

Preservation and Collaboration: Going Digital in Archaeology

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Abstract

Academic databases are perhaps only the beginning for archeology's foray into the digital age. Digital and interactive repositories of information will aid in the dissemination of new knowledge more rapidly than before, and to wider audiences. 3D scanning and mapping techniques, along with more portable and powerful analytical tools, are speeding up the post-excavation cataloging of finds. Collaborative and critical communities may soon have the ability to form, produce work, and disband quite rapidly, once the digital infrastructure is completely in place. At this point, digital archaeology is experiencing rapid growth, to the degree that researchers are encountering the outer limits of available technology, prompting some in the field to call for a slightly more cautious approach.

Introduction

Archaeology has evolved in many ways, making information available to the public and other scholars around the world. In order to collect this data they have been using new techniques, such as GIS, GPS, other remote sensing technologies, and different types of media. However, there are limitations to the building of infrastructures that can aid in the sharing and storage of archaeological data. No matter the limitations and issues, archeologists are determined to build an infrastructure. As Ezra B.W. Zubrow states,

archaeologists today are concerned with improving the observers' intuitive understanding of past events and memory. Given the above, one should take as given that all of the work in cyberarchaeology represents the best of both scientific and interpretationist archaeology. In fact one could argue that if post-processual archaeology will continue to exist it will exist through cyber archaeology (Zubrow 3).

It seems that archaeology is turning to technology in order to keep up with the time. "Cyber Archaeology can represent today a research path of simulation and communication, whose ecological-cybernetic relations organism-environment and the informative-communicative feedback constitute the core, but they have to be still fully investigated" (Forte 13). The following paper discusses the growth,

collection methods, problems, criticism, where it is heading, and some case studies to show the many different aspects of digital archaeology and how it will help with the sharing and preservation of data.

Growth of Digital Archaeology

Digital archaeology has grown in numerous ways over the last half of the Twentieth Century through today. The growth includes trying to build data infrastructures in order to collaborate and store data about archaeological sites around the world. In the book *Archaeology 2.0: New Tools for Communication and Collaboration* edited by Eric C. Kansa, and others talk about how archaeology is trying to embrace the internet in order to build a collaborative infrastructure opened to all for the purpose of doing more effective research and sharing of ideas. Throughout the years multiple groups have developed many different types of search engines to place their data and have it open to the public. However, there have been some problems in their development due to trying to figure out the best, easiest and most effective way to support all the data collected.

The building of a data infrastructure would be beneficial to the members of the humanities community, which included archaeologist, historians, and anthropologist. In Europe they have tried to develop a data infrastructure that could benefit them to store data and to collaborate on projects and to share ideas. Great Britain is a country that is trying to build an open to the public, user friendly database cyber-infrastructure. The system that they have built is called the Archaeological Data Service (ADS) which manages large scale collections by utilizing different government agencies (Kansa and Kansa 28). The ADS has provided the UK with a digital recourse for teaching, learning, and research since 1998 (Richards, et al. 32). Kansa contents that, "In these more centralized settings, the costs of implementing formal semantic standards and Semantic Web technologies are easier to justify. In more centralized settings, it is also easier to formally define and enforce a common ontology, such as the CIDOC-CRM for describing data" (Kansa 28-29). Consequently, there is no resource in the United States that compares, because the expense cannot be justified because the Semantic Web technologies have limited use. However, emerging technologies, including natural language processing (NLP) can pave the way for the growth of Semantic Web in archaeology to grow (Kansa 29). The NLP allows easy navigation through databases to find the information without much trouble. One of the major cyber-infrastructure projects in archaeology is Archaeotools. The goal of the project included a faceted classification and NLP to incorporate over a million structured databases records from grey literature reports and unstructured journal accounts into a single browsing interface (Richards, et al. 31). The project successfully implemented a browsing system in the context of cumulative archaeological records (Richard, et al. 51). It is now accessible to the

public as a replacement for the existing ArchSearch II interface and is embedded with the search interface available to ADS users. However, the building of database in digital infrastructures has flaws because the cumulative data required users to have generalized information about the project in order to understand the fundamentals of methodologies and meaning (Kansa and Kansa 58). To alleviate these problems, the ADS has become like a "Google-like" browsing search engine for easily collection of data that is compiled on databases, archaeologist need to employ new technologies that help to make the building of infrastructures simpler.

