8-2024

Integrated Public Archeology: Innovative Three-Dimensional Modeling and Digital Storytelling Techniques for Historic Preservation and Outreach

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Innovative Three-Dimensional Modeling and Digital Storytelling Techniques for Historic Preservation and Outreach

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts in Anthropology

by

Bryce Drachenberg
University of Arkansas
Bachelor of Arts in Anthropology, 2018

August 2024
University of Arkansas

This thesis is approved for recommendation to the Graduate Council.

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Abstract

This thesis investigates the integration of digital methodologies in public archeology to enhance public engagement and historic preservation. Focusing on digital storytelling and three-dimensional modeling, the research demonstrates how tools like photogrammetry and ArcGIS StoryMaps can democratize archeological knowledge and involve wider audiences. A case study of Cane Hill, Arkansas, showcases the practical application of these techniques. The study highlights the creation of three-dimensional models and their integration into interactive StoryMaps, discussing the benefits, challenges, and future directions of digital public archeology.

Acknowledgements

Special thanks to Vanessa McKuin and Lawrence McElroy at Historic Cane Hill, Inc., for their permission and continued enthusiasm for this project. I extend my appreciation to my advisor, Dr. Jessica Kowalski for her continuous guidance throughout this process. I also extend my gratitude to my committee members Dr. Carla Klehm and Dr. Kirstin Erickson in the Department of Anthropology and the Center for Advanced Spatial Technologies at the University of Arkansas for their support. I also wish to thank Jared Pebworth and Micheal Evans at the Arkansas Archeological Survey for their contribution to this project. Everyone's support and expertise has been immensely valuable and influential.

Dedication

To my wonderfully patient and loving partner, Amanda.

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Chapter 1: Introduction

This thesis examines the use of digital methods in public archeology by focusing on digital storytelling and three-dimensional (3D) modeling to improve public engagement with historic preservation. The goal is to demonstrate how the field of public archeology can use digital tools to spread archeological knowledge and encourage wider public participation. The use of digital methods such as photogrammetry and geographic information systems (GIS)-based storytelling have been explored to meet these objectives. Photogrammetry allows for the creation of 3D models from two-dimensional photographs. In archeology, photogrammetry has seen increased use due to its relatively low barrier of entry in comparison to more expensive options like laser scanning (McCarthy 2014; Kaufman et al. 2015; Sapirstien 2018; Magnani et al. 2020; Ubik et al. 2022). Meanwhile, GIS-based storytelling platforms like ArcGIS StoryMaps (ESRI 2019) offer both dynamic and interactive ways to present and distribute archeological and spatial data (Cope et al 2018; Cortes Arevalo et al. 2020; Duan 2023). This thesis outlines the workflows involved in creating 3D models with photogrammetry and developing effective StoryMaps to present archeology through digital storytelling. In addition, this thesis argues how these tools have the potential to expand archeological knowledge into broader narrative-driven projects and how that can benefit public archeology. Moreover, this thesis outlines the history and development of public archeology theory, highlighting trends in changing attitudes towards public engagement and the democratization of information. The analysis provides a context for understanding the significance of integrating digital technologies in contemporary archeological practices. Finally, this thesis discusses the practical challenges and limitations of using digital methods in public archeology. This includes the technical requirements for photogrammetry, the need for digital data management and for preserving the integrity of that data, and potential

accessibility barriers for funding localized digital storytelling projects. Recommendations for overcoming these challenges are provided which prioritize the need for developing sustainable and user-friendly digital solutions.

Cane Hill, Arkansas is used as a case study to demonstrate the applicability of digital methods to public archeology. Cane Hill is a small town in Northwest Arkansas that contains numerous historic properties dating to the nineteenth century. Documenting these resources can demonstrate the practical and effective use of digital methodologies in the field of public archeology due to Cane Hill's transition to becoming a growing site of Arkansas historic preservation. The town's significance is highlighted by its role in early education as the site of one of Arkansas's first colleges and its diverse range of frontier industries, including pottery production and milling, which together contribute to its unique character. Cane Hill's well-preserved historic buildings and archeological deposits are perfect candidates for digital representation as they represent a distinctive Ozark tradition of pottery and have become the main draw for people visiting the museum, therefore digitizing these artifacts will aid in expanding outreach opportunities. Cane Hill is associated with Historic Cane Hill, Inc., a non-profit organization that focuses on preserving the historic buildings and other aspects of cultural heritage of Cane Hill and western Washington County while offering programs to engage with the region's history (Historic Cane Hill, Inc. 2024). Historic Cane Hill, Inc. operates a small museum, has a small staff of historic preservation specialists, and is actively engaged in public outreach activities telling local history. Although Historic Cane Hill, Inc. and the local community are engaged in historic preservation in the area, the reach of Cane Hill is limited in scope at the moment, being very local. Therefore, Cane Hill is an ideal case study to see how digital story telling can expand small organization's outreach efforts.

The sites and objects recreated using photogrammetry in this thesis were based on the historical context of Cane Hill. Cane Hill College was chosen as it is one of the town's largest and most notable features, and the J.D. Wilbur pottery collection is featured because of its significance to the region and value for the town's museum. Creating 3D models of this structure and objects and integrating them into an interactive digital storytelling project not only preserves the physical attributes of the buildings and artifacts digitally, but also increases the reach of this historical data within digital spaces by expanding its connectivity across broader educational and public contexts. The StoryMap created for this project will be available for public use and will be given editing permissions to Historic Cane Hill Inc. Continual editing will not only expand the potential of the StoryMap, but also allows the StoryMap to continue to benefit broader understanding of Cane Hill's history through new outreach and educational experiences for visitors, in-person and online. In short, Cane Hill as a case study for digital storytelling may lead to demonstrating the effectiveness of these techniques both in preserving and promoting cultural heritage and offering a useful framework for future public archeology projects, particularly for smaller local museums and non-profit organizations.

Scientific information has historically prioritized textual formats like academic articles that limit accessibility to specialists and loses the potential for broader public understanding of those topics. Effective outreach efforts require a shift in focus and this shift can be achieved through promoting publicly available digital data that bridges academic discourse and public interests. Digital storytelling has the potential to broaden the appeal of archeological research and inspire the public to become co-creators of that knowledge (Bollwerk et al. 2015; McDavid and Brock 2015; Rivera-Cortez et al. 2020).

Evaluating the potential of digital storytelling projects and the development of 3D models leads to several key questions about their implementation and sustainability over time, such as how can narrative-driven techniques be effectively integrated into public archeology? How can digital archeology projects be structured to engage and motivate public participation? How can photogrammetry and StoryMaps, or other narrative tools, be applied outside academia to facilitate interest in broader historical questions? Further howe can these tools support the goals of preservation and archeology? How might these projects be sustained over time? These questions, and more, also raise additional issues concerning ethics, privacy, ownership, and security of these newly distributed works. Addressing these questions requires reconsidering the configuration and long-term role of digital media within the scientific community. They also serve as a framework for both non-specialists and professionals to reflect upon when attempting to expand the impact of their work beyond traditional formats. While a perfect solution may not yet exist to increase public awareness through digital formats, we can still strive to advance our methodologies in these fields.

In the following chapters, I discuss the theoretical and methodological framework of digital archeology as public archeology. I provide a detailed methodology for digital archeological practices, present a case study of Cane Hill to demonstrate practical applications of these methods, and finally, explore the broader implications, limitations, and future directions of digital methods in public archeology. In Chapter 2, I review the foundational theories and current approaches in public archeology, highlighting the founding and the role of the Arkansas Archeological Survey in public archeology, as well as contemporary community-driven approaches to this field. Throughout the chapter, I examine various contemporary case studies to identify successful projects and challenges in current practices and propose a framework for

incorporating digital technologies to enhance public engagement in archeology. Chapter 3 outlines specific methodologies, focusing on photogrammetry and digital storytelling through ArcGIS StoryMaps. It provides a comprehensive workflow for creating 3D models using both object-based and aerial photogrammetry, as well as how to create ArcGIS StoryMaps. Additionally, it discusses the integration of these models into engaging digital narratives, and addresses technical challenges and solutions related to digital data management and its application in online spaces. Chapter 4 uses Cane Hill as a case study to demonstrate the practical application of digital methods in public archeology. This chapter details the historic context of Cane Hill, particularly focusing on its pioneer economy, the college and other significant sites, and the history of stoneware production in context to J.D. Wilbur. This chapter also introduces, and provides examples, for how to integrate interactive non-linear StoryMaps as a method to enhance public engagement with these storytelling formats. Finally, Chapter 5 discusses the contribution of the project to public archeology, various limitations encountered throughout its development and offers recommendations for future directions of research in the field of digital public archeology.

Chapter 2: Theory and Method in Public and Digital Archeology

In this chapter, I will review approaches to public archeology, discuss the role of the Arkansas Archeological Survey in public archeology as an example of institutional and volunteer partnership, and discuss future directions in this field. I will identify successful projects and potential problems with current public archeology practices by investigating various contemporary case studies. Finally, I will discuss digital approaches in public archeology, offering a theoretical framework for considering how to involve the public in interpretive spaces.

Public Archeology

Public archeology is defined as any endeavor where archeologists engage with individuals or groups not identifying as professional archeologists, encompassing research—whether practical or theoretical— that explores or analyzes the public aspects of conducting archeology (McDavid and Brock 2015: 12). From this broad definition of public archeology, any project that involves community engagement, promotes public awareness, or uses methodologies to make archeological findings more accessible to a wider audience has the potential to meet the criteria of public archeology. The goal of public archeology is varied and has changed over time. Education in the service of protecting cultural heritage, ethical obligations of professionals to communicate findings, and simply learning about past can be considered integral aspects of public archeology.

Since the time of Charles McGimsey's (1972) publication *Public Archeology*, approaches to engaging the public with the past have evolved. Once public archeology was directed toward the protection of what McGimsey called "a quickly disappearing non-renewable resource," namely finding solutions to protect archeological sites and material culture being lost to industrial development. Today, more recent approaches to public archeology attempt to engage in productive conversations with diverse communities connected to these resources. Recent approaches to public archeology encourage mutli-vocal interpretations of historic resources, emphasize ethical practices, and encourage increased democratization of the field or archeology (Shadla-Hall 1999; Merriman 2004; Moshenska 2008, 2010; Hauptman Wahlgren and Svanberg 2013; Richardson and Almansa-Sánchez 2015; McDavid and Brock 2015; Rivera-Collezo et al. 2020). However, to understand these changes in the practice of public archeology, it is important to both acknowledge and recognize the contributions of McGimsey's (1972) foundational work.

McGimsey's (1972) conception of public archeology is best defined by the following:

"It follows that no individual may act in a manner such that the public right to knowledge of the past is unduly endangered or destroyed." …and to this extent…"no one owns exclusive rights to an archeological object or data"…nor should any entity "possess the right permanently to deprive the public of any significant part of [their] heritage"… and therefore it is paramount for "the active practitioners of archeology, both full-time and part time…to educate the remainder of the public," to work towards the preservation of history (McGimsey 1972: 5 – 7).

McGimsey (1972) discusses the nature of the public's role in archeology, particularly the relationships between the amateur and professional. He writes, "archeology is exceptional among the professions in the degree to which persons without advanced degrees can and do contribute to the accumulation and interpretation of knowledge in the subject" (McGimsey 1976: 9). He argues that the educated 'amateur' or non-degree holding individual who has been trained by qualified professionals, must play an active role in bringing attention to the preservation efforts being made in archeology. It is the duty of the professional archeologist to understand the intrinsic motivations the public has for conducting informal or formal archeology, and to respect their individual rights to do so, while simultaneously making collective efforts to educate these individuals and enlist their aid (McGimsey 1972: 17-19). He acknowledges the responsible 'amateur' may have to work twice as hard to gain support and acceptance among professional communities, but their contribution in publicizing the importance of archeology to their communities is indispensable in the struggle to protect disappearing resources.

Public attention, and support from volunteers and archeologists for increased funds directed towards recovery and preservation of cultural resources, ultimately paved the way for legal action by the state, including establishment of the Arkansas Archeological Survey (ARAS) in 1967. McGimsey alongside Hester Davis, one of the original founders and station archeologist at ARAS, were able to mobilize strong support from legislators, community archeologists, and the

already established the Arkansas Archeological Society (AAS) (1960), to lay the groundwork for a state-funded Archeological Survey program. By 1967, Act 39 was passed establishing the Arkansas Archeological Survey with a structure and mission that remains largely unchanged today (Sabo 2017).

The ARAS focuses on preserving the archeological heritage of Arkansas while addressing challenges related to historic resources. In part, McGimsey's (1972) motivation for establishing the ARAS came from increasing rates of looting and damage to archeological sites caused by economic development and industrial-scale farming. These activities threatened the physical integrity of the sites and risked the loss of cultural heritage. To sufficiently address these challenges, the ARAS was designed to consist of regional research stations, typically staffed by one or two archeologists. Each of the 10 stations across Arkansas served as a focal point for archeological activities within its jurisdiction. The role of the station archeologists was to be responsible for familiarizing themselves with the sites and historic occupations in their area, including building and maintaining relationships with descendant communities, particular Native American tribes. Moreover, stations worked to educate the college and local residents about the ARAS, writing summaries of research gaps, identifying preservation needs, and offering new excavation opportunities for the public (McGimsey and Davis 1992: 42-43). Station archeologists work to maintain the special relationship between the ARAS and the Arkansas Archeological Society (AAS), by encouraging their involvement in field excavations and cataloging collections. This cooperation is important for fulfilling the workload needed to record sites, provide training programs, and further engage in outreach with the local area (McGimsey and Davis 1992: 44-45). In 1992, 20 years since the publication of *Public Archeology* (McGimsey 1972), the ARAS was successful in expanding the scope of public archeology through the establishment of the first

Certification Program for amateur archeologists. This program was initiated by Bob McGimsey and aimed to provide structured training and goals for participants to develop skills in the field. Over the years, McGimsey and Hester Davis report that more than 600 people registered for Certification (McGimsey and Davis 1992: 56-57). Practically speaking, a trained workforce of avocational archeologists could provide the labor needed for salvage operations, collections work, and ultimately, provide the support needed to make informed interpretations about the past. In other words, McGimsey's approach to public archeology was practical, closely entwined with the structure of the ARAS and the goals of historic preservation. Although the certification is now defunct, training avocational archeologists remains a critical component to station operations throughout the state.

Today, the ARAS continues to operate through a network of ten research stations. Each station is led by a station archeologist, and additional support from state archeologists, students, and research assistants. The ARAS functions as the central hub for archeological research in Arkansas, with its activities encompassing various domains, such as site discovery and recording, research across different archeological periods, and collaboration with external entities like landowners and government agencies. The ARAS mission encompasses educational outreach aimed at stimulating public interest and engagement in archeology, as well as maintaining close collaboration with the AAS. The ARAS is the primary repository for all state-funded archeological activities and records, and ensures the management of, preservation, and accessibility of those resources to both the scientific community and the public.

