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Remote Research as Authentic Learning Online

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Abstract

This article reports on a pilot effort to use ArcGIS Online to create a decentralized archaeological mapping lab for digitizing and analyzing archaeological materials visible in satellite imagery. This effort meets student and project needs through an authentic learning opportunity. This effort promises to help us document and study archaeological sites that are likely to be erased before adequate study can be completed on the ground. The Casma Hinterland Archaeological Project (CHAP) reported on here has been successful in both advancing archaeological research in the Sechín Branch of the Casma River Valley, Peru, and in supporting students in skill building, degree completion, and as employees.

Introduction

I came to online teaching and learning as a matter both of accident and necessity. To my knowledge, neither my undergraduate nor graduate institutions offered online courses for credit in degree programs during my time at those places (ending in 2003 and 2014, respectively). I was surprised and unprepared, then, when the department of my first off-campus teaching job offered online classes each semester as a matter of course. So, too, for the second department I taught in. As fate would have it, the first full-time, benefits-paying job I found in higher education was in a school of continuing and online learning.

Thanks to those first two institutions for introducing me to online education as a normal, if not necessary, part of higher education; and thanks also to them for providing models and formal instruction in online course development and pedagogy. Because somewhere between my first off-campus (read: adjunct) gigs and my stint with a school of continuing and online learning I learned that online teaching and learning are authentically valuable for two reasons: first, much of the real-world work done by archaeologists and our colleagues in the humanities and social sciences is done entirely online by necessity; second, "traditional" students no longer exist as abundantly as they once did. Regarding the former point, given that scholars rely on Internet connectivity for our work, we should not dismiss online learning offhand as a cheapened pedagogy (though it certainly can be). Regarding the latter, we are directed to focus on the way in which online functionality meets the needs of our evolving students. Considered together, we might find the most authentic use of online teaching and learning by matching the needs of our students with the demands of the disciplinary activities that we want them to engage in.

I leave it to more experienced colleagues to explore and explain deep pedagogies in online methodology. Here I share how I have used online technologies to provide students with authentic, experiential learning opportunities that also advance my own research into late precolonial polities on the North Coast of Peru. Online technology in this case is a tool for meeting student needs and research needs simultaneously (Figure 1). The value here beyond the benefits for an individual student or individual scholar is that this teaching/research is helping us document and analyze archaeological sites that are rapidly being consumed by agricultural expansion in provincial Peru. There is little hope of effective intervention by local archaeological officials or academic archaeologists because the scale of the problem far outpaces research and preservation resources. The research project reported here is very young – only three semesters old at time of publication – so the results are preliminary, and the methods are ever evolving. Still, the model presented here is one that can serve as an analogy for other research and teaching contexts.

