enabling lesson content to be adapted for each site's needs and goals.

The original plan was to have artifact models as the center point of the lesson, i.e., introduced early and featured throughout. However, the more effective strategy became to feature models within individual lesson activities. The final activities follow a similar format. Educators open the digital artifact model on a projected classroom screen or have students access it on their personal devices. Activity instructions prompt students to examine the featured artifact by digitally manipulating the model. They then

answer discussion questions about the object, either by writing on their handouts or talking together as a group. Depending on the targeted grade level, discussion questions ranged from simple to complex. For example, students may be asked: From what material is this artifact made? How did people use it in the past? How did it end up where archaeologists found it? How can it help interpret past people's experiences at this site?

Through these 3D models, the lessons accomplish two objectives. First, they allow students to move beyond traditional, textbook-based learning. This experience opens the door to different types of learning and, as Means (2017) notes, may especially benefit tactile learners. Second, by connecting to larger themes, lessons help students meet required educational milestones.

The lesson "Neither Cold Nor A Harbor: A Civil War Soldier's Experience at the Battle of Cold Harbor" focuses on a Civil War battlefield near Richmond, Virginia. Between May 31 and June 12, 1864, Confederate soldiers under General Robert E. Lee and Union troops under Lieutenant General Ulysses S. Grant fought at Cold Harbor to defend or seize the Confederate capital of Richmond. Soldiers' daily tasks included obtaining (often contaminated) water from the nearby streams, erecting makeshift shelters to shield themselves from the blazing summer sun, and digging trenches and mounded earthworks that would protect them from enemy fire (National Park Service 2018a).

Visitors to Cold Harbor battlefield today can view these still-surviving earthworks. They can also tour a small museum that features one archaeological artifact: a canteen soldiers split in half to use as a shovel for digging the earthworks (Figure 4). Educators teaching students about the Civil War can schedule Ranger-led site tours or request a "Traveling Trunk" loan. These materials emphasize the conditions soldiers faced and the historical events of the Civil War. Furthermore, lessons connect soil erosion processes that students learn about in their science classes with site preservation efforts.

The initial proposal was to use a 3D model of the modified canteen to educate students about archaeological methods and Civil War history. However, this proved challenging since the artifact did not have a known context. Instead of being discovered through archaeological excavation, it was "recovered" from somewhere around the battlefield. Because of this lack of provenience, the canteen was not a useful tool to teach students about traditional excavation procedures. The lesson therefore morphed from an introduction to scientific methodologies to an historical interpretation of a Civil War soldier's life. It teaches students two concepts: 1) the daily experiences of the

soldiers who were at Cold Harbor in 1864; and 2) how cultural landscapes are created and preserved.

Figure 4: The modified canteen found at Cold Harbor Battlefield. The VCU Virtual Curation Laboratory staff created the 3D model of this artifact. *(National Park Service, Richmond National Battlefield park collection)*

First, students are presented with primary and secondary sources of the battle. These materials include maps of troop positions, historic photographs, newspaper excerpts, and entries from a soldier's diary. Questions on the handouts ensure reading comprehension and prompt students to think about the conditions soldiers faced while at Cold Harbor as well as the daily tasks they undertook. Students are specifically asked to identify the natural resources that were available. They then review how the soldiers modified these resources to meet their various survival needs.

The lesson showcases a digital 3D model of the modified canteen. Educators may choose to display the model on a large classroom screen, or have students access it on their personal devices. Students are able to digitally manipulate the model to explore all aspects of the artifact. They are then shown a modern photograph of Cold Harbor earthworks that the soldier who used this makeshift shovel helped create. Handout questions prompt students to "read" the landscape as an archaeologist would.

These questions lead to group discussions about past historical events and how cultural landscapes are formed and altered over time. They may also include review of erosion processes already emphasized in existing park curriculum and students' science classes.

By using the 3D model alongside historical sources, the Cold Harbor lesson establishes a clear relationship between past and present. Students learn about the historical events of the Civil War and are shown two direct, material connections to the soldiers who experienced it. They are introduced to new concepts and gain a greater understanding of familiar ones, all while participating in an interactive, meaningful learning experience.

Lesson Example #2: Virtual Tours and Ellis Island

The NPS Historic American Building Survey, Historic American Engineering Record, and the Historic American Landscapes Survey (HABS/HAER/HALS) created the tours featured in this project. These programs' surveys compose the "nation's largest archive of historic architectural, engineering, and landscape documentation" (NPS 2019). The tours, which are available on the programs' website, feature sites around the world (National Park Service 2018c). The author began designing lesson plans around these tours. Sites with archaeological materials, including excavation reports and artifacts, were selected. Unlike the lessons featuring 3D models, the new type of lesson allows students to explore virtual landscapes rather than virtual artifacts.