While closely entwined with the ARAS, the AAS is an independent organization, primarily composed of volunteers, and dedicated to preserving and studying Arkansas's archeological heritage. The AAS engages its members in activities that promote the preservation and awareness

of the past, aiming to bring recognition to history by sharing knowledge and encouraging community interest in preservation. The AAS advocates for the protection of archeological sites from destruction and vandalism and strives to educate about the lives of the people integral to Arkansas (Arkansas Archeological Society 2024).

The AAS, founded in 1960, prior to the Arkansas Archeological Survey, has been an exemplary example of amateur archeologists contributing to the literature and goals of the discipline without being full time practitioners. Since the 1970s, the newsletter *The Arkansas Amateur* (today known as Field Notes) along with peer-reviewed journal, *The Arkansas Archeologist*, have served as outlets where avocational archeologists can publish their research.

Much as in the past, today the Arkansas Archeological Society is an organization comprised of volunteers that offer support to the Arkansas Archeological Survey, host public outreach and education events, participate with archeological training programs, and host state-wide meetings and events as part of Arkansas Archeological Month. The mission of the AAS archeology month, in 2024, is summed up by the following announcement:

> Arkansas Archeology Month is an annual event designed to broaden the public's interest and appreciation for Arkansas's archeological resources and to encourage the public's participation in conservation and preservation efforts. Archeology Month is cosponsored by the Arkansas Archeological Survey and the Arkansas Archeological Society and is made possible through the efforts of supporters throughout the state at parks, libraries, museums, and other agencies and organizations, providing a wide variety of programs, exhibits, hands-on activities, and tours (ARAS Archeology Month Promotion 2024).

These outreach efforts adhere closely to McGimsey's (1972) vision by which the only effective way to enforce protection of historic resources is through the inspiration and involvement of private citizens in those affairs.

In addition to archeology month, AAS also hosts an annual training program, where students, society members, and other interested community members can participate in an excavation project augmented by seminars on a variety of topics. The training program is an excellent example of the partnership McGimsey envisioned, with professional archeologists from the ARAS training and collaborating with volunteers in a controlled setting. Notably, in 2023 and 2034, seminars or trainings at the annual training including 3D modeling and photogrammetry. These seminars are designed to increase interest and practical skills in archeology, but also connect public archeology with the digital humanities by utilizing technology-based techniques to explore and highlight contemporary archeological questions.

The model of partnership established by the Arkansas Archeological Survey still exists today, and other states have attempted to emulate it with varying degrees of success. However, this approach to public archeology might be considered somewhat narrow by today's standards. In McGimsey's (1972) view, the public is instrumental in protecting archeological sites and supporting the work of professional archeologists. McGimsey envisioned a structured system where amateur archeologists would be trained in ethical and modern field methods. While this system had successes and contributed to the goals of public archeology, it did not always provide a clear path to professionalization, nor was it intended too.

The focus on generating a large enough labor force to fulfill statewide contract and preservation projects was successful. However, as of 2024, on-site 'salvage' excavations led by the Survey are becoming less frequent, although the need for trained archeologists remains significant in areas such collections inventory, analysis, writing, and public outreach events. Professional attention has expanded from solely addressing and mitigating the loss of historic resources to also include questions of curation of collections, non-destructive archeological

methods, and repatriating ownership of those resources. This broader aim has significantly evolved the goals of the Survey. The shortcomings of McGimsey's approach are often discussed by contemporary experts (Shadla-Hall 1999; Merriman 2004; Moshenska 2008, 2010; Hauptman Wahlgren and Svanberg 2013; Richardson and Almansa-Sánchez 2015; McDavid and Brock 2015; Rivera-Collezo et al. 2020) argue that his approach was overly concentrated on recovery rather than empowering groups to contribute to the interpretation of that history. Nevertheless, McGimsey's work laid essential groundwork for the inclusive and sustainable practices seen today.

Early critiques of McGimsey's work argue that he underestimated the public's role in interpreting the past (Shadla-Hall 1999: 149). Expanding McGimsey's (1972) approach to public archeology, Schadla-Hall (1999:147) defined public archeology as "any area of archaeological activity that interacted or had the potential to interact with the public." This perspective considered McGimsey's approach to public engagement reserved, noting that while McGimsey (1972) addressed significant advancements in legislation and management of archeological resources, "he was surprisingly dismissive of the need for, and level of, public involvement" (Schadla-Hall 1999: 150). Although this statement is not a necessarily a fair assessment of McGimsey's work or vision, Schadla-Hall's (1999) work provides an example of the changing perception of the public's right and role in archeology.

As an example of the shifting perspectives on the public right in archeology, Schadla-Hall (1999) discusses the role of authenticity in relation to public experience and tourism. The authors discuss the reconstruction of Shakespeare's Globe Theatre Southwark, in London and the public's response to the project. The reconstruction aimed to recreate the historic theater as accurately as possible, which in turn prompted discussions among archeologists, historians, and other scholars about the authenticity of the reconstructions being made (Schadla-Hall 1999). Despite the ongoing

academic debates regarding the accuracy of the reconstruction, such as decorations and the overall authenticity of the experience, the public reception indicated that people valued the experiential and educational aspects of the project more than the technical concerns over historical accuracy. This dichotomy revealed a discrepancy between professional attitudes on adhering to strict 'positivist' approach and the public's interest in being able to access and engage with historical sites. The case study demonstrates that, despite differing concerns between the public and professionals in archeology, it is necessary to balance multiple perspectives on preservation. Balancing perspectives can increase awareness, appreciation, and support for these types of projects. In addition, listening to public opinion highlights the importance of making archeological projects relevant to them.

Shadla-Hall (1999) suggests that we "consider not only public interest in terms of protecting and recording the past but also ways in which we can both involve the public and make it possible for them to engage in many of the issues which we too often debate without reference to them" (Shadla-Hall 1999: 156). In essence, establishing a dialogue between the needs of both parties and recognizing that the management of historic spaces does not necessarily need to adhere strictly to the obligation of safeguarding preservation for scientific inquiry; rather, they can also reflect the desires of the community who resides in those spaces.

What McGimsey (1972) and Schadla-Hall (1999) works have in common is the tendency to define the 'public' as being a separate entity, in other words 'othering' those who are not considered part of the professional network of trained academics. In Nick Merriman's book, *Public Archeology* (2004), focus is shifted away from a perceived 'public' as existing alongside a recognized 'professional' sector of society. Previously, professionals were understood to be

actively engaged in facilitating initiatives on behalf of an interested or uninterested at-large public body for their collective benefit. However, Merriman (2004) contends the only characteristic of a perceived ‘public,’ is that of ‘not being professional archeologists’ and by eliminating this characteristic from the equation the ‘public’ would by any other measure not exist (Merriam 2004: 2). He suggests defining the public as various interest groups, including professionals and stakeholders, thereby allowing them to have agency to decide if their participation aligns with their interests and objectives.

To better understand this relationship, Merriman (2004) introduces two terms to identify common communicative methods used by professionals in their interactions with the public. The first is a traditional 'deficit model' which emphasizes the role of experts in enhancing public understanding of archeology (or any professional endeavor for that matter) for its economic and civic benefits (Richardson & Almansa-Sánchez 2015; Merriman 2004). In this approach, archeologists play a role in designing and executing projects, presenting ethical considerations behind findings, implementing modern data curation methods, and detailing the correct processes involved in site reporting and excavation. However, this long-standing approach (not dissimilar from McGimsey’s [1972]) is tantamount to perceiving the public as being separate; thus, the deficit model is often critiqued for its inherent hierarchical 'top-down' approach.

As an alternative, Merriam (2004) offers the multiple perspectives model, characterized by professionals recognizing the potential to supplement these deficits through expanding the democratic aspects of the discipline. The public becomes equal participants in the archeological process through the contributions of their own insights and feedback, rather than being passive recipients of information. Idealistically, the multiple perspectives model asks for a commitment from archeologists to genuinely listen to and engage with different communities about their

histories. However, community engagement still requires a certain amount of learning and guidance from professionals. Along with Richardson & Almansa-Sánchez (2015) and Schadla-Hall (1999), Merriman (2004) recognizes the conflicting nature of embracing diverse viewpoints while also safeguarding the integrity of archeological practices, while considering the dynamics of power, representation, and ethics in these approaches. Merriman (2004) sets a foundation for balancing the public's relationship with archeologists and history and establishes a thorough argument for later scholars to begin reinterpreting the goals of public archeology.

Gabriel Moshenska, a British public archeologist, builds on Merriman's (2004) multiple perspectives model by arguing the concept of the 'public' in archeology should be reimagined as a 'community.' Moshenska (2008) defines community archeology as revolving around the needs and actions of non-professional individuals or groups who wish to "investigate the archeology of their local area or other areas of interest or importance" (Moshenska 2008: 52). In this slight reassessment of public archeology, the author agrees with ideas shared by Merriman (2004); Katty Hauptman Wahlgren and Fredrik Svanberg (2013); Richardson and Almansa-Sanchez (2015); and McDavid and Brock (2015) that suggest that professional archeologists and academics should not try to overshadow community-led projects and efforts. Instead, professionals should collaborate with and prioritize the "needs and interests of the community as its starting point, rather than existing research priorities" (Moshenska 2008: 52). For example, rather than imposing their own research priorities, archeologists should support a local community museum's initiative to document and preserve its own heritage. The author's reasoning is that implementing bottom-up and community-led initiatives assists in granting individuals agency to develop the necessary skills and experience for higher-levels of project management. Community-led initiatives are necessary since "history" as a concept is a space of

contestation, in that narratives have transformational power where communities are affected by the telling of those histories (Richardson & Almansa-Sanchez 2015).

Lorna-Jane Richardson and Jaime Almansa-Sánchez (2015) evaluate the intersection of archeological practice, theory, public engagement, and societal impact. The authors emphasize public archeology's dual nature as both a methodological approach that engages with various publics and a theoretical stance which advocates for representative access to heritage and knowledge construction (Richardson & Almansa-Sánchez, 2015: 194-211). Central to their discussion is the recognition that choices made in public archeology are inherently political acts and therefore are shaped by, and must respond to, societal, political, and economic contexts (Richardson & Almansa-Sánchez 2015: 206; Matsuda and Okamura 2011: 6). Overall, these contexts emphasize the importance of developing ethical practices, because within the field of archeology and history, all questions and answers must contend with human beings (Richardson & Almansa-Sánchez 2015: 206). Richardson and Almansa-Sánchez (2015), along with Moshenksa (2008), support the notion of transforming archeology into a collaborative laboratory, where the idiosyncrasies of the ‘community’ can be channeled ethically, to democratize the production and dissemination of knowledge across various contexts and groups. In American archeology, this style of multi-vocality has lagged significantly behind its counterparts in Europe, therefore I will draw upon Sweden’s Katty Hauptman Wahlgren and Fredrik Svanberg (2013) project which showcases how a museum can take on the challenge of redirecting historical narratives surrounding their collections to reflect the needs of the community.

To develop a multi-vocal and collaborative approach, the authors invited community members to become an archeologist for a day where they could bring in their own artifacts or

participate in excavating the rich material history beneath the museum's courtyard (Wahlgren and Svanberg 2013). On another occasion, they invited school-aged students to excavate and formulate research questions surrounding a twentieth-century farm building in Hjulsta, Sweden. Adopting similar theoretical strategies as Schadla-Hall (1999), Merriman (2004), Moshenska (2008), the authors argue for shifting traditional museum practices towards a more inclusive and democratic approach, raising important questions about the role of museums in the community, such as who is authoring the "historic authenticity" of items and the politics surrounding how these histories are affecting representation. Hauptman Wahlgren and Svanberg (2013) demonstrate how museums can become more responsive to local community history by reexamining the museum's own collection through the artifacts that were brought in or unearthed by the participants. This approach ultimately opened a dialogue between the newly appointed community archeologists and the museum specialists surrounding the narratives behind each object and the future organization of their collections.

Providing the public with the agency to craft the future outcomes of the museum's collection and allowing individual narratives to be recorded in the museum's database, revealed a core inequality in the system. Why are some items considered valuable for their historical insight, while others are deemed to be unworthy of attention (Hauptman Wahlgren and Svanberg 2013: 243-244)? The project was conceived to challenge conventional museum practices that have historically defined a criterion for what to curate and collect, such as classifying hierarchies of importance between objects and deciding which information is significant enough to be recorded (Hauptman Wahlgren and Svanberg 2013: 248). The authors conclude that by adopting a strong public influence in archeology, a museum can "become a facilitator for historical interest rather than the sole authority over objects." They discuss the importance of developing a

more egalitarian system of collaboration, where the public becomes "co-producers rather than just visitors" to the museum. By democratizing certain aspects of public archeology, they showed the potential of being more introspective, leading to uncovering "hidden histories" which may have been otherwise ignored (Hauptman Wahlgren and Svanberg 2013: 202; Walsh 1992). As I will discuss next, co-creation has become an important aspect in public archeology, and is a critical component of developing online spaces for storytelling.

In *Co-Creation and Public Archeology* by Bollwerk et al. (2015), the authors argue if public archeology is to succeed it must adopt a collaborative approach that involves sharing power and creative processes between archeologists, communities, and other stakeholders to nurture more reciprocal relationships. Drawing upon their experiences hosting public conferences in Mississippi during archeology month, they found that by adhering to the criteria of 'co-creation'—defined as an act of sharing power ('co') to innovate new methodologies and outcomes ('creation')—topics and discussions could be tailored to each group's concerns and curiosities. They noted that maintaining a co-creative mentality redirects attention towards providing a productive space for open and reflexive communication between stakeholders (the public) and professional archeologists.

Rivera-Collazo et al. (2020) presents a case study in Puerto Rico that addresses how co-creation and training citizen scientists for archeological projects can be structured, by offering in-depth educational and hands-on experience for students and community members. Opting for the term 'communal archeology' – defined as pertaining to two or more engaged, self-defined communities, who together form a dialogic space for knowledge to be owned and shared – Rivera-Collazo et al. (2020: 131) characterizes their redefinition of public archeology as being anticolonial, open-access, and heterarchical. The research team adopted an Informal Science

Education (ISE) model that offers participants three levels of contribution, each with their own role and responsibilities: Contributors, Collaborators, and Co-creators. In brief, contributors primarily do field work gathering and recording information, collaborators engage deeper with that data by analyzing it and being involved with decisions related to the project, and finally co-creators work in conjunction with the head researchers to formulate hypothesis and publicize their results. Spearheaded by Para la Naturaleza (PLN), their primary goal was to investigate the effectiveness of ISE practices in developing Hispanic Citizen Scientists, by implementing the strategy within a project called "Unearthing our Roots." This investigation aimed to demonstrate whether open channels for equitable involvement by the public, particularly local decedent communities, would further encourage participation in archeological research and provide a space for facilitating their understandings of the findings.