It is interesting that the United States does not have a state sponsored culture heritage management tools like that of some European nations. In today's world we have become a social media culture, always sharing data through the internet. Yet, the amount of data that archeologists collect is difficult to place on simple and comprehensive databases. Though trial and error they may be able to be able to place easier to use search engines out there for people to see their work and do research. For archaeology, the rise of digital databases of information become new media concerns because user-enabled functionality is not simply the take-up of the shift to Web 2.0 principles and technologies, there is profound symmetry between the logic of new media work and archaeology (Webmoor 196). For archaeology there is a need of digitizing databases and for creating cultural heritage (Webmoor 196). For archaeology, the need of digitizing databases and preserving cultural heritage is essential to give access to archived data (Webmoor 196).

Methods of Collection

In order to collect the data for the database archaeologists have begun to use new tools to aid them. These newer technologies include Global Information Systems (GIS), Global Positioning Systems (GPS), media, cameras, video recorders, remote sensing, and laser scanners. These techniques have become what Ezra B.W. Zubrow in "From Archaeology to I-Archaeology: Cyberarchaeology, Paradigms, and the End of the Twentieth Century" says have become a part of the standard tool kit of archaeologist throughout the world (Zubrow 1). They are the "new" archaeology of remote sensing, reconstructions, and GIS (Zubrow 1). However, not all archaeologists can afford these new technologies and there are not always applicable to the area or problems (Zubrow 1).

Global Information Systems (GIS)

Global Information Systems (GIS) is used in many application of digital archaeology today gives the ability to map areas of a site and place the information in a digital database. Google Earth is one database that has used GIS in an effective way. Utilizing Google Earth and GIS, archaeologists are able to perceive and employ geospatial data in their work (Dunn 54). With Google Earth the public can

look at 3D maps of archaeological sites and the landscapes with both natural and man-made formations (Dunn 58). Overlaying images, incorporating websites and the ability to visualize present-day terrain in 3D, reduces the need for resources and technical skills to gain outcomes that would require archaeological illustration practice and methods (Dunn 54). Massive amounts of archeological evidence attests to the importance of geography as a means to organize and communicate information allowing us to further understand the human past (Dunn 53). Dunn continues that "the deluge of complex digital information is not confined to archaeology or classics" (Dunn 53). There are other uses of GIS such as the use of GIS and a variety of other field techniques to understand the relationships that nomadic pastoralists have with their landscape (Palmer and Daly 97). The surveys helped in understanding the changes in the pastoral way of life in the Wadi Faynan area in Jordan. Their research showed the current patterns of camp location not only reflects access to water but also the availability of work opportunities (Palmer and Daley 121). This type of work demonstrates how GIS can be used in dealing with 'living archaeology' (Palmer and Daly 123). Also their work allows them to explore the nature of the Bedouin ways of life in modern times, as well as to identify signatures that can be used to recognize earlier pastoral campsites and to distinguish them from the much earlier prehistoric features that share the same space (Palmer and Daly 124). It was stated that "an increased emphasis on the variety of different types of spatial, geometric and temporal systems as digital archaeology increases its reach into more and more prehistoric problems using methods such as GIS" (Zubrow 27). Also "increased use of digital visualizations and communication systems will change the nature of archaeology requiring the fusion of different types of realities while broadening participation" (Zubrow 27). Michael Frachetti explores digital techniques used to model the social and economic landscapes of mobile pastoralists in his article "Digital Archaeology and the Scalar Structure of Pastoral Landscapes" (Frachetti 128). Frachetti specifically explores how "archaeological and ecological data of various conceptual and analytical scales can be correlated in a digital environment to provide a more refined picture of the spatial and temporal patterns of movement for pastoral societies during prehistory" (Frachetti 128). Commentators on the GIS have urged the social and cultural dimension be incorporated into GIS to ensure that different local, regional, and international perceptions are effective in decision-making through participatory planning (Fletcher, et al. 395). The field of spatial information science, such as GIS and remote sensing, has become widely recognized as an essential and successful addition to enhance cultural heritage management (Fletcher, et al. 393).