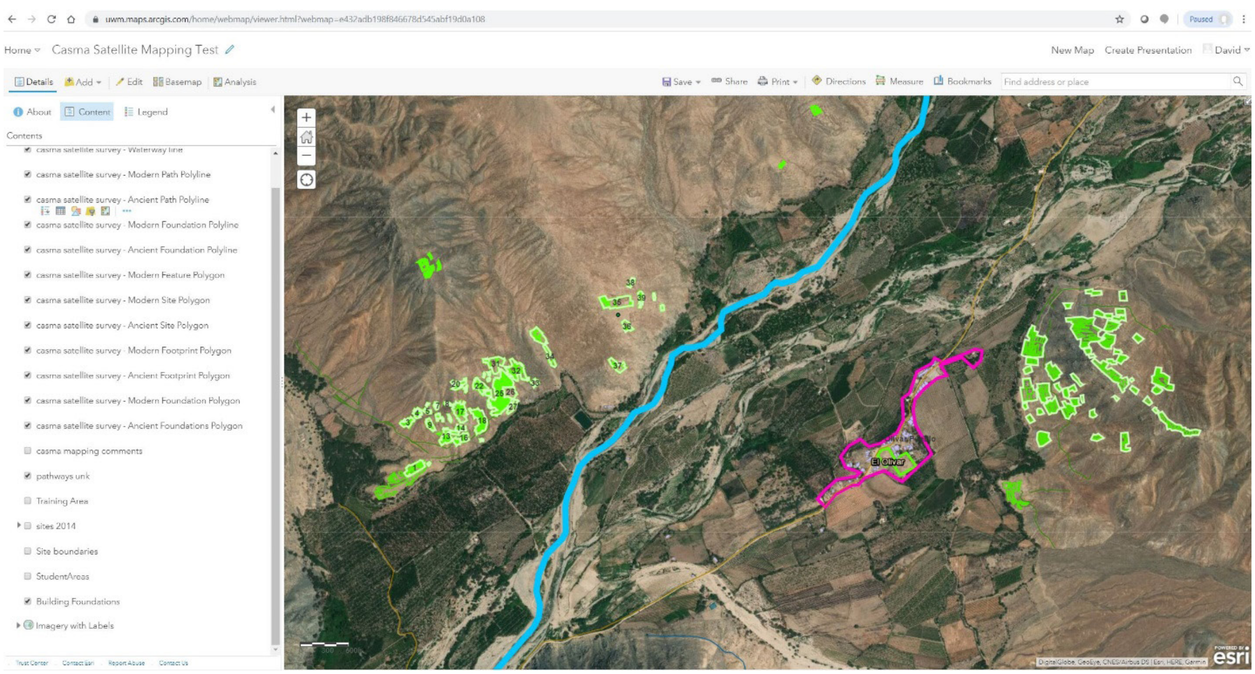

Figure 1: ArcGIS Online Environment for this project. Digitization by Maira Castillo and Riley Rockford.

Matching Learning Modes to Modern Students

Authentic, experiential, and student-centered learning

One of the traditional reactions to online teaching and learning is that it is an inauthentic mode of learning. Based on my own experiences as a student in the late twentieth

and early twenty-first century, it would certainly seem to be an inauthentic form of learning from a common-sense perspective. Most of my learning and training was done face-to-face in the classroom and in the field. However, in my brief experience implementing online teaching, learning, and research strategies, online technology has uniquely provided opportunities for authentic learning. Authentic learning is that mode of learning that is based in addressing real-world problems in creative contexts with ample opportunity for self-directed exploration under instructor supervision (Maina 2004). Authentic learning, in this case, also provides a foundation for experiential learning. Experiential learning can be glossed as learning by doing followed by reflection (Kolb and Kolb 2017:14). Student-centered course design focuses on what students will do to learn, rather than focusing on how a professor's performance leads students to acquire content knowledge (Wright 2011:93). In the archaeological mapping project described below students are primarily "doing" in that most of their activities are to identify, digitize, and categorize archaeological features in satellite images, making the project solidly student-centered. It is also highly authentic in that it addresses exactly the real-world challenges researchers routinely tackle: seeking, recording, and analyzing data. The project could be improved by expanding the reflective component to enhance its experiential quality. While student analysis has been central to the study so far, student reflection has been less emphasized at this stage of development. Still, as the project has developed and workflows have been established, we have begun to open additional space for student reflection and interpretation of the data, the methods, and the project's future potential.

Consequently, a foundation in authentic learning opens space for constructivist teaching/learning experiences wherein the teacher and student work together with the data, methods, and equipment to create new knowledge instead of arriving at a predetermined endpoint (Bada 2015:67, citing Bereiter 1994). In that the entire project is based on what the student is doing (rather than the professor) and that this doing is more than reading and repeating, this methodology is squarely student-centered (Wright 2011:93). These aspects of the project – authentic, experiential, constructivist, and student-centered – are facilitated by the online technology (detailed below) that consequently promises greater learning retention and positive learning outcomes than "traditional" teaching methods.

New traditional students

Traditional students are most easily defined in relief, by highlighting characteristics of non-traditional students and posing traditional students as the standard -- a standard that is increasingly contravened (see National Center for Education Statistics n.d.). Thus, traditional students are those who dedicate a discrete number of years to pursuing and completing a degree, typically while living away from home without

responsibility for dependents. While traditional students often work part-time and engage in extracurriculars, their defining feature is their primary focus on degree completion.