If an individual wishes to become a 'Citizen Scientist' then they must first show the same ethical standards as defined by professionals in archeology and, second, follow through on the questions and outcomes of their own research. Interestingly, their findings indicated that many of those who became citizen scientists often felt as having a dual identity as both community members and pseudo-researchers. They found through the simple act of labeling someone as a 'citizen scientist' introduced unintentional biases by distinguishing them from 'real scientists,' harking back to the criticism faced by McGimsey's (1972) approach to public archeology. This phenomenon contributed to negatively impacting participants' perceptions of their own abilities and research outcomes. To counter the divide between the specialists and the public, the research team made efforts to find opportunities for participants to yield their own contributions to the program, but ultimately were unable find a fully satisfactory outcome. Addressing their own mixed feelings and reflections on the project, the researchers remarked that while teaching

archeology outside of academia is greatly beneficial there will always be concerns about untrained individuals conducting excavations on their own. Moreover, they agree there are forms of archeological research that the public can participate in, which can certainly enhance ongoing research and benefit the public (Rivera-Collezo 2020: 128-129).

Encouraging co-creation has become a primary objective for contemporary public archeology projects, in that as these case studies reveal (Hauptman Wahlgren and Svanberg 2013; Bollwerk et al. 2015; Rivera-Collazo et al. 2020) researchers are interested in facilitating channels for open communication and even the professional development of individuals. However, managing these channels for shared collaborations and ownership of research may be effective within controlled settings like formalized meetings and excavation sites where specialists are present and directly working with community members. In less regulated spaces, such as those online, these channels can quickly lose their integrity. Building upon Bollwerk et al (2015) collaborative approach to public archeology, McDavid and Brock (2015) emphasizes the role of co-creation in online spaces to develop active communities concerned with archeology as a method to spread and disseminate historic and cultural information. They caution that social interaction within online spaces varies greatly from physical settings, citing that the utilization of social media can change significantly between individuals, where the power of being anonymous can influence communication and ultimately reduce the credibility of narratives developed in these spaces (McDavid 2015; Nolan 2012; Turkle 1984, 1995). These issues are certainly relevant, if not heightened, in today's media landscape, and will remain a divisive component in digital public archeology. McDavid and Brock (2015) suggest developing reflexive strategies such as increasing transparency surrounding the background process of creating knowledge, but note that the human resources needed to adopt such strategies within a sizable online space is

unlikely to be fully realized (McDavid and Brock 2015). Therefore, if co-creative activities are to be successful online, then we must develop controlled outlets where the production of knowledge can be regulated, while also granting the public—whether descendants, communities, or professionals—a meaningful share of control in the dialogues being shared.

The "Unearthing our Roots" (Rivera-Collazo et al. 2020) project and "Co-Creation" (Bollwerk et al. 2020, McDavid and Brok 2015) case-studies reveal how scientific non-academia-orientated education can serve as a communicative tool to connect scientists as knowledge holders and the public as knowledge consumers, but in doing so raises additional challenges. The goal should not be to assimilate community members into the objectives of academia or archeology, but rather to inculcate their interest in scientific endeavors and develop a respect for the knowledge they share and produce. Earlier practices in public archeology focused on inviting the public to participate in archeology as contributors to the needs of the academy or efforts being made in CRM (McGimsey 1972). Public archeology later evolved into understanding the public as knowledge producers, who should be given agency to affect the varying discourses surrounding the past (Schadla-Hall 1999; Merriman 2004; Richardson and Sanchez 2013). This understanding of the public gave rise to attempts to create more inclusive and democratic research models, which aimed to not only give a voice to the public, but also allowed them opportunities to participate holistically in the production and distribution of knowledge (Hauptman Whalberg and Svanberg 2013, Bollwerk et al 2015, McDavid and Brock 2015; Rivera-Collezo et al 2020).

What these studies do not show, however, is how the changing demographics in archeology will affect the methods in which co-creation will be achieved. For instance, the socio-economic status of participants is a key factor to consider when asking groups or communities to

contribute to online projects as access to computers, internet, or software is not always equally available. Secondly, they do not consider whether these co-creative approaches will be effective at inviting younger voices to participate in these discussions and projects, an increasingly salient problem as seen by the aging cohort of active members in the AAS. When discussing the viability of digital co-creation approaches, it may be important to address how younger individuals navigate and understand online spaces today, such as what type of content they would be interested in co-creating with archeologists, or what type of media will actively engage their attention. My project attempts to address these issues by integrating enticing technologies like 3D modeling (discussed further in chapter 3) with modern digital story telling approaches which allows for further creative personalization of one's research and for digestibility of that information that can be readily shared.

The goals of public archelogy have continued to steer away from 'top-down' approaches, but by doing so have also introduced new challenges, occupying a multifaceted problem which integrates consistent professionalism, ethical standards that reflect involved communities (ethnicity, socioeconomic status, gender etc.), and responsible consideration of privacy, ownership, and historical narratives. In practice, solving these difficulties will not be easy to accomplish. Developing a formalized online digital outlet can create a collaborative space where diverse voices contribute to an understanding of the past. In the next section, I will discuss digital resources as public archeology and how these digital resources can be used in an integrated, dynamic, and modern take to public archeology.

Digital Archeology as Public Archeology

Digital archeology includes advanced digital technologies, such as 3D modeling, geographic information systems (GIS) and remote sensing to document, analyze, and interpret

archeological data. Furthermore, digital archeology involves the preservation of digital objects and the analysis of the impact on contemporary and historical contexts, exploring how these digital environments can undergo processes that influence and shape their significance (Kansa and Kansa 2021: 1594). Digital storytelling, on the other hand, integrates text with visual and interactive elements to enhance engagement and understanding. This method is increasingly used by researchers to effectively communicate their findings to a broader audience, including both scientific and non-scientific communities (Figueiras 2014, in Cortes Arevalo et al. 2020:1014). In the context of public archeology, both digital archeology and digital storytelling are complementary resources that aim to enhance and publicize our understanding of archeological knowledge. The former focuses on the study and maintenance of digital data, while the latter translates those findings into narratives that resonate with wide-reaching audiences. Together, they provide an avenue for democratizing access to archeological knowledge and further promoting its relevance in society.

However, democratizing archeological knowledge through digital means is not without challenges. The ability to navigate access, distribution, and control over these works is crucial for the continued success of this endeavor. Huggett et al. (2018) discusses the importance of balancing quality assurance, participation, and transparency within online spaces to maintain credibility, while successfully finding frameworks to incentivize involvement in digital projects. For example, examining whether these works should operate in a controlled environment where standardized practices and oversight always ensure reliability, or if they can have the flexibility to promote broader participation and sharing, but lead to challenges of factual consistency.

Hugget et al. (2018) introduces four conceptual frameworks or approaches developed to better understand the diverse strategies employed in the dissemination of academic information online, particularly in the field of archeology. These frameworks range from fully democratized to privatized approaches. These frameworks include the Ministry of Digital Orthodoxy, the School of Digital Citizenship**,** the Academy of Digital Advancement, and the Commune of Digital Anarchism which perfectly reflects its namesake advocating for a decentralized and self-regulated approach, mirroring popular content creation and sharing communities like YouTube, GitHub, and Reddit. Here I review the Ministry of Digital Orthodoxy and the School of Digital Citizenship as these frameworks directly related to this thesis and the intersection of public and digital archeology.

The Ministry of Digital Orthodoxy represents a formalized and structured approach to the use of digital technologies in archeology. Emphasizing standardization, this approach advocates for qualified knowledge producers to be the arbitrators for data collection and distribution and ensure stricter adherence to proven methods. In other words, formal scientific investigation should remain within control of the academy, resembling a traditional top-down approach in the handling of digital data. Furthermore, under this framework any digital tools adopted by or advocated for in the scientific community should be regulated to maintain professional standards. A good example of this approach in Arkansas archeology is the Automated Management of Archeological Site Data in Arkansas (AMASDA) database which requires permission to access and follows strict guidelines for the inclusion of new data. While this approach ensures quality and reliability of data, it does limit flexibility and creativity for outside contributors, or non-professionals.

In contrast, the School of Digital Citizenship emphasizes inclusivity and public engagement. Here, digital tools are democratized or open to a large and diverse group of constituents, allowing for a broad spectrum of participants to contribute to archeological projects. This approach values open-access data and collaborative platforms where citizens and professionals alike can contribute to and learn from the archeological record. The success of digital public archeology projects hinges on the willingness and active contribution of enthusiasts in online content production, such as digital storytelling or 3D models of artifacts and historic places. Often times, busy researchers and universities do not have adequate funding or availability to reliably focus their attention on small-scale historic preservation projects opting instead to focus their resources on projects that will have more substantial outcomes or offer the possibility of national grant funding.

Generating broad appeal for these projects will require enlisting the help of the interested public, whose various backgrounds and expertise can not only produce research that professional archeologists are unable to focus on but also produce potentially high-quality content that aspires to meet professional standards and has the potential to be impactful. However, where this approach differs from the others, is the expectation that these contributors will have an active personal interest in the projects they are working on, and therefore be willing to collaborate closely with experts. To further support this notion, let me draw attention to a quote from the article in which he discusses the community of individuals existing within the framework of the School of Digital Citizenship:

> "These are people who are prepared to altruistically give up their time and talents to be guided by, and to assist, experts in order to discover, uncover, reveal and share our national cultural patrimony and common heritage, ideally on a shared, open, and easy to use infrastructure to maximize the social benefit. In the process, the digital archeologists behind the

prospectus now have much greater freedom to fulfil a broader number of roles in the design, creation and delivery of new digitally enabled vehicles which extend the range and the reach of archeology." (Hugget et al. 2018: 48)

There are some problems with this approach. Alternative interpretations of data outside the standard set by museums or academics, and the potential for inaccurate or poorly sourced data are risks associated with the school of digital citizenship as a public archeology approach. The tension between alternative history, pseudoarcheology, and the academy will always be present when narrating the past and presenting historical discourses. Universities and museums have traditionally functioned as custodians of historical knowledge, due to their dependence on evidence-based interpretations which help build a reliable understanding of the past. However, the rise of the internet and other digital presentation outlets has expanded access to potential misinformation and empowered people to become self-proclaimed experts, or archeologists. Expanding digital footprints can lead to fringe theories and misinterpretations. Pseudoarcheology, for example, may use cursory evidence to support and embellish outlandish claims about the past. This potential not only undermines the credibility of legitimate research in archeology but can also distort perceptions of the past and have a negative impact on decedent communities.

In response to the questions of who narrates the past. Stanly-Price (2006) attempts to reconcile this dilemma. He asserts that 'ownership of the past' is passé, stating that the narration of history is inherently political and resides in the domains of memory, shared identity, power, social justice issues, and legal and economic tensions (Stanly-Price 2006: 39-40). Addressing these multi-faceted domains of interpretations and their ethical quandaries is no doubt complicated, but vital when developing digital storytelling and public archeology projects. The need for protocols and guiding principles, like those outlined for researchers conducting

fieldwork in cultural anthropology or writing ethnography (American Anthropological Association 2012), ensures ethical responsibility, necessary permissions, and inclusive perspectives are each respected. To assist in navigating these quandaries may require integrating a system of approved public peer review for digital content that assists with maintaining the integrity and accuracy of the narratives being presented. While many of the dilemmas posed by Stanley-Price (2006) may be resolved by engaging in dialogue with the involved communities and obtaining permissions, this issue will continue to be relevant for any organization to consider before publishing on storytelling platforms.

However, even after resolving these domains, there still exists the challenge of ensuring the long-term sustainability of the chosen online platforms for producing and distributing storytelling projects. Establishing partnerships with academic institutions, public organizations, and technology companies can provide the necessary resources and expertise to maintain these platforms. This includes addressing issues such as platform stability, data preservation, and ongoing accessibility to ensure that these narratives remain available and intact over time.

A key concern is the longevity of published works, such as the potential discontinuation of web services like ArcGIS StoryMaps or the disbanding of teams responsible for maintaining and supporting these platforms. Smaller-scale web services like Terrastories (2024) face a higher risk of losing development teams over time due to factors such as lack of funding, waning interest, or competition with larger online platform providers like Environmental Systems Research Institute, Inc. (ESRI), a relatively stable industry standard. These uncertainties raise questions about the long-term accessibility and preservation of digital storytelling projects. Without reliable and sustained support, valuable archeological narratives may become

inaccessible or lost. These practical points are important when planning the development and maintenance of a digital storytelling project for public archeology, and will rely on increased data literacy, cooperation with state organizations or universities, and some expertise in the field of computer sciences.

A potential solution to long-term development and maintenance problems may require university institutions such as ARAS or public organizations like AAS to secure funding for a specific product which can then be used exclusively for all storytelling projects and has the potential to be shared with museum partners. Deciding on which service will be the best fit over an extended period of time is an important factor to consider. Unless user demand for StoryMaps decreases because of the widespread adoption of a new digital storytelling platform, there does appear to be an inherent risk in ESRI shutting down their StoryMaps service since the company is already strongly established in the geospatial industry and will likely maintain consistent development of their products. Therefore, an ongoing account with ESRI, a service that the University of Arkansas faculty and students already pay for the licensing to use, is a safe option if not completely ideal.

Scaling up digital storytelling projects may involve collaborating with state-run organizations to secure funding and ensure long-term sustainability. While initially challenging, this approach can broaden access and increase attention toward new public archeology projects. However, the accumulation of new digital data will also pose challenges in data management and project prioritization. This will manifest in decisions regarding what information is collected (Nolan 2020) and the development of an infrastructure to manage that data (Kansa and Kansa 2021). Nolan (2020) suggests a selective approach to information processing, using Information

Theory (IT) to quantify valuable information in the archeological record. He advocates for evaluating each site's potential to uncover new information and emphasizes the need for an evaluative method focusing on humanistic significance, especially for oversampled resources (Nolan 2020: 1192). Nolan's approach distinguishes between "information" and "data" to reduce redundancy and achieve more constructive results for archeologists and Cultural Resource Management (CRM). While not directly addressing 3D data or digital infrastructures, Nolan's (2020) critique of CRM challenges current data and information management practices, potentially informing the future of artifact digitization. Applying Nolan's (2020) approach to 3D data suggests it should be assessed for relevance and utility to a particular community or society in general. This perspective suggests that 3D data, if used managed appropriately can enhance narrative and informational depth by evaluating the effective contribution that each digital publication project will supply.