HABS/HAER/HALS staff created interactive virtual tours in 2014 through laser scanning and photogrammetry. Many are available online for members of the public. After opening the tour, individuals are presented with a view of the site in the center of their screens. By moving their mouse, individuals can rotate this view 360 degrees and zoom in on desired views. Individuals move through the site by clicking on one of the scenes within the two navigation panes on the bottom and right of the main view. These panes provide an overall site map and additional information on key areas, and can be turned on or off by the viewing tool.

The lesson "Archaeology at Ellis Island: Uncovering Immigrants' Experiences" guides students around the 19th-20th century immigration complex on Ellis Island. Between 1892 and 1954, over 12 million immigrants were processed at Ellis Island. The first immigration station opened on January 1, 1892. After operating for five years, this wooden complex burned down. A replacement masonry station opened on December 17, 1900 (National Park Service 2018b). This second complex eventually included a multi-wing hospital, a recreation building and courtyard, staff housing, laundry room,

and kitchen. All of these buildings still stand today, yet only the main Immigration Station has been restored.

Immigrants stayed on the island from a few hours to several weeks. Physicians examined newly-arrived individuals for any mental or physical illness. If deemed healthy, immigrants were directly processed by officials and allowed to enter the country. If ill, they were sent to the hospital complex for treatment or sent back to the country they came from. It is due to these various experiences that Ellis Island became known as both the “Island of Hope” and the “Island of Tears.”

In 2014, the NPS Historic American Building Survey (HABS) documented the Ellis Island building complex utilizing laser scanning and photogrammetry. The project produced both a virtual fly-through and a room-by-room interactive tour. Both show the striking differences between the restored Immigration Station and the deteriorated condition of the other buildings at the site (Figure 5). While visitors can take a hard-hat tour of the facilities, the virtual tour allows them to view certain areas that they may not be able to access while at the site.

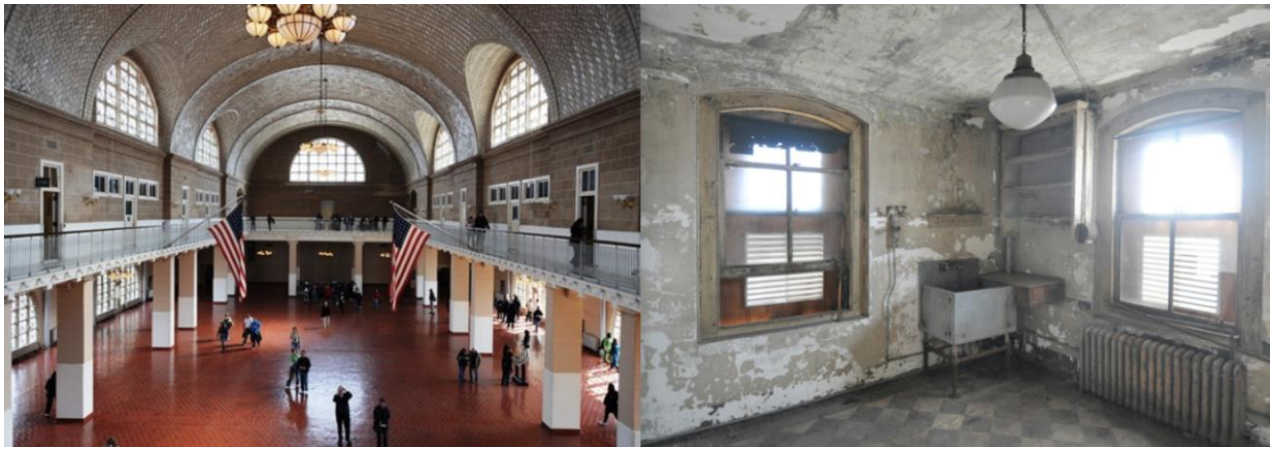

Figure 5: The restored Immigration Station at Ellis Island (left) and the unrestored pharmacist’s laboratory (right) are featured in the virtual tour. *(National Park Service, Statue of Liberty National Monument collection, available at https://www.nps.gov/media/multimedia-search.htm)*

Within the “Archaeology at Ellis Island: Uncovering Immigrants’ Experience” lesson, the author united historical information, excavation data, and a virtual tour to teach students the history of Ellis Island and how scholars interpret individuals’ experiences there in the past. The lesson handout acts as a tour guide, directing students to these various areas of the complex on their screens. At each “stop,” the handout provides background information, historic photographs of the area while it was

in use, and images of artifacts uncovered during archaeological excavation. Questions prompt students to combine these sources with the panoramic views they see on their screens to understand how immigrants and staff members experienced the featured space.