Media, Cameras, Laser Scanners, and Video Recorders

The use of other forms of media, cameras, laser scanners, and video are also useful in the collection of data because when used together in combinations to can

map out many different things so the details can be seen and recorded for analysis. In the article "Archaeological Survey in a Digital World," Matt Bradley discusses different survey techniques used on two different sites in England. The first one, at the Abby of St. Peter and St. Paul in Dorchester; they used a reflectorless TST which produce 'real-time' survey as the basis for recording the elevations (Bradley 36-37). Total Station Theodolite or TST, allows automate and angular measurements of objects and surfaces through laser scanning. A reflectorless TST was employed because an ordinary TST has problems recording elevation and the data can only be verified after it has been downloaded (Bradley 37). Employing 'real-time' survey, with laptops connected to the TST allowed them to fix problems as they occurred and allowed them to continue with the survey without having to do much post survey processing. They also decided that they should not record the elevations in 3D because it would take too much time to convert the data for a building of that size (Bradley 38-39). They also used photos and drawings in order to make a more detailed 2D model of the windows and paintings on the walls.

The second site was the Ferrybridge Chariot burial in Yorkshire. The site was unusual because this type of burial is very rare in Britain. This was also an important site because of the other 20 two-wheeled chariots were found before modern surveying techniques (Bradley 43). By using new types of surveying techniques they would gain enough information to reconstruct the chariot and also preserve not only it and other elements of the excavation so others can reconstruct the approach that Oxford Archaeology used to deconstruct the burial site (Bradley 44). They also used a reflectorless TST at this site, but they also used a series of rectified photographs of each phase of the excavation and developed a 3D model. Each day their data was backed up and any work conducted in TPSCAD, was transferred into AutoCAD r14 (Bradley 44). AutoCAD is a software application for computer-aided design (CAD) and drafting and supports both 2D and 3D formats. They also took photos of the site in order to help in their research placed them in digital format. The photos were downloaded and rectified during the excavation. With all the data collected they could use it to compare the site to others in Britain and throughout Europe that are the similar.

Remote Sensing

Remote sensing techniques include GIS, GPS, and digital imagery. All of these techniques have potential to find sites and to locate parts of a site already discovered and place that data into a system. Remote sensing techniques were used at the Angkor World Heritage Site in Cambodia. This site is vast and in a remote area which is covered in natural plant life. By using remote sensing the area can be surveyed better and more can be learned from the site.

The Greater Angkor Project began to survey the area. Multiple groups who

have collaborated on the project include the Authority for the Protection and Management of Angkor and the Region of Siem Reap (APSARA), the French School of the Far East (EFEO), and the University of Sydney, who were able to make a full extend and scale map of the site along with the surrounding area (Fletcher, et al. 387). The surveys were taken by aerial radar from the NASA/JPL AIRSAR system in 2000 and they have been further extended both spatially and in more systematic detail (Fletcher, et al. 387). Mapping is essential to preserving the site as tourism has increased in this area, increasing the likelihood of damage to the structures and monuments (Fletcher, et al. 388).

One of the first tasks for Living with Heritage was to construct an integrated spatial data-management system capable of indexing disparate sources of information (Fletcher, et al. 393). These tasks included base maps, satellite images, aerial photography, topographical surveys, and archaeological survey results to help form the core of the dataset of the site (Fletcher, et al. 393). The online database records detailed metadata on each dataset and allows spatial search and simple mapping of site and sampling locations through Google Maps and TimeMap (Fletcher, et al. 393). The system is based on an open source product to make it freely open to the public beyond Angkor (Fletcher, et al. 393).

Living with Heritage brings together the humanities, social, and natural sciences to address the conceptual and methodological problems of managing very large and populated World Heritage Sites (Fletcher, et al. 401). The next phase of the project will assess the system's portability to cultural World Heritage Sites in developing countries (Fletcher, et al. 401). The Angkor site provides the development of temporal GIS monitoring system for heritage sites, which hope to integrate value-based participatory planning and community based GIS, archaeological remote sensing and development in information management and web delivery using open standards (Fletcher, et al. 401).

Case Studies

Digital archaeology also helps in the reconstruction of sites, preserve documents, and to help to locate patterns of settlement of a group of people that have been living in the same area for many hundreds of years. Two cases help to illustrate these principles, the first is a project in Bologna, Italy and the other is in the development of a digital museum in Helsinki, Finland.

The method of reconstruction for databases is explored in the article "An Open Source Approach to Cultural Heritage: Nu.M.E. Project and the Virtual Reconstruction of Bologna" by Nicola Lercari (Lercari 125). Since the founding of the Iron Age village of Felsina, built by the Etruscans c. 510 B.C., the site has involved in many different phases (Lercari 125). The project helps to demonstrates

that 3D graphics and real-time engines are useful tools for representation of ancient urban landscapes (Lercari 126). Working on 3D visualization of a set of historical information, they discovered that basing modeling activity on historiographical description is not sufficient (Lercari 126). So the results of the methodology they used is a multidisciplinary approach that opened new prospective for urban history and reduces the gap between humanities and information sciences (Lercari 126).