Kansa and Kansa (2021) raise the issue of how archeologists manage digitized artifacts within digital infrastructures. The authors argue for a collaborative approach between archeologists and computer scientists to increase understanding in managing and interpreting digital artifacts. They suggest that training and such collaborations could lead to user-friendly interfaces for outreach efforts and more efficient management of digital content and databases. In their work, they draw upon Aycock (2021) to discuss the challenges of future-proofing digital archives. Speculating that with an expanded volume of digitized resources will increase the importance of making digital content accessible and intelligible for reuse. For instance, file hosting sites like Sketchfab (2024) and Nira (2024) may offer a temporary solution for data management, but there is a need to explore third-party infrastructures tailored to the needs of

public archeology and the digital humanities. Deciding upon a widely adopted file-hosting service could provide a foundation for archiving and allow for easier revisions of that data.

Mitigation of ‘unauthorized’ interpretation of historic information or ‘bad’ data in general could be solved by setting standardized protocols for publishing new digital data. These protocols could certainly be manageable at a small-scale as it would only require a small team or an individual to run checks on the published material. However, at a large-scale this issue will become more challenging and will likely require either state-department teams or opening new jobs where individuals work to moderate published content. Although it must be kept in mind that no amount of moderation will prevent all inaccuracies and by increasing barriers of entry through excessive moderation will only disincentive participation, leading back to the initial problems posed surrounding exclusivity with specialist publications and encouraging involvement in public archeology. Unwanted material will inevitably flow through the cracks, but this does not necessarily mean a complete collapse of integrity or a descent into anarchy. Rather, if advertised properly and supervised appropriately as educational material which is supported and backed by reputable names, then the ‘altruism’ of the public trust as described by Hugget et al. (2018) will address many of these issues.

In this chapter, I have reviewed various approaches to public archeology. Tracking the shift from traditional, top-down methodologies to more inclusive and community-centered models. Key approaches include McGimsey's (1972) foundational work on integrating public involvement in archeology, Schadla-Hall's (1999) emphasis on listening to public input, Merriman's (2008) redefinition of 'public' as diverse interest groups, and Moshenska's (2008, 2010) community-focused archeology. I have also explored contemporary practices in co-

creation and communal archeology, which advocate for sharing power and creative processes between archeologists and communities (Hauptman Whalberg and Svanberg 2013, Bollwerk et al 2015, McDavid and Brock 2015; Rivera-Collezo et al 2020). These approaches collectively show the importance of democratizing archeological practices to make them more accessible and relevant to diverse publics, by contributing their input on how to develop a holistic and integrated approach to public archeology.

In addition, I have identified several pitfalls and challenges in digital archeology, such as the ethical dilemmas of narrating history (Stanly-Price 2006) and the technical difficulties of maintaining platform stability and data preservation (Nolan 2020; Kansa and Kansa 2021). Furthermore, issues like ensuring accessibility and inclusivity in digital projects were considered, particularly with the challenge of integrating digital tools into existing frameworks in a way that enhances rather than detracts from traditional archeological methods.

To accomplish this task of integrating digital technologies and public archeology, the particular approach focus of this project is with collaborating with community stakeholders interested in archeology. I aim to create shared historical narratives that work to expand the reach of archeology through the use of digital storytelling projects. By creating digital storytelling platforms for public participation with accessible avenues for entry, such as ArcGIS StoryMaps, we can encourage community members to actively engage with and contribute to archeological projects. This approach not only creates outlets for digital data, but also helps manage that incoming data, so as not to be stuck indefinitely in backlogs. Lastly, increased participation enables communities to take an active role in interpreting and sharing their perspectives surrounding their own histories. In essence, by leveraging digital tools, we can create a more

holistic experience with archeology that resonates with a broader audience, particularly with those who are younger or those interested in computer technologies more than traditional excavation. This, in effect, both encourages their ongoing involvement in future projects and helps increase data management overall. In Chapter 3, I present methods and workflows for applying digital methods in public archeology, focusing primarily on the methods surrounding photogrammetry and three-dimensional rendering, and StoryMap construction.

Chapter 3: Methods in Digital Archeology

As discussed in Chapter 2, I suggest that digital outlets, or methods in digital storytelling can be used as part of an integrated approach to public archeology. In this chapter, I will discuss specific types of digital data including three-dimensional (3D) models created through photogrammetry, both object-based and through drone platforms. I will present a methodology for collecting these kinds of data, then explore how to integrate these data into StoryMaps, addressing narrative and organizational challenges for developing effective multi-media presentations. I aim to show how these digital tools are both feasible to learn for non-specialists, and how if implemented correctly they can enhance the experience and perceptions of archeological data. Lastly, I will discuss specific challenges with digital data in relation to public archeology and digital spaces.

Photogrammetry

Photogrammetry is a technique that uses overlapping photographs to create 3D models and maps of physical objects and environments. Since entering the consumer market, photogrammetry has seen extensive exploratory use across multiple fields of research and industry. The ability to utilize off-the-shelf equipment and software creates a relatively low

barrier to entry in photogrammetry. Because of this perceived ease-of-use, photogrammetric methods have also attracted many archeologists such as (McCarthy 2014; Ubik 2020, Kingsland 2020; Magnani et al. 2020) to find ways to apply it towards efforts in heritage and public archeology. For instance, McCarthy (2014) explores the use of photogrammetry in heritage projects, demonstrating its effectiveness through a case study with the Young Archeologists' Club in Scotland, where participants as young as eight years old successfully created detailed 3D models of historical gravestones. Kaitlyn Kingsland (2020) evaluated the accuracy and processing capabilities of various photogrammetry software. Ubik et al. (2022) highlighted the importance of digital tools in heritage studies by developing Interactive Heritage 3D (IH3D), a platform that allows institutions to host interactive 3D models, enhancing public engagement and educational opportunities. Their work is significant because it simplifies the integration of 3D technology into heritage preservation, making it accessible for smaller institutions and promoting the interactive exploration of cultural artifacts.

The use-cases of photogrammetry are no doubt abundant; therefore Matthew Magnani et al. (2020) has provided a comprehensive outlook on the current state and future of photogrammetry. *The Digital Revolution to Come: Photogrammetry in Archeological Practice* (2020) covers the contributions and challenges of using photogrammetry in archeological research. They draw from case studies detailing the benefits of having a cost-effective and accessible means to create 3D visual representations spanning from sub-centimeter analysis on artifacts to larger GIS-orientated coverage of landscapes and archeological features (Magnani et al. 2020: 737-738). Magnani et al (2020) believes in the transformative potential that photogrammetry brings to archeology, such as further democratization of data production, but argues there is a strong need for innovative analytical techniques to fully harness its capabilities. They found that of the 96 research

publications in 2018 photogrammetry, nearly all only focused on its ability to offer a versatile means for data production with a relatively low learning curve. Significantly, underutilizing its potential for developing novel analytical questions and demonstrating creative uses for 3D data (Magnani et al. 2020: 743).

For example, of the major concerns cited about the trajectory of 3D data, object-based photogrammetry is targeted most heavily. They argue this technique has yet to find conclusive groundwork to transition from studies detailing its technological advantages and capability to generating more practical applications of the produced models. Furthermore, it's not understated that object-based photogrammetric methods must now contend with structured-light and laser scanners which have continued to decrease in price and improve in performance, challenging its utility directly (Magnani et al. 2020). Aerial photogrammetry, on the other hand, is more promising. It offers a user-friendly and reliable way to access sites and quickly generate high quality textures and digital elevation models (DEMs). However, aerial methods are not without their own hurdles, the use of sUAS specifically has seen increased limitations due to legal and logistical mandates (Magnani et al 2020: 748). For instance, this decreased accessibility can be seen by the recent American Security Drone Act (ASDA 2023), included in the National Defense Authorization Act for. Effectively restricting Chinese manufactured drones (such as the popular brand DJI) for commercial and research purposes.

Despite these limitations, photogrammetry is still actively pursued by researchers for field documentation or to promote the potential for cultural heritage applications and community outreach. Magnani et al. (2020) stresses the need for the archeological community to explore the capabilities of photogrammetry. This might include the potential for virtual reality platforms, 3D

printing, educational applications to further enhance the utility of the technology and to broaden the questions we ask of 3D datasets. Although progress has been slow in these areas, Magnani et al. (2020) along with McCarthy (2014), Ubik (2020), Kingsland (2020), Kansa and Kansa (2021) are optimistic for the future of photogrammetry, agreeing that anthropology and cultural heritage are the most promising avenues for significant contributions in further democratizing science and facilitating broader community involvement. In short, there will be a catalyst for a 'digital revolution' in archeology to happen, but there is still no certainty if photogrammetry will be the key to that revolution unless the focus shifts from the technology itself to its practical applications and creative purposes.

Photogrammetry remains at a crossroads in determining whether it will revolutionize aspects of public archeology, the digital humanities, or museum studies. While it shows promise in each of the applications described above, what has become increasingly apparent is the lack of a cohesive schema for small-scale utilization and distribution of artifacts in digital space. For instance, organizations with institutional support such as the Center for Spatial Technologies at the University of Arkansas or CyArk (CyArk Projects 2024) have the resources to draw public attention by creating customized websites that can both display digitized models within larger immersive landscapes and to create interactive presentations within those environments. Unfortunately, this type of infrastructure is not widespread among the humanities, leading to most 3D models ending up on Sketchfab, Nira, or hosted by internal file readers like 3D Heritage Online Presenter (3DHOP) (Computers & Graphics 2015), which also increases the potential for the website displaying the model being defunct or unoptimized to viewers. While services like Sketchfab offer free options to embed their content into various websites, it must be noted that simply viewing a 3D model in a media box will likely not have immediate appeal to audiences

and will require creative solutions to enhance its presentation. Therefore, the focus should be on the development of both innovative and organized ways to distribute 3D data and to draw genuine interest from wider audiences to engage with that data.

Photogrammetry Workflow

In this section, I will detail each step of the process, from capturing images to generating 3D models. The discussion will cover equipment selection, including the types of cameras, drones (sUAS), and photogrammetry software used during my project. I will cover the step-by-step method I used for capturing images, specifically utilizing turntable scanning, to ensure complete coverage and clarity of the subject. In the aerial photogrammetry section, I will discuss the preparation and safety requirements for using drones, including FAA certification and compliance, as well as the process of sUAS imaging. Additionally, I will describe the methods for processing these images in Agisoft Metashape, including aligning photos, generating point clouds, creating meshes, and applying textures to produce 3D models. Through this overview, I aim to provide a clear and detailed workflow to effectively do photogrammetry for both object-based and aerial scans.

The workflow for turntable scanning, as documented by Kaufman (2015), involves specific techniques for achieving optimal photographic results. This section introduces the processes used and discusses basic methods and tools. The essential tools required are a high-resolution camera, a turntable, adequate lighting, and a backdrop. A professional-grade electronic turntable is recommended for 3D scanning due to its precise rotation measurements and stable, shake-free platform. However, a ‘Lazy-Susan’ style table is typically sufficient and may be preferred in public or museum settings. Lighting facilitates quicker photography and

increases scan quality. Two standard incandescent floodlights, along with ambient light from the room and windows can be used to reduce shadows and increase shutter speed. Proper light management is necessary to avoid overexposure and glare. Common solutions to glare include using diffusers or increasing ambient light, in some cases an outdoor setup is necessary. In my experience, most glare issues were resolved during the photo alignment phase with the photogrammetry software. Lastly, a backdrop should be used to isolate the subject and provide a contrasting background. Bright greens or blues are commonly used for masking due to their easy detection by software, although they can cause color bleed. A black velvet backdrop is recommended for consistent contrast and minimal light reflection.

The final tool to be considered is the camera. Selecting a camera and lens involves choosing between factors such as sensor size, megapixels, focal length, and lens sharpness and clarity. Recent advancements in camera technology have introduced high-resolution mirrorless sensors, with major brands like Nikon, Sony, Canon, and Fujifilm offering consumer-priced systems. The choice between full-frame, APS-C, or Micro Four Thirds sensors depends on user preference and utility. Most consumer and prosumer cameras offer 23–40-megapixel sensors within an affordable price range, which will be sufficient for photogrammetry. Arguably, Lens selection is more important for subject clarity. A fixed prime lens is recommended for increased photo sharpness and focus accuracy. A lens with a focal length between 35mm and 70mm helps limit photo distortion, which is important during the alignment phase. If a prime lens is unavailable, then setting the variable zoom lens at its maximum or minimum focal length (depending on the focal range of the lens being used) will provide the most optimal results.

Photogrammetry requires consistent images, therefore configuring camera settings is particularly important. The following workflow serves as a starting point, though settings will ultimately depend on lighting conditions and the type of lens and camera used. Switch the camera to the manual (M) setting to gain full control over focus, aperture (A), shutter speed (SS), and ISO (sensor light sensitivity). A slow aperture and a low ISO (100) are recommended to reduce noise. Apertures between f/8 and f/20 are suitable as these provide a deep depth of field to keep the entire subject in focus. As a result, a slow shutter speed will be necessary due to the small aperture and low ISO. Using a slow shutter speed is feasible since the subject is stationary, with typical settings ranging between 1/4 second and 1.5 seconds, depending on subject brightness. To prevent unwanted shaking from the camera or tripod, which can cause out of focus shots, use a wireless remote or the camera's built-in timer to control the shutter button. Note that increasing the lighting allows for a higher shutter speed, which will also speed up the process. Lastly, position the camera at the appropriate focal distance from the object on the turntable. Measuring the exact distance from the subject to the camera is important for photo alignment, but not strictly necessary. The camera should be placed at a high angle, shooting slightly downward to ensure the subject and backdrop fill the frame, eliminating all unwanted elements from the photograph. For complex objects with handles or obscured details, adjust the camera height to capture additional images of those parts, but avoid moving the tripod from its original position to maintain (CAST 2024; Agisoft LLC 2024:12-34).

The next step is to ensure global coverage of the entire subject, particularly with capturing the bottom of the subject. Two methods are available to achieve full coverage: one uses control points and stitching separate chunks together in Agisoft Metashape (Agisoft LLC 2024) (I will introduce in the next workflow), and another captures the entire object without

control points, but is more precarious. For my results, the control points method was primarily used due to the delicate nature of stoneware vessels and the need for accurate scaling. However, this method can present difficulties with post-processing alignment. For the control points workflow, a printout provided by GWALS (Geospatial and Virtual Archeology Laboratory and Studio) and Badillo's (2022) photogrammetry workflow was used. Badillo's (2022) method involves placing a printed-out control point sheet underneath the object to aid in accurate photo alignment and scaling during the post-processing stage.

If using control points, the workflow is as follows: Secure the print-out onto the turntable to prevent movement during the process. Place the object at the center of the control points on the turntable. For the first lap around the vessel, adjust the turntable by 10 to 15 degrees per turn and snap the shutter to ensure thorough overlap, this will capture the major portions of the object. Next, flip the vessel upside down and repeat the process to capture the bottom rim and base of the vessel. Placing the vessel upside down is generally feasible for stoneware, which typically has a stable flat top. In both orientations, approximately 26 photos will be taken, which is generally sufficient for creating a full 3D model. Additional photos may be needed depending on the subject's features and shape. Note that mounting pedestals may be necessary depending on the object's shape. The pedestal will be cropped out after the aligning phase in Metashape, so they are not a concern.