Like all traditions, this one is invented. The roots of the traditional student model likely lie in the aristocratic model of college as a place with a narrow curriculum designed for upper class character development and for exporting teachers around the country. Early curricular models aimed to proselytize elite social order with greater or lesser influence from local contexts (Katz 1983, reviewing Burke 1982 and Hall 1984) by training men for various church and university roles (Kraus 1961:64). The late nineteenth and early twentieth century saw a proliferation of disciplines as the research university developed, in part due to the "application of science to industry, the growth of scientific and experimental methods, and an increased awareness of social problems brought about by an increasingly industrial and urban society" (Goldin and Katz 1999:38). In each of these models, students are men who dedicate a brief number of years to completing a curriculum. The postwar era marks a dramatic change in college attendance with veterans taking advantage of Servicemen's Readjustment Act of 1944 funds to attend college and trade schools (Olsen 1973). However, returning to college after serving in the military means that this early boom in college attendance was facilitated by *non*-traditional students who were likely older, had more professional experience, and were more likely to have dependents than today's freshmen. The expansion of federal loans and the influx of high school graduates in the baby boomer era marks a clearer beginning of the traditional student, as defined above.

In the early twenty-first century, a new tradition has emerged. Decreasing numbers of students dedicate four years exclusively to study. It seems fewer and fewer live in a collective liminal state between their hometown-based high school years and their diasporic post-college professional years. Today many students in college (and graduate school) remain connected to their home networks by living at home, connecting regularly with their families and friends from high school, and by continuing to work jobs they had before college. Students today may simultaneously hold internships at the companies or in the fields they hope to join after graduation. They often participate in intense extracurricular activities while struggling marvelously to provide adequate attention to their physical and mental health. Frequently they also contribute to their communities through additional volunteering and service activities. To the extent that students have done this all along – and certainly some have – the notion of a traditional student is not only invented, but somewhat illusory.

Most teachers in higher education are 'lifers' who have dedicated not only four years to college, but about eight years to graduate school, and more still to research and publication pursuits. Most of us, then, once fit the model of (or thought of ourselves as) a traditional student. Most of us were taught by faculty who were also traditional students. And most of us received limited formal pedagogical training before starting to teach. We logically and dutifully enact the tradition that served us well and imagine our

students as benefitting from this tradition. In many respects this strategy is beneficial. The traditions of teaching, learning, and research in higher education are indeed, to quote a former dean, “sacred, but mutable.” Recognizing that our students are increasingly enacting a new tradition can help us select better methods for meeting collaborative learning goals and to use supportive technologies, like the Internet, more effectively.

Meeting research needs, meeting student needs

The satellite survey project described below meets the needs of today’s students, the research needs of an archaeological investigation and preservation project, and efficiently draws on available resources. If today’s students are both overburdened and eager for development in real life experience, then a project that allows for flexibility in terms of equipment, location, and hours *that also* facilitates archaeological documentation and multi-user integration meets both research and student needs. Through a subscription to ESRI’s ArcGIS Online facilitated by the University of Wisconsin - Milwaukee we have been able to begin mapping the middle Sechín branch of the Casma Valley. This project has a primary focus on late precolonial archaeological sites and a secondary focus on modern structures that may threaten archaeological sites, particularly the unauthorized expansion of irrigation systems and modern villages.

Mapping Casma

The Casma Hinterland Archaeological Project (CHAP) and its satellite survey component is based on the Corinth Computer Project (CCP), which has been directed by David Gilman Romano since 1988 (Romano 2009). The CCP developed a block-by-block reconstruction of the site of ancient Corinth from its archaic period through the modern period, though the project’s intellectual emphasis was largely on Roman Corinth. The project’s methodology was to use a total station to survey the main features of the standing structures in the ancient city, return home with the survey data, and then georectify state plan drawings published primarily in the Corinth monograph series from the American School of Classical Studies in Athens, its journal *Hesperia*, and *Corinth, the Centenary: 1896-1996* by C.K. Williams and Nancy Bookidis. Additional sources, including field notebooks, were also consulted. Plan and elevation drawings would be scanned, georectified, and digitized using Autodesk’s AutoCAD program. As a work-study and later research assistant in charge of managing the digitization effort from 2001-2006, I learned the workflow for this kind of project in a context that preceded online collaboration and cloud storage.