To aid in the reconstruction of Bologna, they used the voluminous documents and employed comparative analysis (Lercari 127). These documents came from rental agreements between religious institutions and private citizens, real estate contacts, medieval cadastre, and early urban planning documents (Lercari 127). Also two different visual materials, the first was the works of Italian artists and cartographers and the second was modern aerial photos, and satellite images (Lercari 127). Utilizing these items they were able to do complex methodological task such as: quantitative analysis, architectonic analysis, spatial survives, etc. (Lercari 128). The main focus of the project was to show the efficient communicative process for the virtual museum of Bologna and proved the involvement of cognitive and emotional factors in the improvement of museum communication (Lercari 129-130). Technology evolution and new cultural paradigms push museums to find different models for the future (Lercari 132). This project shows how documentation and digital technologies can work together in the reconstruction of urban landscapes.

The other project was the building of a digital museum in Helsinki, Finland. The project was headed by Lily Díaz, who defines digital archaeology as the strategies for the use of visualization methods to present historical data, along with testing and evaluating of the methods through prototypes (Díaz 283). Such projects like the Digital Archeology and Museum Design (DAMD) utilize digital archaeology because they can show artifacts, reconstruction, and other objects to the public without fear of them destroyed and were a multidisciplinary practice that was situated between the arts and humanities (Díaz 283-284). The aim of the project was to develop methodologies that utilize virtual environments to reconstruct and make previously inaccessible cultural artifacts available to the public (Díaz 284). Additionally, it also helps preserve artifacts (Díaz 285). The group in Finland used a map of Mexico from 1554 to demonstrate the uses of digital archeology (Díaz 285). The current state of the map makes it only available to specialist and people willing to make the trip to Sweden (Díaz 285). Once it is digitized it will be made available to everyone and preserving it for the future (Díaz 285). They are also developing and compiling research about everyday life in Finland during the Iron Age (Díaz 287). Furthermore, the project wants to investigate the changing role of museums as an educational institution (Díaz 287).

These projects are both different in many ways, but are similar in because they are trying to make their work accessible to the public and to other members of the academic and research world. They also point to the idea of preservation for the future and the reconstruction of sites to help the sites remain intact. They also show what a landscape that has been build over by building over the centuries looked like in a point in time.

Problems With Digital Archaeology

Although building digital infrastructures would help members of the humanities and other areas of research, there are still problems in building those infrastructures. One problem is that there is no standardized method of data collection. Another disadvantage is that there is no software program that serves the needs of archaeologists directly. Paul Backhouse discusses the problems in his article "Drowning in Data?: Digital Data in a British Contracting Unit." He states that "the adoption of technology has generally been undertaken in a reactionary and sporadic way: *we have a problem, this may be a solution* (Backhouse 51). By using CAD and GIS requires different information to be collected in diverse ways and standards. However, the different ways of collection creates a problem when evaluating the data months or years later as find key elements could be missing, preventing the technology being used as intended. Also adopting programs or hardware that is not designed for the application has also meant a waste of time and recourse (Backhouse 51). This causes them to redo data collection over and over again. Both of these issues also cost money and uses other scarce resources. Analyzing data onsite is a step in the right direction and this led to the creation of Framework Archaeology, a joint venture by Oxford Archaeology and Wessex Archaeological Trust (Backhouse 56). The Framework adopted a series of key ideals to undertake an excavation; first analysis on site and second train the site staff to consider the whole site to figure out what areas that need further exploration. To achieve this they created an exceptional series of databases and a unified GIS. "The model adopted by Framework combines technology with an overall data collection strategy" (Backhouse 57). This allows decision to be made on site based on greater understanding, allowing teams to remove false or inaccurate data before post-excavation and making it more cost effective.

Even though they are building search engines like that of Open Context, they are still having problems making this information useful and informative to users. It involves many different aspects of technology, information architecture, data modeling, and service design, which archaeologist do not have much experience or theoretical guidance (Kansa and Kansa 88). Yet, they hope in the future to have conversations that will expand beyond those with the technical skills to find an effective way to think about, produce, and share and reuse the data with many

different people.