The second method, which I will refer to as the global coverage method, allows for stitching an object together in Metashape without using control points. This method is advantageous because it allows for capturing the entire vessel in one continuous session and should eliminate the need to align multiple chunks together in Metashape. Instead of flipping the

vessel upside down, this technique involves tilting the vessel onto its side. This is challenging due to rolling since pottery tends to be cylindrical. Additionally, a pedestal is required to elevate the vessel above the turntable, this is important because it allows for the turntable to be cropped out during post-processing. If these concerns can be resolved, the same basic workflow applies. Rotate the vessel 90 degrees onto its side, then rotate it again to capture the side that was initially facing down. This method presented two challenges. First, creating scale bars for the object proved difficult. Second, the overall quality of the 3D scan was lower compared to those produced by the other method. However, it's important to consider that the object scanned was my first attempt with this method. Despite these challenges, this method remains under exploration and has potential for future development.

Aerial Photogrammetry Workflow

Aerial photogrammetry has become increasingly prevalent in research due to advancements in drone imaging processing and autonomous flying technology. It follows the same principles as 3D object scanning but requires additional equipment and specialization. For instance, drone (sUAS) operators conducting research must be FAA compliant and certified, which requires passing the 14 CFR Part 107 examination at a licensed FAA testing facility and registering the drone. Numerous online resources aid in studying for the test; the mobile application Prepware Remote Pilot (Aviation Supplies & Academics 2023) is particularly useful for study. All sUAS aircraft must follow standard FAA air safety regulations (see FAA.gov/uas). Ensuring the drone is safe to fly typically requires downloading a mobile application that provides current airspace information, weather conditions, do not fly zones, and other potential obstacles. The application will indicate if LAANC (Low Altitude Authorization and Notification Capability) authorization is required before flight, this is typically reserved for airspace other

than Class G. For my project, I relied on the mobile application AutoPylot for Drones (AutoPylot INC. 2024). The FAA previously provided their own application known as B4UFLY, which has since been discontinued.

According to the FAA Recreational Flyer webpage, the basic checklist of requirements before conducting a sUAS mission are the following: Pass the Recreational UAS Safety Test (TRUST) or the 14 CFR Part 107 Certification. Keep the drone within visual line of sight or always have a visual observer. Fly at or below 400 feet in uncontrolled airspace. Ensure to register the drone if it weighs more than 0.55 pounds, however, beginning in 2023, if the drone requires an FAA registration number it will also be required to broadcast remote ID information. Lastly, do not interfere with other aircraft, and do not endanger or interfere with the safety of the national airspace systems (Federal Aviation Administration 2023). Additional regulations are particularly contingent on where the mission is being conducted, but for the purposes of 3D scanning (particularly in rural areas) these guidelines are sufficient.

Once safety is met and certifications are completed, the next step is choosing the proper drone. As mentioned earlier when discussing photogrammetry (Magnani et al. 2020), new federal policies (ASDA 2023) against the use of Chinese manufactured DJI drones has placed restrictions for their application in research. The immediate consequence is the current lack of smaller and more affordable sUAS options, like the DJI mini. As a result, the American drone manufacture Skydio (Skydio Inc, 2024) has stepped in to provide high-quality sUAS options with advanced air mobility and imaging capabilities. However, Skydio only sells to commercial markets substantially raising the cost of drones, with the Skydio 2+ model ranging between $1,099 for a starter kit and $2,169 for the pro version. Additionally, to have access to Skydio's

autonomous scanning software will cost upward of $3,000 per year. This means unless an individual has access to a Skydio through a university or other professional sector, these drones will not be conducive for most private or minor research projects. This aside, in the case of public archeology, for private citizens to use other drone options (such as DJI) for doing photogrammetry on private land, is still compliant to the FAA Recreational Flyer policy, but whether the results can be published for a state (or grant)-funded digital storytelling project does require additional investigation and is unlikely.

Despite these setbacks, archeologists are using drones to document historic structures, excavation sites and natural features like bluffs that are difficult to reach. It also has the potential in public archeology to further enhance digital story telling projects through 3D scans of historic buildings across the country. There are two basic methods for taking photos for photogrammetry with a drone: 1) The drone operator can manually fly the aircraft around the structure, taking pictures at overlapping intervals until the entire structure is captured. Once the photos are gathered, the workflow given for Agisoft Metashape should be followed to produce a completed scan. 2) Utilizing the Skydio 2+ scanning software can greatly simplify the process. This software guides the operator through an automated and user-friendly workflow. The procedure involves flying the drone over the structure to set the minimum and maximum height of the study area, then flying to four locations around the structure to establish 'pillars' that define the study area. Autonomous scanning will significantly reduce margins of error compared to human operation. Although, the effectiveness of the scan will depend on the structure being imaged. Cane Hill College, which is mostly symmetrical with few interior regions or complex geometries, was captured without much issue, resulting in a solid mesh of 1,077 photos. Conversely, the Zeb Edmiston house, totaling 780 photos, presented challenges due to a covered

back deck causing dark shadows along the walls and a small, stooped entrance at the front. These finer details were not captured with much detail in the autonomous scan. Solving this issue would require either starting a new scan for these areas or capturing these details manually.

Agisoft Metashape Workflow

There are many software options that will align photos and create 3D models, such as Agisoft Metashape, ContextCapture (CC), and RealityCapture (RC). However, Agisoft Metashape is superior due to its extensive control over the processing workflow, and consistent reliability in producing high-quality 3D models. In her comparative analysis, Kingsland (2020) remarks of the three software's that, "Metashape's ability to include all types of data as well as its versatility, reliability, and repeatability of its process has been proven many times in the literature, specifically in the application of UAV and landscape and architectural 3D models. Its pervasiveness in cultural heritage digitization is not to be ignored" (Kingsland 2020: 9). She points out that Metashape, although having the longest processing time among the three, is the most reliable in terms of photo alignment for small-scale digitization projects. Additionally, Metashape offers the capability to process data in separate chunks and merge them later, which is particularly beneficial for complex projects involving multiple data sets, a feature that is used in the workflow for merging the bottom and top halves of the stoneware vessels. Notably, this chunk-based processing is a feature not available in ContextCapture and RealityCapture (Kingsland 2023). Furthermore, Kingsland (2020) discusses financial considerations, noting that Metashape requires a one-time license fee, which includes updates to newer versions without additional costs. Both CC and RC operate on subscription models. In total, Kingsland's (2020) findings show that while open-source software, like, Meshlab, MicMac, and other competitors

(RC, CC, and Pix4Dmapper, produce similar quality results to Metashape, they tend to be less versatile and consistent (Kingsland 2020: 9).

No matter what is used, the task of all photogrammetry software is to align overlapping images to construct a three-dimensional model of the scanned object. To accomplish this, the processing step begins with loading the data into Agisoft Metashape. Once the data is loaded, the next step is aligning the photos. This involves Metashape selecting the align photos task under the workflow tab, this task will find feature points on the images and match them across images into tie points. This process also determines the camera positions for each image, which can be viewed to check consistency of photographs (Agisoft Metashape User Manual, 2024).

Under the workflow tab, the next processing task is generating a point cloud. A point cloud is a collection of data points defined in a given three-dimensional coordinate system. These points represent the external surface of an object captured by a photogrammetry process, which are derived from the feature points matched during the image alignment (Agisoft Metashape User Manual, 2024). After a point cloud is rendered, a mesh is generated to create the basic shape of the object. A mesh is a digital representation of a three-dimensional object's surface, composed of vertices, edges, and faces. It is generated from the point cloud by connecting the points to form a continuous surface, creating the basic structure of the object (Agisoft Metashape User Manual, 2024). Once the mesh is finalized, a textured model is simply a conversion of the actual photographs to create a photorealistic skin over the mesh.

Following a basic workflow provided by Agisoft Metashape will produce usable results, but achieving high-quality results requires familiarity with the built-in tools to remove unwanted geometries and smooth out the edges of the mesh. This can be time-consuming, especially when

a high number of photos are uploaded, as this will substantially increase processing time. For instance, a high-quality mesh for Cane Hill College took nearly ten hours to render. Additionally, before generating point clouds and meshes, it is important to check the confidence ratio for the photographs. This can be done by right clicking the image and selecting “Scan for Image Quality.” Ensure images have a confidence level above 4 or 5 to be usable for reliable results and delete photos that are too low in confidence.

The method used for capturing images as discussed in the photogrammetry workflow will also impact the workflow for creating a completed 3D model. The control points method requires segmenting the images into two separate chunks and performing a point-based alignment. By identifying corresponding points in multiple images, the software can determine the spatial relationship between the images and accurately align them to create a coherent 3D model (Agisoft Metashape User Manual, 2024). For example, in the case of my stoneware vessels, the first chunk consisted of images of the vessel right-side-up, while the second chunk is of it upside down. Ideally, if the point-based alignment is successful the two halves should stitch seamlessly together. I closely followed Badillo’s (2022) video tutorial for aligning chunks within Agisoft Metashape; his process involves identifying control points on the turntable printout, doing a standard photo alignment, reducing regions to fit around the subject (cropping), rendering a standard low texture mesh of each chunk, and then performing a point-based alignment which relies on the control points and masks to stitch the two chunks together.

Each step, except for cropping, is processed automatically by the built-in tools in the software. These tools use a confidence metric to match each chunk effectively, but as a result this step can often fail due to a variety of reasons, leading to adjustments if misalignment issues arise.

Examples of issues I encountered were lighting variations that caused a ring around the vessel's base, and an inaccurate chunk alignment that resulted in jagged edges around the merged seams. In contrast, the global coverage method simplifies the workflow significantly. All photos are imported into one chunk, the 'align photos' function is used, the turntable is cropped out, and then the mesh and texture are built. If done correctly, this method automatically masks out unnecessary elements like the pedestal, resulting in a completed model of the vessel. Once the model is complete, it can be uploaded to platforms like Sketchfab (2024), Nira (2024), 3DHOP (2024), or even Blender (2024) for further analysis or display.

This detailed guide on photogrammetry workflows provides a foundation for producing 3D models. By employing these various tools and methods, these models can then be integrated into online digital platforms like Sketchfab, which then can be embedded into ArcGIS StoryMap, in combination these tools can be used to enhance online digital storytelling projects by providing viewers with more immersive and interactive experiences of historical sites and objects.

SketchFab and KnightLab Workflow

Sketchfab (2024) is a subscription-based platform that offers a streamlined method for presenting 3D models online. The immediate advantage of the service is that it offers a free version and provides an intuitive interface for uploading, editing, and sharing 3D models. This makes it accessible for users across various professional contexts. Agisoft Metashape offers a built-in functionality in the software’s interface to upload models directly to a Sketchfab account, this can be done by navigating the ‘Tools’ menu, selecting ‘Upload Model,’ and choosing ‘Sketchfab.’ Follow the prompts to log into your Sketchfab account and upload the model

directly from Metashape. Alternatively, models can be exported as .obj files, a widely supported format for three-dimensional files. This involves selecting 'File', 'Export', and 'Export Model' in Metashape, then logging into Sketchfab, finding the 'Upload' button to complete the upload process.

Once uploaded, the free version of Sketchfab offers various useful editing functionalities, such as the function to create annotations to highlight specific features of the 3D model. This is done by navigating to the model's editing page, selecting the 'Annotations' tab, and double clicking the object to create numbered text boxes. Each text box offers a title option and description. The style of the annotated numbers or text boxes cannot be changed in the free version. The background color adjustments can be made by accessing the '3D Settings' menu, selecting 'Environment', and adjusting the 'Background Color'. Note that there are online services, or Photoshop, which will provide functionality to find the exact color hex code for a given page. Lastly, incorporating 3D models into webpages or ArcGIS StoryMaps involves using an iframe, a code element for embedding external content. To generate an iframe code, access the model’s 'View' menu, select 'Embed', and copy the provided iframe link. This link can then be inserted into the HTML code of a webpage or StoryMap to display the 3D model.

Sketchfab's free service has certain limitations, including restrictions on file size and the number of uploads allowed per account. The restricted file size limit may necessitate compressing 3D models, which for larger models like buildings will reduce its quality. I encountered this problem when uploaded Cane Hill College scan (discussed in Chapter 4), leading to the final model in my StoryMap to be lacking in clarity. Secondly, the ability to make models private is a feature reserved for paid accounts, therefore free users can only disable

downloads by accessing the model's 'Settings' and turning off the 'Downloadable' option. In short, Sketchfab is not a perfect solution for all contexts, but is well suited for small-organized due to its user-friendly interface and basic functionalities. However, for larger-scale projects, alternatives like 3DHOP (3D Heritage Online Presenter) might be more appropriate due to their advanced customization options and flexibility, though these options were not explored in this project.

Another service I used to incorporate a 360-degree virtual tour of the museum into StoryMap was provided by Northwestern University's (2023) KnightLab storytelling tools, an experimental service designed to push journalism projects into digital spaces. This service is an open-sourced and collaborative project that offers various web tools to create dynamic online presentations, such as their own version of StoryMaps, timelines, inline audio for text, and Virtual Reality (VR) stories. My project utilized their VR stories as a way to upload photos captured by a 360-degree camera. The basic workflow involves creating the project from KnightLab 'Projects' webpage, signing into a user-created account, and following the tool's tutorial provided by KnightLab. Although, it is important to note that before uploading 360-degree images will require pre-processing steps of the photos, this is usually provided by the given manufacturer of the camera. Processing 360-degree photos typically involves downloading proprietary software from the manufacturer (or other software services) that can read and convert the image files appropriately to be viewed in VR space.

However, like Sketchfab, the choice to host 360-degree virtual tours on KnightLab shares similar limitations regarding data privacy, longevity, and scalability. Despite this, KnightLab (2023) does seem advantageous for its simplicity and ease of use, making it ideal for creating

straightforward presentations that can be embedded using iframes. For my project, this tool was mainly utilized to demonstrate an open-sourced workaround solution that offered interactive interfaces to digital storytelling projects.