Following my departure from the CCP for graduate school several important (and ongoing) changes in geospatial and Internet technologies both inspired continuing interest in this kind of work as well as efforts to stay abreast of best practices.

An early probe into the feasibility of the Casma project centered on using Google Earth to digitize structures visible in the Peruvian desert using Google Earth's polygon and line digitization tools. The benefits of Google Earth are that it is free, it is very easy to learn, it allows for rapid georectification of raster images (like scanned detail maps) and it is somewhat easy to share. It also saves to a cloud server, which provides some level of security over the vulnerability of physical hard drives. Later, Google's My Maps application provided a more intensive, lightweight Geographical Information System (GIS) interface that is more familiar to users of the industry-standard ArcGIS desktop-based GIS. Its mapmaking tools and its ability to organize features more closely mimics ArcGIS. It also allows for group collaboration in developing a single GIS and map generated by the efforts of multiple users. One such context would be a professor instructing and then relying on the independent work of multiple students. ArcGIS desktop is the most powerful GIS tool commonly available to researchers and students. However, group collaboration is not as easy. More recently, ArcGIS Online has been developed to facilitate multi-user collaboration through an online interface. ArcGIS Online is available for free (at time of writing) through a 'public account' to anyone with a valid email address. Theoretically, ArcGIS Online allows multiple users to collaborate using free accounts; but the functionality is limited without an additional paid license for ArcGIS Desktop.

The University of Wisconsin - Milwaukee, which I joined in the Autumn of 2018, has supported the initiation of the project described here. An institutional subscription to ArcGIS and ArcGIS Online as well as institutional structures for credit- and pay-based undergraduate research opportunities has dramatically facilitated the implementation of a student-centered, experiential and authentic learning and research project.

Our current methodology is as follows. Students are recruited through the Office of Undergraduate Research (OUR), Department of Art History, and Center for Latin American and Caribbean Studies (CLACS). Interdisciplinary recruiting connections to the Department of Anthropology, Museum Studies Program, and Foreign Languages and Literature – Classics also exist. So far, students have been able to earn credit in both CLACS and Art History and have also won funding from OUR for contributing to the project and completing their own independent study within the project. Students are all granted access to ArcGIS Online. Because ArcGIS Online is browser based, students can log in online from anywhere with Internet access, regardless of their operating system platform. Using the ArcGIS Online web interface (Figure 1), students can view a base map of satellite imagery gathered through several sources as determined by ESRI, ArcGIS's manufacturer. The resolution of these images is approximately 60 cm per pixel. I created several pre-defined feature layers that were added to an online GIS map. Early in this trial study, those features had to be built on the desktop, though ArcGIS Online now seems to have the ability to build feature layers directly through the browser. Students access the map and digitize features in the landscape. Digitization

is essentially recording features by tracing them. Students learn to identify ancient and modern architecture, agricultural installations, and other features in the landscape during periodic in-person meetings and through additional resources available online. Students also learn to categorize the ancient features based on my previous fieldwork in the area (Vogel and Pacifico 2011; Pacifico 2014). Following their digitization and categorization efforts, students contribute both to the overall project and to projects of their own definition, as required by their OUR grant stipulations (Figure 2).