This lesson deepens students' connections with Ellis Island history. Again, lines between the past and present are blurred. Digital technology allows students to explore the very same spaces that immigrants, perhaps their own ancestors, used and moved through in the past. They are also introduced to the methodologies used by archaeologists, historic preservationists, and others to preserve these spaces and narratives. At the end of the lesson, students are asked to consider how these spaces and the artifacts immigrants and staff members left behind help to interpret Ellis Island today.

Considerations for Future Projects

Along with these lesson plans, the project resulted in the much-needed guidance document missing at the beginning of the project. While this guidance was created specifically for NPS staff writing future lesson plans, it contains a list of considerations for anyone looking to create cultural resource education materials utilizing digital technology.

First among these considerations is how to match available cultural resources with educational goals. Resources may vary from a single artifact, an entire collection, part of a landscape, to an entire site. However, not all materials are appropriate for highlighting certain educational topics. Before spending time and funds on scanning initiatives, staff of future projects need to be very selective about which objects or sites best represent their unique needs. As seen with Cold Harbor, this concept may also work in reverse: if a limited number of objects is available, the curriculum may need to be adapted.

Second, staff should also consider basic project logistics. Along with educational goals, within each project funds, time, personnel, and technology will vary. Depending on these factors, digital technology may or may not be an appropriate tool to create curriculum. While these methods are powerful, "it should not be assumed that computer-based visualization is the most appropriate means" to address specific educational aims (Denard 2009). Other methods that require less time, funds, and technological expertise may prove just as effective.

If digital technology is appropriate, other factors should be taken into account. Large-scale projects, such as those creating virtual tours of entire sites, may require expensive equipment, specialized knowledge, or extended time periods to complete. Selected artifacts may be easily scanned and printed or have inherent qualities that make creating usable models difficult. Project staff may not have on-site scanners or printers and need to partner with local individuals or institutions. Finally, the individual scanning the cultural materials may not be the same individual who is writing the final curriculum. Before beginning projects, staff should review all of these logistical variables and make decisions accordingly.

Third, the produced curriculum should be both engaging and educational. Students and educators alike enjoy viewing and manipulating 3D models, virtual tours, and other digital products. However, as Sanders (2014:30) notes, these materials should be "instructive, not just eye candy." The featured cultural materials should be clearly identified and connected to a larger academic topic. There are countless ways to accomplish these objectives and staff should feel free to be creative in discovering which strategies work best. As this project demonstrates, activities and discussion questions may be useful ways to guide students through educational themes while still allowing them free time to explore digital materials.

Finally, all projects should include a post-evaluation stage that assesses curriculum effectiveness in a classroom or other educational setting. Such evaluation is critical, for without it, the true educational value and impact of created curriculum remain unknown. Unfortunately, this project could not include such an undertaking due to various constraints. However, data do exist for future evaluations.

There are many ways to gather data on project impact. Within NPS, because lesson plans are primarily web-based, two online tools are used: the "Add Your Review" button and the email-based comment form that appear at the top right and bottom of each lesson webpage respectively. The review button allows educators to rate the lesson on a scale of 1-5 on five criteria: source authority, credibility, and authenticity; the addressed curriculum standards; clarity, structure, and readability; ease of use; and creativity and innovation. The comment form, on the other hand, does not contain a prompt or word limit, thereby enabling a wide variety of narrative answers. Together these tools provide qualitative and quantitative data that could be useful in assessing curriculum success.

Other strategies include in-person classroom visits, a full participant survey, or comment box where activity participants can leave observations and suggestions. Staff can then use these data to alter and improve their created products. This perform-

review-modify cycle is, in the author's experience, the key to creating a lasting and impactful product.

Conclusion

The NPS/NCPE project is just one of many that demonstrates the remarkable capabilities digital technology has within cultural resource education. The lesson plans detailed above show students how concepts they are learning in their classrooms today help interpret what other individuals did in the past. Digital technology then allows students to connect with and enter into that past, even while sitting at their desks. Virtual tours and 3D models are only two of the methods that can help accomplish these goals. With the ever-accelerating development of digital technology, dozens more may soon become available.

One can hope that the case study presented here is among the first of many projects to use digital technology to further engage students, educators, and other members of the public with these resources and the countless topics that they can help explore. If the projects address the above considerations, namely the matching of available materials and desired educational message, the balance of interactive elements and meaningful content, and the need for a post-evaluation, it is likely that the created educational materials will prove successful in teaching students about cultural resources and enabling them to interact with these materials in innovative and inspiring ways.

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