Digital Storytelling: ArcGIS StoryMaps

As mentioned earlier, digital storytelling integrates text with visual and interactive elements to enhance engagement and understanding of history (Figueiras 2014, in Cortes Arevalo et al. 2020:1014). There have been various platforms developed to achieve to goal. For example, of the specifically story map orientated services I have explored like KnightLab (Northwestern University 2024) and Terrastories (2024), although free and open source, fall short in functionality and customizability needed to truly support a dynamic and broadly appealing presentation. Terrastories focuses primarily on map-based annotations, audio, and additional support for links to external media like images and videos. Meanwhile, the story map offered by KnightLab is quite basic and far less intuitive, offering functions to visit locations, images, and annotations. The primary drawback for both is being that 'maps' are their core explorative functionality, where ArcGIS StoryMaps, as I will explore further, provides extensive options for customization. Despite this, open-source services such as Terrastories offer notable advantages, particularly in cost and accessibility, making it potentially more valuable to underrepresented groups and descendant communities to publish work surrounding their histories. However, if the goal is sustainable engagement within public archeology and digital storytelling, I believe a more robust platform is going to be essential. For instance, the platform should not be at risk of sudden discontinuation, compromise data security and storage, nor lack popular appeal. ESRI (2024), while certainly not perfect, is a reputable industry leader. This likely ensures the longevity and regular support of its services. They also provide large, secure

servers relied upon by researchers, state organizations, and corporate entities for data privacy. Moreover, ESRI offers the highest potential for distribution and shareability of StoryMap content, while also leaving room for ongoing growth and maintenance of published collections as demand persists.

ArcGIS StoryMaps (ESRI 2024) offer a blend of geographic data and multimedia storytelling that guides viewers through topics in an interactive and visual way. StoryMaps have become increasingly explored by academics for their value in answering spatial questions within the humanities. They have also seen widespread use in education particularly within the STEM disciplines (Cope et al. 2018; Groshans et al. 2019; Duan 2023). ArcGIS StoryMap is a web tool developed by the Environmental Systems Research Institute (ESRI), which has piqued the interest of educators due to its ready-to-use ecosystem that closely aligns with modern pedagogical needs and cognitive theories about multimedia learning. For example, Cope et al. (2018) and Groshans et al. (2019) both developed ESRI StoryMaps for teaching introductory soil science. In their StoryMaps they focused on different soil forming factors, such as the effects of topography and climate. Their research particularly focused on the learning outcomes of students with this new presentational model and found that when StoryMaps can utilize the "five principles of effective storytelling," as described by ESRI's story planning method, they were able to increase assessment scores and receive higher positive feedback on the learning experience. They note that StoryMaps helped combine complex scientific concepts with self-paced learning, comparing it more favorably than methods like PowerPoint (Cope et al., 2018; Groshans et al., 2019).

Another study focuses on utilizing StoryMaps for high school education. Duan (2023) integrated ESRI's StoryMaps with lessons on regional geography, noting that the ease of organizing educational content into "chapters," helps both with developing real-life narratives surrounding the topic and supports problem-based learning. Duan (2023) a proponent of student-centered learning environments found that story maps facilitated a further shift from teacher-centered learning, since students were able to reach learning objectives through their own exploration of the topic. Beyond the classroom, story maps are also bridging the gap between research and applied science by targeting specific audiences for ongoing projects. For instance, Cortes Arevalo et al. (2020) in his research about environmental management developed storylines for sustainable river management that tailored scenario-based content to appeal to on-the-ground practitioners rather than researchers.

Collectively, these studies underscore the potential of story maps not only as educational tools but also as mediums for effectively translating academic research into practical, actionable knowledge. This is particularly useful in fields like public archeology or the humanities more broadly. The strategic use of story maps can be seen as adding a beneficial component in landscape of digital education, since they offer creators an ease of production with greater potential for higher learning outcomes, and effectiveness in reaching intended audiences.

Whether intended by ESRI's design philosophy or not, StoryMaps have created the potential for further democratization of information, by allowing creators from various backgrounds to develop and distribute data through visually compelling narratives, which have proven to be effective in learning retention. This leads us to a prominent issue, while story maps do excel in making knowledge accessible, it must also be considered *who* creates these resources

and *who* has access to them. Navigating who is creating knowledge and where their data is sourced is nothing new to the world of academia, but in the case of an open-publication resource like ESRI's StoryMaps highlights a greater chance for inadequate quality control. Furthermore, aspects such as digital literacy and internet availability across different regions and demographics factor in when considering socio-economic inequalities. As such, the challenge lies not only in creating regulated and reflexive digital tools but also in ensuring equitable access and participation in their creation and use. This ensures that the benefits of digital storytelling methods in education are both standardized but still have potential to be created and shared more broadly, rather than being confined to those who have existing access to digital technologies and scholarly resources.

ArcGIS StoryMap Workflow

ArcGIS StoryMaps uses ESRI's (2024) mapping software and can serve as a tool for historic preservation and archeology by providing a new method to engage public interest through interactive, spatially oriented narratives. StoryMaps introduces an innovative storytelling method that incorporates geospatial data, including satellite images, remote sensing data, and more, allowing users to present their findings through visually driven narratives. For example, the platform offers various content blocks that allow users to build out their narratives with multimedia elements such as text, images, videos, interactive maps, and embedding media. The main advantages of StoryMaps are features like the sidecar block and map tour, which merges scrolling text panels with dynamic maps and media. The express map provides a way to tell geographical narratives by emphasizing locations or routes on a map with basic annotations. Its integration with the broader ArcGIS ecosystem allows for embedding of web maps and scenes, allowing for complex geospatial questions to be explored. Customization and theme building lets

the user tailor the aesthetic of their stories through colors, fonts, and layouts. And lastly, social media sharing, publications, and accessibility across all mobile formats, extends the narratives' reach.

I will lay out the steps involved in creating a StoryMap. Navigate to the ArcGIS StoryMaps homepage and click on "Create new story." Select a template that fits the narrative style. Templates include Sidecar, a base style presentation that highlights media with supportive supplementary text, and Map Tour and Guided Tour, which focus on guiding the viewer through selected locations on a map, each location can be supported by images and text. These functionalities can be added, revised, and removed during the editing process. Next, enter a title and a brief sub-heading for your StoryMap to provide context for the story. Then, use content blocks to build out the content. As of the most recent update in May 2024, blocks can include maps (including those generated using ArcGIS Pro and other web maps or scenes), text boxes, images, videos, buttons, web links, and embedded media. This includes the ability to embed 3D models from Sketchfab by using a basic HTML iframe provided by Sketchfab. To add a block, click on the "+" icon and select the type of content. Proceed by creating an aesthetic for the StoryMap by creating customized themes. This can be found under the homepage column labeled "themes." Custom themes can alter the primary color palette and fonts of the presentation, which is helpful for creating a layout that matches the subject matter. Next, view the presentation by selecting the "Preview" tab. During the preview, icons will appear that allow for viewing the StoryMap on various devices, such as desktop computers, tablets, and mobiles. This is important, as some features in the StoryMap may not display or function properly on smaller devices. Finally, by clicking "Publish," navigate to the publishing editing screen where options such as 'public,' 'private,' or 'selected viewership' can be chosen before making the

StoryMap live. StoryMaps can be easily shared via a link found within the publishing screen. Note that edits can easily be made after publishing; when viewing the StoryMap builder screen, click the ellipses and select "Edit Story." Lastly, the most important thing to do when creating a StoryMap is to experiment with its functions and have fun with the creative process.

Other functionalities, like “Collections,” were also explored for this project but not fully implemented. Collections allow multiple StoryMaps to be part of a larger narrative, enabling users to navigate through a collection and select which story they wish to learn about and explore. This feature will be a useful component if ArcGIS StoryMaps are adopted for larger storytelling projects, as it allows for the distribution and archiving of related stories in a well-organized manner. For instance, in the context of Cane Hill, multiple stories could be created to explore various aspects of the town’s history, geography, and architecture. These stories can be integrated through “Collections” to create a holistic and dynamic narrative of the region. Cane Hill is an ideal location for experimenting with public accessibility of StoryMaps because the region's history covers a wide range of interconnected topics that can be compiled into a collection. Moreover, since the Historic Cane Hill non-profit has ongoing interests in promoting itself as a heritage site in Arkansas, extends the longevity for future projects to be inventoried into a broad collection, tracking more attention to the town.

Integrating 3D models and other multimedia elements with digital storytelling techniques offers an approach to public archeology that provides replicability and offers a template that small museums or non-profits can follow. By combining these technologies, archeologists, and in some cases non-specialists, can create interactive and potentially immersive experiences that bring the archeological process to a wider audience. This method not only enhances engagement

with potentially lesser-known histories or sites but also ensures that the cultural material within those sites is archived and preserved digitally. Finally, these digital methods allow for ongoing updates and additions, which ensures that the information remains current and relevant.

In the next chapter, I will describe the case study of Cane Hill, demonstrating the utility of these approaches in a modern context of public archeology. This case study will first provide a context surrounding the towns notable histories, then it will highlight the practical application and benefits of combining photogrammetry and digital storytelling to expand the reach and impact of archeological projects investigating those histories. By showcasing Cane Hill as an example, I will illustrate how these digital tools can be effectively utilized to engage and educate the public, preserve cultural heritage, and support Historic Cane Hill's initiatives. This discussion will hopefully provide a clear framework for other institutions looking to adopt similar methods.

Chapter 4: Case Study: Cane Hill

On December 31, 1984, the Cane Hill community was nominated by the national register of historic places as a multiple resource area, including houses, a commercial structure, a church, a school building, and historic archeological sites (United States Department of the Interior, National Park Service 1982). The nomination included fifteen sites such as Cane Hill College and the United Presbyterian Church. Cane Hill is characterized by its 'comfortable human scale' and 'nineteenth-century ambience' (United States Department of the Interior, National Park Service 1982). It is situated in a sparsely populated area surrounded by orchards, hills, and pastures, reflecting the natural contours of the landscape.

Today, Historic Cane Hill, Inc. focuses on preserving the historic buildings of Cane Hill and western Washington County, Arkansas, while offering programs and venues to engage with the region's rich cultural and natural heritage. Under the Historic Cane Hill initiative, many buildings and structures have now been restored to reflect their historical character, such as the Zeb Edmiston House and Cane Hill College. Their mission emphasizes enhancing the area's architectural, educational, and artistic legacies (Historic Cane Hill, Inc. 2024). At the Historic Cane Hill Museum, visitors can learn about the community's history through various artifacts that connect them to the lives and times of its past residents. Every year, the non-profit organizes a variety of cultural events, farmers markets, as well as arts and music, but are still largely unknown to the greater area. The current historic preservation team at Historic Cane Hill wishes to broaden the public's knowledge of this town and promote it as a site of heritage by using their funds to recreate much of Cane Hill's historic landscape. Cane Hill, Arkansas, presents a suitable case study for employing digital methods in public archeology for the following reasons.

First, Cane Hill's proximity to the expanding population in Northwest Arkansas has the potential to attract interest due to its growing status as a successful non-profit organization and the variety of local events held in the town throughout the year. Additionally, its success as a non-profit also provides an active site for new and ongoing archeological research to gain visibility. Secondly, Cane Hill's historical significance, rooted in its pioneer origins, is reflected in its architectural, educational, and artistic legacies, which offer substantial material for digital representation. Digital technologies can contribute to the preservation of Cane Hill's historical data by creating digital archives and facilitate increased community involvement in archeological projects, aiding broader and more diverse public engagement with both the mission of Historic Cane Hill and public archeology.

To better understand the influence and significance of Cane Hill, here I will provide a brief historic context detailing the nineteenth century economy of the Ozarks and present a short history of Cane Hill college along with structures that have been listed on the National Register of Historic Places (NRHP). In addition, I will provide an overview of the history and production of American stoneware to highlight significance of J.D. Wilbur's pottery to the nineteenth century economy on the frontier.

Nineteenth-century Economy of the Ozarks

Cane Hill was founded in 1828 and is one of the most historically significant communities in Arkansas (Historic Cane Hill, Inc. 2024). The town is notable for being the location of one of Arkansas's first four-year colleges and the site of the 1862 Civil War Battle of Cane Hill. Cane Hill grew significantly from the 1860s to 1880s supported by an apple orchard industry, stoneware production, and milling. The 1828 Treaty of Washington resulted in the Cherokee's tragic relocation to lands further west in Oklahoma (McGlothin 2014), clearing the way for Cumberland Presbyterians and a group of Methodists to become the region's primary inhabitants. It was a group of Cumberland Presbyterians that founded the town, established a church, and ultimately Cane Hill College in 1850 (Basham 1970).

Post-Civil War, the Ozarks underwent significant economic redevelopment. The disruption of agricultural practices and damage to infrastructure necessitated the production of utilitarian goods to support reconstruction efforts (Sabo et al. 1996). As communities rebuilt, the need for food storage and preservation increased, leading to a demand for stoneware. In Cane Hill, J.D. Wilbur's pottery operation emerged to meet the local demands for functional stoneware after the Civil War, according to current archeological thought (personal communication, Michael Evans). Today, the pottery production area exists as an archeological site with intact

deposits, currently being investigated by archeologists with the ARAS in partnership with Historic Cane Hill, Inc.

Early settlements in Cane Hill and the broader Ozark region focused on cultivating wheat and corn and utilizing waterpower from local streams to grind them into meal and flour (Goodspeed 1889, cited in Sabo et al. 1990), as evident by the Pyeatte (circa 1830) water-powered wheel mill nearby Cane Hill. However, by the late nineteenth and early twentieth centuries, due to the widespread failure of farm crops, large fruit orchards became more common in the region, leading to a shift in the local economy (Sabo et al. 1990). The success of apple production was further stimulated by the arrival of railroad companies, providing a more efficient means of transporting goods to broader markets.

This increased focus on orchards in the Ozarks likely created additional demand for durable stoneware containers for storage, fermentation, and preservation of foods, making stoneware an important commodity for both subsistence and economic growth in the region (Sabo et al. 1990). Local potter J.D. Wilbur capitalized on this need by producing stoneware jars, jugs, and other vessels. The country store played a complementary role by providing essential services and supporting local enterprises like J.D. Wilbur's pottery operation through distribution and access to supplies and markets (Stoffle 1972, cited in Sabo et al. 1990). However, the introduction of the railroad in nearby Lincoln, Arkansas, in the late nineteenth century significantly impacted Cane Hill’s economy. The improved rail infrastructure may have expanded economic opportunities for local potters like J.D. Wilbur (Flanders 1979, cited in Sabo et al. 1990) but eventually led to the decline of his industry and those like it post-1890s. Technological advancements and the introduction of cheaper, more sanitary containers like glass

reduced the need for traditional stoneware, contributing to the decline of J.D. Wilbur's pottery operation despite its initial contribution to the local economy (Sabo et al. 1990).

While these broad economic developments significantly shaped Cane Hill's history, the community's commitment to education is reflected by the establishment of Cane Hill College, one of the earliest colleges in Arkansas.