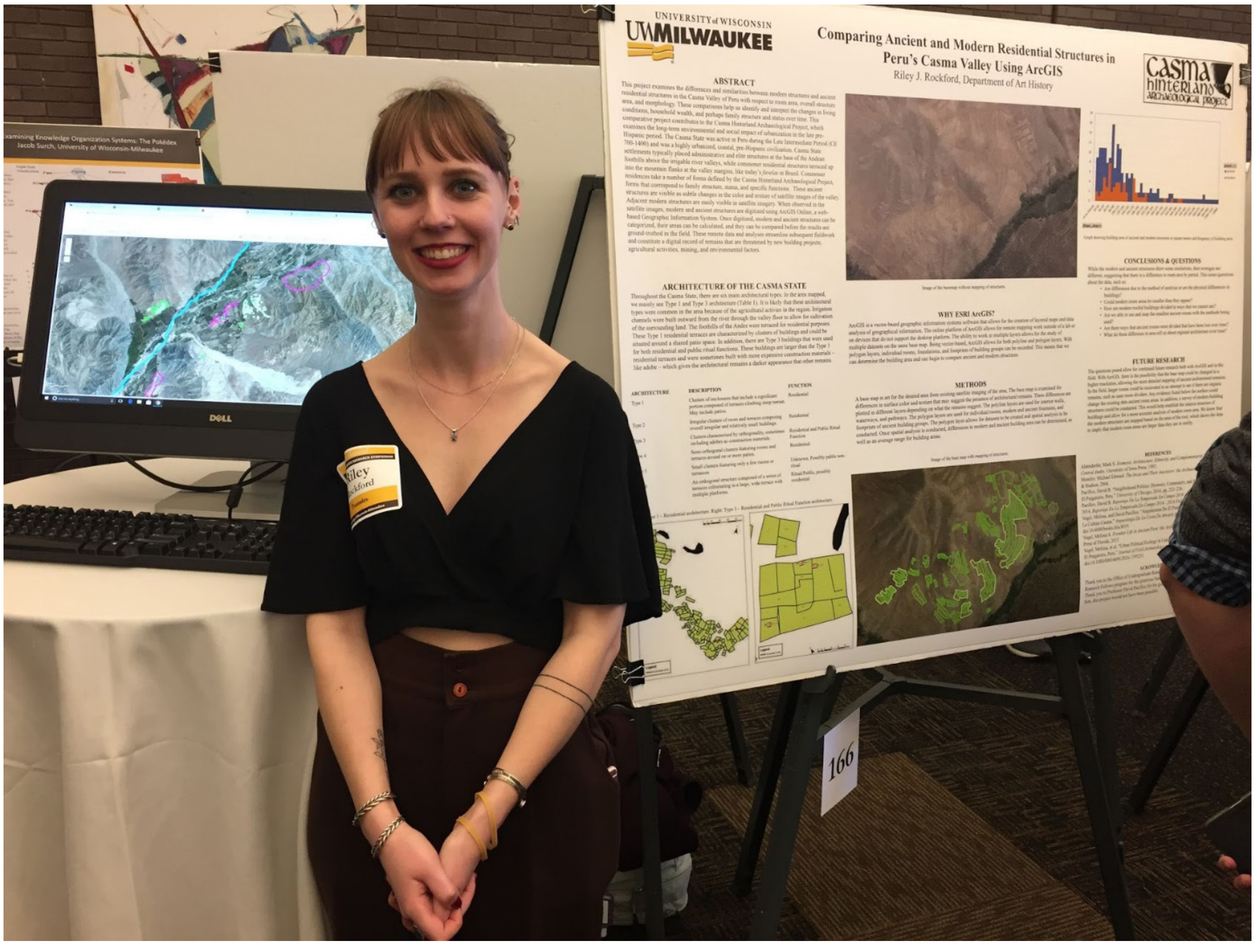

Figure 2: Student researcher Riley Rockford presents at the Student Undergraduate Research Conference at the University of Wisconsin - Milwaukee. In addition to a poster, she provided a live demonstration of the research process using the computer at the left of the photo.

Successes

This project is something of an experiment, but nonetheless has been successful in advancing methodological strategies, in advancing archaeological research and preservation, and in providing students with real-world experience in learning ArcGIS and computer-based archaeological methods. Methodologically, we have been

able to identify challenges and obstacles to doing this kind of collaborative, remote archaeological work. Accordingly, we have been able to develop increasingly effective workflows, and – above all – workarounds that help us meet our goals. Methodological improvements specific to this project include the defining of the universe of feature types that are needed for digitizing ancient and modern features in the desert landscape. We are continually testing the boundaries of application of that feature set. Research results include the identification of several sites in the area, as well as their hypothetical function, period, and the possible interrelationships between structures within those sites. These research results, however hypothetical, have helped develop a preliminary base map of archaeological features for recording the provenance of surface finds with a precision down to 4 m^2, which corresponds to about a 2 x 2 m square – which is also both the typical test pit size in this area and the size of a small domestic storage room. This base map promises to facilitate efficient field research founded upon preliminary remote research. In 2004, when I first visited this valley, sketch maps were made by hand in the field to facilitate total station mapping on the ground. Now we get much more accurate sketch maps without even going into the field, which reduces cost, time, and risk. It also dramatically increases the accessibility of archaeological research to students.