Archaeology is a global endeavor that has archaeologist and other types of specialist needing a way to communicate the data in effective ways. This is why no single existing technology can meet all the needs of the archaeologist. These “off-the-shelf” tools were designed for different conditions and contexts that are not characteristic of archaeological fieldwork (Kansa 157). They have tried to work with these tools, but they do not adapt well for archeological needs. For this reason there have been attempts to use a Mobile Web to stream-line fieldwork (Kansa 157).

Although there are limitations and problems the usefulness of digital technologies is clear. It is essential for the archeologists to find the right programming and structure to make their databases work for them and their work. Also trying to find the funding and right technologies that can work for them is also a problem. Although there are problems there are many uses for digital technologies, such as protecting manuscripts that are fragile or getting the manuscripts to many people throughout the world.

Criticisms of Digital Technologies

New techniques and new methods create advantages for those using the technology. However, some believe there are issues with it, including the reconstruction that archaeologist make with their data are reconstructions based on their own personal ideas and may not be based in fact. Jeffery T. Clark, who wrote the article “The Fallacy of Reconstruction” which talks about the reconstructions of history in the digital world and point outs that archaeologists say they have created a “reconstruction” of some facet of the past, but believes that with a few exceptions archaeologists cannot “reconstruct” the past (Clark 63). The problem is that archaeologists cannot say for sure that the reconstruction is true to its actual original appearance. Calling one’s construction a reconstruction can be misleading. Which is detrimental to the archaeologists research and in the education of their students and the public (Clark 63). To say that they have “reconstructed” something is to infer that they have definitively and unquestionably re-created the building or artifact as if the archaeologist was there at its creation (Clark 63). “To say that one has actually created an archaeological reconstruction is in most cases fallacious. This is not to say that is malicious, but simply a legacy of the discipline that has been perpetuated” (Clark 64). The biggest issue with reconstruction models, whether it is digital or drawing, is that accounts do not disentangle fact from fiction (Clark 67). Post-processual archaeologists accept the use of models as potentially useful fictions rather than as explicitly scientific tools (Clark 67). The idea that archaeologists deal with reconstruction has carried into cyber-archaeology (Clark 68). Improvements in virtual software and hardware have made it possible to create more realistic models (Clark 69). “Instead of reconstructing the past, archaeologists are always

dealing with models, or constructions. This is most evident when we look at the domain of virtual archaeology” (Clark 71). Virtual simulations provide a visual model of the way a place may have looked, but it also gives the viewer the sense that this is really the way something looked (Clark 71). The author does not doubt that some models are more accurate than others, but he wants the archaeologist to say they are representations and not reconstructions (Clark 71).

How it is Helping Archeologists

Although there are problems and critics of digital archaeology there are numerous benefits. It allows archaeologist to preserve sites that will be destroyed by modern progress. This can be seen clearly in Chinese sites that will be destroyed by city development. It also preserves documents for the future in digital formats.

In China, the Western Han Tombs and the murals were in danger. The group that mapped the murals came from the University of California Merced and the Italian CNR, VHLabs (Galeazzi et al. 97). Their aim was to make digital documentation of the Western Han monuments for its preservation and communication purposes (Galeazzi et al. 97). The goal of the project was going to create the Western Han Dynasty Virtual Museum so that the murals can be seen for many years to come even though they were physically destroyed (Galeazzi et al. 97). The project moved quickly as the construction that uncovered the tombs was going to continue (Galeazzi et al. 97). They designed the project to be divided into several specific tasks: tomb 3D relief, high resolution 3D models, and cybermaps (Galeazzi et al. 98). After collecting the images using the Riegl LMS Z390i laser scanner they organized all the data and put it into a digital model (Galeazzi et al. 102). The digital model was texturized using different maps, in order to provide the different levels of perception (Galeazzi et al. 103). Different 3D models were outputted, first a 3D short movie and then a virtual system using an open source engine (Galeazzi et al. 103). This project forced archaeologists to re-think and rearrange the old way to make archaeological documentation (Galeazzi et al. 105). By increasing the amount of perception level of heritage through technologies, creates a way to preserve and educate the public about history (Galeazzi et al. 105). This project also proved that high resolution data capture has potential for preserving heritage sites at risk from construction (Galeazzi et al. 106).