Key Historical Sites

Cane Hill is known for early collegiate education efforts in the state. Shortly after establishing Cane Hill, the Cumberland Presbyterians opened schools to educate the next generations. The first school was founded in 1834, and by 1850, it had evolved into the Cane Hill Collegiate Institute, making it one of the earliest colleges in Arkansas (Basham 1970; McGlothin, 2014). According to Robert Basham's (1970) dissertation, the college's largest graduating class, in 1877, consisted of only six individuals. From its first full year of operation in 1853 to its closure in 1891, Cane Hill College had only fourteen graduating classes. Despite its modest size, the institution had a notable impact on the local community, particularly with educating religious leaders. Established in the same year as Cane Hill College, the Cane Hill Female Seminary became the first degree-granting institution for women in Arkansas. The female seminary buildings, along with the original college building, were both destroyed during the Civil War in 1864 (Basham 1970: 115-124). By 1868, a new two-story frame building was constructed to replace the college, however the female seminary remains lost. On October 10, 1885, a fire, believed to be caused by arson, destroyed the college yet again. The Methodist Church congregation offered their own accommodations for classes to resume until a new brick building, the college structure that stands today, was completed in early 1886 (Basham 1970).

After the college closed in 1891, the building was used by the public schools of Cane Hill until the early 1950s, when the Cane Hill District merged with the Lincoln School District. The building continued to serve the community, being used for music lessons for girls as late as the summer of 1968 (Basham 1970: 274).

Cane Hill College remains significant today as it exists isolated within a largely rural landscape. The architectural design of Cane Hill College features a two-story brick structure that exhibits influences of the Italianate style, notable with its tall, slender rectangular windows, gable roof, and a distinctive entrance with trefoil-arched tracery. The building stands today as an example of classical architecture, reflecting the educational and formal nature of the institution (United States Department of the Interior, National Park Service 1982). Cane Hill College remains a lasting legacy and a heritage site for the region, now seeing usage potentially surpassing that of the past after its most recent renovation in 2017, overseen by then-director Bobby Braly. Today, the college, alongside other structures (such as the Zeb Edmiston house) within Cane Hill, has been remodeled to restore the historic landscape. The college remains an active venue for events and exhibitions for the community and the Northwest Arkansas region and has been included as a historic site on the National Register of Historic Places.

Cane Hill's rich historical context, with its numerous NRHP sites and its non-profit's active interest in expanding their outreach, provides a unique opportunity to link the past with modern digital storytelling. For instance, the J.D. Wilbur's pottery factory, is highlighted for this project to explore what we are currently learning and what is still left to be discovered about living on the frontier in Northwest Arkansas.

J.D. Wilbur, originally from Zanesville, Ohio, relocated to Arkansas around 1876, bringing his pottery expertise. J.D. Wilbur's pottery operation in Cane Hill thrived due to a combination of historical, economic, and technological influences during the post-Civil War era. His kiln produced affordable and high-quality utilitarian ware, distinguished by maker's marks indicating a collaboration with business partner James Michael Roark or Wilbur's own unique stamp. This operation primarily catered to the essential needs of local residents and surrounding townships and reflected a blend of northern and southern ceramic traditions. The kiln site had remained largely untouched until Historic Cane Hill Inc. purchased the land, leading the ARAS to investigate it as an active excavation site in 2023 (3WA208). Today, careful excavation and curation continue, aiding in the understanding of the site and Cane Hill.

The kiln was first documented in 1972 as a 26-foot diameter structure with a height of 3.5 feet. Further archeological investigations by the University of Arkansas Fayetteville Research Station in 2023 revealed an older, larger groundhog kiln (kiln #1) beneath the known kiln mound (kiln #2). Archeologists found that Kiln #1, measuring 2.6 m by 9.8 m, presented extensive brick and sandstone construction, including an intact firebox and firing chamber elements, as well as remnants of salt glaze on the interior brick walls (Pebworth and Evans 2023). J.D. Wilbur's pottery factory also provides a unique lens through which to examine broader trends in 19th-century American stoneware production. Stoneware is an important aspect of the history and appeal of Cane Hill as an archeological site. According to Mary Starr (2003), exploring the history of Arkansas' stoneware industry, stoneware can be classified by surface finishes: salt glazing, alkaline glazing, Albany slipping, and Bristol slipping. Most of J.D. Wilbur's vessels were manufactured using a salt glazing technique, meaning sodium bonds were added on the surface of the clay which helped form a shiny surface, often with an orange peel texture.

Moreover, Alkaline glazing, linked to Southern stoneware traditions, used wood-ash lye and sometimes ground glass that produce green or brown glossy finishes, also reflected in Wilbur's work (Starr 2003).

These differences in stoneware manufacturing techniques play a role in the characteristic of J.D. Wilbur's work as it reflects many of broader trends and economic adaptations in nineteenth-century stoneware production. Timothy Galluci's (1996) dissertation explores the development and production of stoneware in nineteenth-century America and highlights how regional traditions evolved from European roots and adapted to new landscapes. As North America was colonized, salt-glazed stoneware emerged as a rustic alternative to refined imports, with potters often prioritizing economic practicality over elegance (Galluci 1996, citing Hamer 1975). Northern potters incorporated cobalt blue decorations inspired by Germany's Westerwald aesthetic, reflecting a shift towards more refined and sanitary-looking wares as rural areas became urbanized (Galluci 1996, citing Schaltenbrand 1996). In contrast, Southern stoneware, characterized by alkaline glazes and bell-shaped jugs, used lower quality clay and horizontal groundhog kilns suited to rural economies (Galluci 1996, citing Burrison 1983; Guilland 1971; Hughes 1987). Influenced by English pottery traditions, Southern potters continued using simple, functional methods into the mid-twentieth century (Crawford 1964; Troy 1977, cited in Galluci 1996). Early Arkansas potters, like J.D. Wilbur, relied on these rural techniques, producing utilitarian stoneware that met the practical needs of agricultural communities with minimal resources (Starr 2003). This stable tradition resisted industrial pressures, allowing Southern stoneware to retain its forms longer than in other regions (Troy 1977; Burrison 1983, cited in Galluci 1996).

Wilbur was known for his use of differing glazing techniques, including both salt and alkaline glazes. He often chose to forego cobalt blue in his pottery, reflecting deliberate decisions influenced by factors such as family tradition or economic considerations. His pottery factory is an interesting case study in the history of stoneware as it provides a window into a distinctive Ozark tradition of potting, therefore today it is still under investigation by archeologists at the University of Arkansas Fayetteville Station of the ARAS to uncover the extent and methods of his production. See Appendix 1 for additional information provided by Historic Cane Hill Inc. detailing brief specifics on each J.D. Wilbur vessel scanned for this StoryMap project.

Many of these historic sites, like Cane Hill College and the J.D. Wilbur pottery factory provide rich insight into the history of Cane Hill, but they also offer researchers the potential for developing historical narratives, which can be explored through digital storytelling tools and methodologies. ArcGIS StoryMaps (ESRI 2019) as described above offer museums or small non-profits the ability to enhance exhibits by incorporating them as interactive kiosks or sharing them as online resources. This platform allows museums to reach wider audiences by creating detailed, engaging stories about specific artifacts, exhibits, or historical narratives. StoryMaps represent an affordable solution for high-quality presentations, which is beneficial for smaller museums like Cane Hill and those with limited budgets. The aim is to illustrate how StoryMaps can showcase 3D models while packaging them as interactive educational material. Historic Cane Hill can use this StoryMap a number of ways, by promoting it on their website, or presented via tablet and setup on a kiosk next to the J.D. Wilbur stoneware collection, with the intent on educating visitors on better understanding and appreciating the collection.

While the Cane Hill Museum provides information about Wilbur's work on its website, the StoryMap allows for a more interactive experience with his creations. By incorporating 3D models

and detailed annotations, the narrative of Wilbur's life through his pottery was reconstructed, highlighting the unique features of his stoneware. This was achieved using custom maps showing the geography and genealogy of Wilbur's style, and annotations to aid viewers in understanding and appreciating each piece. This approach aimed to transform historical data, often overlooked, into a clear and engaging format. The goal of public digital storytelling projects should appeal to the majority of people viewing the topic, as it may be the only encounter of that information available to them. A StoryMap should be an interactive microlearning experience (Lee et al. 2021; Sung et al. 2023), therefore, to maximize potential, strategically structuring information will be the ultimate strength of this digital story format.

Project Timeline

On November 17, 2023, the first drone flight with Skydio 2+ was conducted to 3D scan Cane Hill College. The 3D model was rendered the following week on Agisoft Metashape (2024) and was included in the final StoryMap. On March 26, 2024, I met with Historic Cane Hill Inc. directors Vanessa McKuin and Lawrence McElroy, who received my project proposal positively. The project was narrowed to creating a StoryMap of the vessels as a prototype for potential storytelling applications in their museum. The scanning process for the first vessel began on March 29 and served as a successful test run. From April 1 to April 12, I completed a total of five total scans, and had transitioned to only using the control points method to ensure each vessel's safety and accuracy of the scans. On April 18, additional historical context about each vessel was provided by Historic Cane Hill, this initiated the first step for the StoryMap drafting phase. By June 4, 2024, the StoryMap and final 3D renders neared completion. Discussions on June 18 with Historic Cane Hill finalized the publication and future applicability of the StoryMap, focusing on verifying accuracy and providing them with the accumulated data

for future outreach goals. Since this is a public archeology project, I wanted to ensure Historic Cane Hill Inc. had input over content before publication and also provide them with tutorials on how to do their own updates. The project generated significant new data through the creation of digital recreations, transforming tangible artifacts into detailed 3D models. These models facilitate detailed examination without physical handling, minimizing research risks, and expanding accessibility. The digital assets democratize access to cultural artifacts, enabling broader engagement and new creative projects. Additionally, the creation of 3D models provides redundancy, safeguarding against loss or damage to the original objects. Using these models in educational and interactive media, such as StoryMaps, enhances public engagement and ideally results in a deeper appreciation of these historical materials.

Integrating Content into StoryMaps

The StoryMap I created aims to improve retention by employing a non-linear, multi-layered approach with organized and self-contained interactivity. Its design philosophy follows a maximalist approach, inviting users into the story by clearly outlining what will be learned and offering opportunities for decision-making based on that content. Based on various user observations while developing the StoryMap; to maintain a clear direction and user-control throughout the presentation, I incorporated layers of signposting, interactive displays, and supplemental information to enhance the depth and clarity. Although this presentation does not include GIS-based datasets, I aimed to demonstrate that StoryMaps can still be effective by using multimedia elements such as annotated maps, three-dimensional models, and 360-degree virtual tours. View the StoryMap for this project here:
https://storymaps.arcgis.com/stories/a72a5420ec9a400f99daf46c80aa9a15

From my exploration of other user-created StoryMaps, including examples provided by ESRI ArcGIS StoryMap tutorial (2024), I observed several issues. Many projects assume the platform inherently innovates information delivery. They often present (at times aesthetically appealing) data and content in a linear style and manage to only briefly encourage users to explore through the topic without inviting further investigation. This approach to StoryMap creation can result in overlooked information and data due to the design's uninviting introduction, poor signposting, lackluster presence, or limited interactivity. Without clear indicators that highlight the topic and encourage engagement, these types of StoryMaps may result in a disconnect between the audience and the content. Furthermore, a core limitation of these StoryMaps lies in their singular narrative path. They typically consist of a sequential presentation of text, images, and occasionally an interactive map. For example, many presentations often include GIS-based datasets accompanied by a wall of text and a picture but do not encourage interaction with that map or scaffold the information beforehand to aid in easier digestibility of that content. Without proper scaffolding, upon someone's initial exposure, may result in both the data and its contextual importance remaining unseen or unclear.

Maximizing StoryMap's features can facilitate engagement, this is the platform's core strength, such as spatially orienting the viewer into a story by using interactive maps or attaching high-quality images and videos with short, annotated text. However, merely adding images and pinned locations to maps may not be sufficient in all cases. It is important to offer a clear path forward to investigate and learn about the topic beyond simple scrolling. In a public-facing project like this one, it is likely that many people will either be unaware of its existence or merely glance at the presentation. Therefore, for those who do encounter the presentation, it should attempt to pique their interest within the first few seconds and try to retain their

engagement throughout its entirety, if possible. Respecting the audience's time and decision to view a particular StoryMap involves increasing the direct visibility of key information you want them to know. This can be achieved by directing attention through the process of understanding that information, such as lightly scaffolding to lead viewers to a point, signposting engagement with embedded multimedia (like 3D models or maps), or using alternate pathways to build out more complex points in a navigable format. While a non-linear or multilayered StoryMap is not guaranteed to achieve this, it remains an untested design avenue worth exploring. As demonstrated in my own style of presentational design, there is still untapped potential in StoryMap creation that may lead to increased interest and exposure.

As an interactive microlearning experience (Lee et al. 2021; Sung et al. 2023), a StoryMap should always deliver digestible pieces of information while respecting the audience's limited time. To achieve this, my StoryMap prioritizes clear and well-signposted content within each section. This ensures users can navigate the experience without additional explanation and to quickly begin learning about the embedded content. As stated earlier, the initial encounter with a StoryMap is vital for retaining attention. To maximize this encounter, I used high-resolution drone footage of the town's landscape (courtesy of Historic Cane Hill Inc.) as an attention grabber. Following this introduction, a concise table of contents outlines the content, and a tutorial introduces the concept of interactivity with ‘media actions’ throughout the story. These ‘actions’ open explorable locations, navigable maps, and 3D models with annotations, providing both context about the upcoming experience and instructions on how to navigate it. A strong highlight video and a tutorial introducing base functionalities are good starting points, but they are not enough to 'sell' the rest of the presentation. 'Selling' the rest requires following through on the intent and purpose of the StoryMap.

The core of my design choice lies in its non-linear narrative structure. Unlike linear maps that follow a singular path and can be easily scrolled through without further engagement, my approach tries to involve the audience in the Storymap by offering choices. For example, in the slide introducing the location of J.D. Wilbur's pottery site, a blue 'jump link' is strategically placed at the bottom of the slide. When clicked, the link navigates to another section of the StoryMap that provides a behind-the-scenes tour of the archeology that occurred there. This method also guides users to explore the history of American stoneware and investigate historic locations in Cane Hill, such as Cane Hill College. Additionally, it allows users to quickly view all the 3D models in one place and take a full 360-degree virtual tour of the Cane Hill Museum.

Including 'jump links' aids in effectively building out the context of key slides by providing additional information about that topic within a fresh page and format, while also minimizing the clutter of extraneous details that may have gotten removed in a linear presentation. To minimize confusion and frustration while navigating these nested links, intuitive signposts such as arrows and color-coded pathways, along with well-defined menus, guide users through the layered story. This navigation method aims to clearly convey the intent and purpose of the presentation by providing an interactive experience that works with the audience to learn and encourages them to take their time exploring the topics. To extend the example a bit further, using strategic navigational tools could be applied to lessen the impact of complex scientific information. For instance, if encountering an artifact in a StoryMap that requires additional exposition, one pathway might investigate its historical context and cultural significance at the beginning of the story. Later in the story, another path could explore the matrix it was discovered in at an archeological excavation. Near the end of the story, a third pathway could focus entirely on the process of curation and interpretation of that data. These pathways are strategically placed

at key intersections to draw the reader to each point succinctly without overloading the page with information. These pathways could be presented linearly, but by doing so in a non-linear way may facilitate further engagement with the process of learning about the artifact, while offering the user agency in navigating that experience, and subtly truncates the information, creating the impression of a more dynamic presentation.