This research method is successful from both the perspectives of research goals and of student learning goals. By providing credit opportunity, it directly supports student movement toward degree completion. It also supports students financially in that our OUR students also earn an hourly wage for their efforts. Because students create an accessible product in the form of a GIS map, they are also able to demonstrate that – through this project – they are acquiring transferrable skills in archaeology and GIS work. Moreover, the project is tailored to our “new traditional” students in that it meets students “where they are” and “when they are” because they can use any equipment at any time, provided they have Internet access. It does so efficiently and in an accessible way because the project is relatively inexpensive. No dedicated lab or computers are required. Students can use their own devices or those available in library computer labs.

Challenges

As with any tool, there are limitations. ArcGIS can feel particularly finicky at times. Subsequent desktop releases seem to move familiar features around and there are frustrating asymmetries between the desktop and online versions. Understandably, the online version does not include all the functions of the desktop version; and some routine procedures may require downloading files to a desktop, re-uploading to the cloud, and then informing project members. This kind of procedure invites error and complicates workflows. This upload/download component may be particularly onerous when attempting to use raster images of even higher resolution than those natively available in ArcGIS Online. We have found that higher-resolution imagery (15 cm/

pixel) is available, but a work-around is needed to use it in an online, decentralized project. This development requires new workflow procedures and a more formalized communication protocol. One solution would be to use a decentralized desktop approach, but it would require the development of new workflows. Moreover, by moving to a desktop environment many of the accessibility benefits of ArcGIS Online – those that so greatly facilitate student involvement and learning – may be lost. Still, there are solutions. A final point applies to all cases of combining raster data for digitization and analysis: when combining imagery from different sources their georectification transformations may not be identical, so structures digitized from one image may not align with the same features captured by other images. Consequently, even though complementary images may provide complementary details, those details may not align as one hopes. They may require further adjustments to create a unified composite.

Resolutions and potentials

This project is only three semesters old as of this writing. As the project develops, clearer workflows will minimize the need for moving between online and desktop versions. Changes in the software itself may also facilitate a more streamlined experience. More experience with a variety of raster datasets will likely lead to more facility in integrating different kinds of images into a cohesive GIS. The potential here is enormous because satellite coverage is extensive and of sufficiently high resolution to allow for the documentation, categorization, and limited analyses of archaeological sites in imminent danger of destruction. As an example, Google Earth historical imagery indicates that Huarazpampa (in the Southern branch of the Casma River; Figure 3 and Figure 4) was significantly damaged by human activity between June 2017 and July 2019. The June 2017 imagery allows us to document the ancient architecture before destruction (Figure 3, see arrows that indicate areas of destruction). Such documentation could allow future scholars to do more meaningful excavations in areas where superficial architecture has been destroyed. Similarly, we can expect a series of sites in the Sechín (Northern) branch of the Casma Valley to see similar destruction. By digitizing currently-available images of standing architecture and incorporating the data into a GIS we may be able to return to these sites – even if destroyed on the surface – and recover what is below ground in known buildings that have been effectively erased. The greatest potential would be realized through an iterative process of superficial observation in the field, integrating imagery into a GIS, digitizing as many features as possible, and then returning to the field for ground-truthing, mapping, analyses of what may remain on the surface, and precisely targeted excavations as a final step in the cycle.

Conclusions about Online Learning and Research

Although still in an early stage, this research effort demonstrates that authentic, experiential, student-centered learning can occur online. In this case, this learning opportunity coincides with a research effort that could only be carried out using Internet technologies. By meeting students where they are and “when they are,” Internet connectivity has allowed for a synergistic relationship between an archaeological documentation project marked by urgency and a rich research-based learning experience for students. As the project develops, more experience will help develop better workflows, more formal training and communication protocols, and expanded student opportunities (including publication). At this stage, the successes to date lay the foundation for an increasingly valuable project – which is exactly what we would expect within a constructivist pedagogical framework.

Figure 3: Huarazpampa as visible in Google Earth from June 2017

Figure 4: Huarazpampa as visible in Google Earth in a photo from July 2019. Heavy squares at center and left are foundations for modern reservoirs.

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