The virtual world has helped in the study of documents and manuscripts because of the ability to scan them in and share them with their colleagues and collaborate together. With advancements in digital imaging and other technologies text become more legible and accessibility has become easier (Bowman, et al. 88). Large amounts of papyri and inscriptions have been digitized, delivered with metadata, and linked together by the APIS and EAGLE networks of projects (Bowman, et al. 88). Simultaneous presence and sharing of ideas are vital in the

progress of reading these documents (Bowman, et al. 88). The ability to meet in a virtual environment with the documents and inscriptions in front of them, researchers from all around the world at different universities can, at the same time, share their thoughts about them while collaborating with their colleagues (Bowman, et al. 88). This collaboration happens in a Virtual Research Environment (VRE) and more significantly to study these items they created a VRE-SDM which is the VRE for the Study of Documents and Manuscripts (Bowman, et al. 90). In the VRE-SDM there are tools that help in the aid of studying the artifacts. In most cases, documents are usually spread in different libraries throughout different countries that require different reference works and the virtual environment makes this possible (Bowman, et al. 90). Not only does VRE help archaeologists, but also other humanities, such as an English scholar working with manuscripts of a Jane Austen novel (Bowman, et al. 90). This is a great way to study documents because it allows people that cannot access them and it helps in their preservation.

Where Digital Archaeology is Heading

Digital archaeology is heading toward doing on site data entries in order to keep the errors, cost, and post-excavation down. Doing this allows data to be gathered with minimal errors and gives them more time to do research and collaboration. The article "On Site Digital Archaeological 3.0 and Cyber-Archaeology. Into the Future of the Past – New Development, Delivery and the Creation of a Data Avalanche" discusses how the advantages of both off-the-shelf technologies and new computer programs and hardware are developed specifically to solve archaeological/cultural heritage problems (Levy, et al. 135). OSDA begins by mapping material culture and any spatial information relevant to their research (Levy, et al. 135). With digital technologies there are also portable analytical tools, such as x-ray fluorescence (XRF) (Levy, et al. 142). The XRF can output the information about the elements that are in their samples (Levy, et al. 142). By doing post-excavation research on-site it allows for archaeologists to save time and have a smaller margin of error in data. Another post-excavation that can be done on site is 3D artifact scanning (Levy, et al. 145). To scan them the team used Next Engine laser scanners which are portable and inexpensive field operable units (Levy, et al. 145). With these tools archaeologists will be able to do some of traditional post-excavation during the fieldwork.

Furthermore digital archaeology is heading toward a more consistent way to find information and share that information. Sebastian Heath stated in his article "Diversity and Reuse of Digital Resources for Ancient Mediterranean Material Culture," that he is "interested in the sources of that information and how diverse entities contribute to, link to, copy or otherwise reuse resources that are discoverable on the public Internet" (Heath 35). He also wants to document how

museums, private individuals, publicly funded repositories, commercial enterprises and academic contribute to the ongoing process of sharing data (Heath 35). He believes that the roles of commercial and private initiatives in this development are not always acknowledged (Heath 35). One of the search engines used in academia is JSTOR, which is like Google in many ways, you do word searches to find the information you want. However, it is limited to those that pay for the information (Heath 46). JSTOR, only has articles that are scholarly reviewed journals (Heath 46). Museums are another way in which material culture is being shared in public domains. Museums "usually acknowledge that the fact and right of ownership comes with a responsibility to share information about their collections" (Heath 47). As with JSTOR the reuse of the material on their sites is limited because there is no direct copying of the images (Heath 48). So in order for the copying of the information onto a different site, you would have to provide a description on how you plan to use the information/image and a field for credit card information appears without being given a price (Heath 49). Scholarly sites, such as *Roman Amphoras: A Digital Resource* hosted by the UK's Archaeological Data Service (ADS) allow some reuse of their information, but only for educational purposes and after they agree to a terms and condition page (Heath 50). Heath believes that information should be deployed in such a manner that it can be easily found and be part of the public reuse and reinterpretation (Heath 51).

Conclusion

Technology has come a long way in the last fifty years of the 20th century. Now in the 21st, newer technological concepts are helping those in the social sciences and in other disciplines to build infrastructures that can help in the sharing of ideas, data, and research with many people throughout the world. With the idea of an infrastructure there are great potential to share data on the international level. The communicative properties of the instant have helped in this process and will continue into the future. Multimedia has raised dramatic possibilities for research, archiving, and publishing, but also raises some doubts. However, there are still great possibilities, even with the many challenges ahead to build the infrastructure for researchers in many different disciplines.

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