Structuring an effective StoryMap is one key aspect explored in this project. In addition to structure, StoryMaps inherent visual design prioritizes user understanding by limiting large spaces for text. Scientific information often comes with a fair bit of reading, but in a StoryMap, narratives may want to avoid text overload, since the audience could ignore it entirely. Following the adage "show do not tell," whenever possible, complex concepts should either be explained interactively or visually. To rectify this in my own StoryMap, I presented text in small chunks, accompanied by interactive elements (such as annotations) and visuals. In most cases, these annotated segments are not forced upon the user as content that must be scrolled through, but are instead offered as explorable material to learn more about the story they are interacting with. For example, embedded in the story are 3D models and historic maps that include interactive annotations which highlight key features and significance about the objects or place. If the reader chooses to view the 3D model, for example, they will get the entirety of the information, but if they choose not to view the model, then there is still enough context from the surrounding story to understand its significance. For the maps, I included explorable annotations and images that highlight aspects of the period the story is set, such as important locations of stoneware production and Civil War battlefield sites in Arkansas. These visual set pieces were added to build out the overall context of the story (i.e., world-building) and to incentive interaction. Knowing there is additional information contained within varying segments to be discovered

adds an additional layer of incentive to want to explore through it, and doing so should be rewarding.

I have introduced my design philosophy, but it is also important to acknowledge the limitations inherent in its design. First, some users may find a linear format simply more intuitive and quicker to engage with. Sometimes less is more and not all StoryMaps need to be overly complex or dynamic. This multi-layered method may also potentially lead to confusion, particularly for those unfamiliar with non-linear navigation. Secondly, the self-contained design increases development time compared to linear StoryMaps. This is especially apparent in ensuring a cohesive design that allows the narrative to flow across various interconnected pathways, which could result in users getting confused and missing key information. Lastly, the design has the potential to work against itself by overloading the user with too many choices, which neither increases the depth of the narrative nor rewards the user for navigating through the nested links.

It could be argued that simply providing external links to other StoryMaps or embedding multiple StoryMaps within each other through an iframe are obvious solutions to these problems and would increase dynamism. However, creating multiple linear StoryMaps that contain the option to open new StoryMap links, can disrupt the narrative flow. The need to open new tabs to view the next StoryMap breaks the immersion of the presentation and places the user back into a browser-based experience. Meanwhile, embedding multiple stories within a primary presentation is a method I explored and believe has potential. However, this method presented many issues with navigation, crowding, and size. Overall, if not well-executed, these methods will still lack the interactivity and dynamic exploration possibilities of a single, well-designed presentation. In

contrast, while not tested, the non-linear approach may offer a higher-retention and potentially more rewarding exploration of the topic.

In conclusion, by implementing these design elements, StoryMaps can transform from static information displays into engaging and interactive micro-learning experiences. The clear communication of the story's intent and purpose has the potential to improve retention for public audiences. This approach can be particularly valuable in educational settings like museums or historical sites, where audiences often have pre-invested interest, extended time, and varying levels of existing knowledge.

Chapter 5: Discussion and Conclusion

In Chapter 4, I discussed the historical context of Cane Hill, as a historically rich site with significant nineteenth-century buildings and archeological deposits. Its local significance is amplified through the activities of Historic Cane Hill, Inc., which aims to preserve and promote the area's cultural heritage. Cane Hill was selected to demonstrate the effectiveness of digital methodologies in public archeology. Its existing engagement in historic preservation and public outreach provided a solid foundation for implementing innovative digital tools. Therefore, StoryMaps were chosen for its ability to integrate dynamic text with three-dimensional models, multimedia elements and interactive maps, providing ample avenues for presenting archeological data and historical narratives. Furthermore, photogrammetry and StoryMaps allows for an interactive and accessible presentation of Cane Hill's history, but more importantly, demonstrates a low-cost solution for smaller organizations, such as local museums, to present their history in innovative ways. Chapter 5 serves to discuss the limitations encountered in the project and to propose future directions for research in digital public archeology. It evaluates the challenges of

implementing digital storytelling and 3D modeling techniques, while suggesting ways to enhance their accessibility and effectiveness.

Since the 1970s, public archeology has evolved significantly, emphasizing community engagement and the democratization of archeological practices, as discussed in Chapter 2. To maintain public interest, archeology must continually innovate to make the field accessible and relatable. While Arkansas's existing public archeology initiatives, such as volunteer opportunities, training programs, and local events, are effective on a manageable scale. I have argued for and demonstrated a method for larger-scale historical and heritage focused initiative, which has the potential to be implemented for museums and other non-profit or state organizations. StoryMaps, with their innovative data presentation, offer a promising solution to enhance public interest and involvement, supporting these broader projects. Additionally, photogrammetry, including 3D modeling and sUAS missions, introduces new occupational fields within archeology, promising sustainable opportunities for both professionals and non-specialists. As demonstrated by my research these approaches collectively have the potential to transform how archeological knowledge is produced, disseminated, and perceived.

This thesis presents an integrated approach to public archeology. As demonstrated, an integrated approach involves combining traditional archeological practices with modern digital tools to democratize access to archeological knowledge. By using digital technologies, public archeology can reach wider audiences, provide higher-quality educational experiences, and promote community involvement in archeological projects. I explored and demonstrated varying digital methodologies that may have the potential to increase public interest in archeology, primarily digital storytelling and three-dimensional (3D) modeling. I also examined the challenges and limitations of using these digital methods such as technical requirements, data

management, and accessibility issues. By identifying these challenges and proposing solutions, the project contributes to the development of best practices in the field.

For my case study, using Cane Hill as an example, I showcased the practical application of digital methodologies in public archeology. Through my time spent in Cane Hill, I was able to detail workflows for creating accurate three-dimensional models of artifacts and sites using photogrammetry. By documenting and sharing these workflows, the project provided a valuable resource for other archeologists and institutions looking to adopt similar methods. In addition, the project included the integration of three-dimensional models into ArcGIS StoryMaps, this allowed for the creation of interactive and visually compelling micro learning experiences. Finally, by making the StoryMap available for use and editing by Historic Cane Hill, Inc., the project offers a sustainable tool for future outreach projects. Overall, this thesis attempts to advance the field of public archeology, by providing a comprehensive framework for other archeologists and institutions to adopt and build upon in their own projects.

Limitations of the Project and Future Directions

However, these approaches do offer a path forward, yet their practical implementation faces significant challenges. The primary limitation of this project lies in the constraints of the methodologies applied. 3D-object and aerial photogrammetry in combination with ArcGIS StoryMaps, present several practical challenges. First off, despite its growing accessibility, producing accurate and detailed three-dimensional models demands a significant understanding of photographic principles and requires advanced computer skills, particularly a working knowledge on how to effectively use software like Agisoft Metashape. This creates a barrier for smaller institutions and individual researchers who may lack the resources for high-end equipment and training. My solution is to embed accessibility in an institution like the ARAS or

the University of Arkansas. While not ideal, public licensing, hosting, etc. can be handled more efficiently. Additionally, the use of StoryMaps is limited by its cost and accessibility. ESRI StoryMap requires a subscription fee. The Creator license costs $550 per year and allows users to create, share, and analyze maps and apps. The GIS Professional Basic license, at $765 per year, enables advanced data mapping and visualization using ArcGIS Pro and connects to ArcGIS Online and the Living Atlas. Both licenses require a foundational user type for account management and can be paired with additional dependent user types, which may add extra costs (ESRI 2024). This financial barrier may limit the widespread adoption of this tool among smaller museums or other organizations that are already operating on tight budgets. Furthermore, these expenses do not account for the costs of photogrammetry software, equipment, among others; for instance, Sketchfab (2024) subscription begins at $180 per year but offers a free version, and Agisoft Metashape (2024) offers a one-time purchase price for their professional product at a staggering $3,499. However, there are open-source options for photogrammetry software. In addition, as I suggested in Chapter 2, pairing with a larger cooperative such as a university or state ran organization is a potential solution for covering these expenses.

Budgets aside, the theoretical framework of this project, which integrates public archeology with digital storytelling, introduces potential biases that could affect the outcomes. First, this approach assumes a level of public engagement and interest that may not be present in all contexts. Moreover, the focus on digital methods may inadvertently prioritize technologically savvy audiences, potentially excluding both aged and less technologically proficient or inaccessible demographics. As mentioned in Chapter 2, security and storage will continue to remain an issue with large and sensitive data sets. Lastly, distribution of StoryMaps is a key concern, if these platforms are to be successful will require robust online infrastructure to ensure

effective promotion, seamless performance, and the ability to be viewed across diverse internet bandwidths and devices. Solving these practical limitations will be a challenge, and still leaves several qualitative questions unanswered, primarily; the uncertainty of long-term effectiveness of digital storytelling in impacting and maintaining public engagement in archeology. It is also unclear whether interest in StoryMaps can be sustained over extended periods, especially for small-scale projects. Additionally, research still needs to be done to report whether the use of StoryMaps translates into a deeper understanding of archeological sites and artifacts. The final ambiguity lies in the interpretation of three-dimensional models, such as evaluating the accuracy and authenticity of these representations, and further stressing whether these digitized artifacts will be valuable and managed in the long term, given the rapid evolution of technology and digital platforms.

To address these limitations, future projects could explore open-source software that has higher potential to democratize access to these technologies. For instance, integrating mobile applications like Polycam: 3D Scanner & Editor (Polycam 2024), which promises lower entry barriers, could enhance the practicality of three-dimensional scanning for both broader audiences and settings. Secondly, conducting longitudinal studies to track the impact of digital storytelling on public engagement over time could showcase its perceived effectiveness. These studies could evaluate how sustained exposure to digital models and interactive narratives influences public interest and participation in archeology. In my StoryMap I included a short analytic survey for people to fill out to collect further data on the project's effectiveness. Lastly, further collaborations with educators could enhance both the long-term sustainability and educational impact of digital storytelling. The use of StoryMaps and 3D models could make archeological knowledge more engaging and interesting for students in the classroom.

Beyond the scope of this study, the integration of technologies like augmented reality (AR) and virtual reality (VR) could also further enhance the potential of digital archeology. Furthermore, utilizing machine learning for analyzing and interpreting archeological data presents another fascinating direction for digital archeology projects. Moreover, the use of AI generation may extend the capacity for non-specialists to develop media-based projects and create narratively rich content without extensive formal training. This could narrow the professional divide by enabling more individuals to contribute to project development. Finally, future research should advocate for funding to support digital storytelling projects. It should also aim to develop guidelines for the ethical use and dissemination of digital data and provide a framework for structuring diverse publications.

In conclusion, the StoryMap developed in this project will be accessible to the public and editable by Historic Cane Hill Inc. Continuous updates will not only enhance the StoryMap's capabilities but also allow it to further enrich the understanding of Cane Hill's history through new outreach and educational activities for both physical and virtual visitors. As a case study for digital storytelling, Cane Hill demonstrates the potential of these techniques to effectively preserve and promote cultural heritage while providing a practical model for future public archeology initiatives, especially for smaller local museums and non-profit organizations. This method takes a holistic and integrated approach to public archeology, respecting ethical responsibility, proper permissions, and multiple perspectives. Furthermore, by emphasizing co-creation in digital spaces, this approach incentivizes and attempts to develop active communities engaged in archeology through facilitating the spread and dissemination of historical and cultural information. This thesis explores the evolution of public archeology through the integration of modern digital tools. It highlights how combining traditional archeological practices with digital

storytelling and 3D modeling can democratize access to archeological knowledge. Despite the many challenges that may exist, projects like these demonstrate the potential of digital methodologies to transform public archeology. Therefore, from this foundation, future research can continue to focus on enhancing accessibility and studying the impact of digital storytelling. Ultimately, this work underscores the importance of continued innovation and collaboration to sustain public interest and involvement in archeology.

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Appendix

Appendix 1:

J.C. & J.D. Wilbur Storage Jar

Date: Circa 1850s - This jar from the Zanesville, Ohio pottery factory represents an early phase in J.D. Wilbur's career when he was likely just finishing his apprenticeship with his brother

J.C. Wilbur. The lack of cobalt blue decoration, which was quite popular in Ohio pottery for its vibrant contrast against the buff-colored clay, marks this piece as unusual. The technique and materials used, such as the buff-colored stoneware clay typical to the Ohio region, represent the regional variations in pottery production in the United States during the mid-19th century. The migration of J.D. Wilbur to the South around the time of the Civil War would have influenced his later works, incorporating Southern styles and needs into his pottery.

Gold (J.D. Wilbur and Roark Canning Jar)

Date: Circa 1868-1869 - This small vessel is a salt-glazed stoneware canning jar made by J.D. Wilbur and James Michael Roark in Boonsboro (Cane Hill), Arkansas. This piece is notable for its golden color, an anomaly in typically brownish-grayish salt-glazed pottery of that era. Salt-glazing is a technique where salt is introduced into the kiln during the high-temperature firing process, creating a glassy, often orange-peel texture on the surface of the pottery. The sodium from the salt reacts with the silica in the clay to form a glaze. This technique was widely used for utility ware because it made the vessels watertight and durable. The presence of J.M. Roark, although primarily active in Denton, Texas, suggests a brief but significant collaboration with J.D. Wilbur. After Roark's departure and Wilbur's subsequent sole ownership, the pottery markings were changed, reflecting common practice when potters would adjust their stamps to reflect the current operation's ownership.

Brown Vessel (J.D. Wilbur Storage Jar)

Date: Circa 1870s - post-1869, the vessels marked solely with J.D. Wilbur’s name indicate a period when he had taken over the complete operation in Cane Hill. The small-mouthed design with a protruding base on this jar is characteristic of the practical and regional adaptations made

by Wilbur to suit the needs of his clientele, likely for storing liquids like broths and preserves, which needed a tighter seal to prevent spoilage.

Wide Rim (J.D. Wilbur Storage Jar)

Date: Circa 1870s - This wide-rimmed jar, used for storing bulk foodstuffs, illustrates the versatility of salt-glazed stoneware in everyday life. The design features such as the wide rim for securing a cloth cover underscore the functional aspect of pottery design, tailored to preserve various food items safely. This piece from the 1870s also showcases the continued evolution of Wilbur's pottery marking system.

Large Pitcher

Date: Unknown - This unmarked pitcher is representative of J.D. Wilbur's style. While it is potentially unknown if Wilbur himself made the pitcher, the style is identical to another vessel that bears his marking.