Designing Digital Experiences in Archaeology: Integrating Participatory Processes into Archaeological Practice

Volume I

Francesca Dolcetti

PhD

University of York

Archaeology

December 2020

Abstract

Archaeology is a graphically rich discipline that has always applied various forms of visualisation to communicate information and interpretation about the archaeological record. In recent decades, the increasing dominance of digital techniques for archaeological visualisation has led to a rapid uptake of digital products, such as 3D models, often without consideration of users' diverse needs or assessment of their impacts on audiences.

This research seeks to address such issues by incorporating User Experience Design (UXD) and Participatory Design (PD) processes into archaeological practice. Through two distinct iterations of design and assessment of digitally mediated experiences, this research explores key themes around UXD in archaeology by investigating the following research questions:

- What is the impact of 3D visual media upon a diverse range of audiences, specifically how different users (specialists and non-specialists alike) engage with this specific form of (re)presentation of the past?
- How can we integrate evaluation frameworks and iterative processes into our methodologies in order to more meaningfully incorporate users' feedback into the design and improvements of these digital resources?
- How can we incorporate UXD and PD processes into archaeological practice to create digital products tailored to the needs and expectations of our audiences?

The first iteration of this research focuses on evaluating the impact that interactive 3D models have upon different audiences, using the case study of the Middle Bronze Age Cypriot settlement at Erimi- *Laonin tou Porakou*. The second iteration aims at assessing the design process behind the creation of digital resources using PD practices, through a series of workshops on the co-design of digitally mediated experiences in archaeology and heritage. The thesis ultimately articulates practical guidelines for archaeologists and other practitioners on incorporating UXD and PD approaches into archaeology. Such guidelines should then enable end users and stakeholders to be involved in digital resource development from the outset, critically tailoring these digital experiences to the needs and expectations of their audiences.

List of Contents

List of Tables

List of Figures

List of Accompanying Material

Erimi 3D Model Metadata Schema: XML file.

Acknowledgements

I would like to thank my supervisor and mentor, Sara Perry, for all her kindness, support, motivation, guidance and friendship. Also, thanks to Julian Richards and Kevin Walsh for their help and assistance.

I am very grateful to: Fabrizio Galeazzi, for all the training and support, Marialucia Amadio, for her affect and all the conversations on building techniques, Claire Boardman, for being an amazing person and an excellent designer. Huge thanks to Paola DiGiuseppantonio di Franco and Alessandra Sprega for their conversation, support and friendship. Thanks also to Luca Bombardieri, all the members of the Erimi Archaeological Project and to all those who agreed to take part in my study, for their time and kindness in sharing their thoughts and expertise with me.

I would also like to thank my family for their endless love and cheering, and the following people for their friendship and moral support: Donald Henson, Constance Dourgeat, Paul Edward Montgomery Ramirez, Caitlin Kitchener, Patrick Gibbs, Allyson Edward, Aubrey Steingraber, James Osborn, Ian Hardwick, Carl Savage, Callum Reilly, Megan von Ackerman, Tom Fox, Alister Oswald and Roger Fairfax. If I have forgotten anyone, please accept my apologies.

For Michele, my love, my partner and my best friend. Thank you for everything, I could not have done this without you.

Declaration

I, Francesca Dolcetti, declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

I also declare that the following publications arose from this thesis:

Amadio, M and Dolcetti, F (2019) GHOST ARCHITECTURE: Contextualizing wooden and perishable structures from Middle Bronze Age Erimi-Laonin tou Porakou. In: D Glörfeld, K Kitting, B Morstadt and C von Rüden (eds), *The many face(t)s of Cyprus*. Bonn: Verlag Dr. Rudolf Habelt GmbH, pp. 27-40.

Dolcetti, F (2021) From fieldwork to virtual reconstruction: 3D models and immersive experiences. In: L Bombardieri and E Panero (eds), *Cipro. Crocevia delle Civiltà*. Roma: DeAngelis Art. In press.

Dolcetti, F, Bonora, V, Fiorini, L, Conti, A and Tucci, G (2017) 3D modelling and architectural visualisation. In: L. Bombardieri (ed.), *Erimi Laonin tou Porakou A Middle Bronze Age Community in Cyprus Excavations 2008-2014*. Uppsala: Paul Åströms Förlag, pp. 327-334.

Dolcetti, F, Boardman, C, Opitz, R and Perry, S (2021) Values-Led Design Cards: Building Ethically Engaged Archaeology and Heritage Experiences. *Sustainability*, 13(7):3659. https://doi.org/10.3390/su13073659

Dolcetti, F and Bombardieri, L (2021) 3D Technologies in Cypriot Prehistoric Archaeology and Heritage: The Erimi User Experience. In: *Proceedings of the joint international event 9th ARQUEOLÓGICA 2.0 & 3rd GEORES*, Valencia (Spain), 26–28 April 2021. Forthcoming.

1 Introduction

Archaeology has always been a profoundly visual discipline, frequently utilising pictures, drawings, illustrations, artist's impressions and, more recently, 3D models. In fact, the field has a long history of using visual representation to communicate the archaeological process and interpretation of the past, as well as to encourage direct reflection on archaeological materials. As stated by Moser (2012, 292), "far beyond simply assuming a descriptive and communicative function, images have long been used to mount hypotheses about the scientific and cultural significance of ancient remains". However, despite the fact that visual media (i.e., art, drawing, photography, filmmaking and so on) have always been an integral part of the discipline of archaeology and hold a critical role in the production of archaeological knowledge, their theoretical value has often been overlooked (Smiles and Moser 2005; Moser 2012; James 2015; Perry 2015; Morgan and Wright 2018). As Moser and Smiles (2005, 2) observe "we need to engage with the problematics surrounding the image's mediating function as a bearer of archaeological knowledge, and this is as valid for the analysis of virtual reality (VR) reconstructions as it is for eighteenth-century engravings".

In recent decades digital technologies for recording archaeological evidence, visualising and communicating interpretations of the archaeological record have become widespread. However, it has often been argued that their rapid uptake has not been accompanied by a sustained body of critical theoretical discussion on their application. According to Gillings (2005) in his discussion around virtual reality (VR) techniques in archaeology, even where critical discussion has taken place it has tended to occur as an after-thought, a post-hoc justification rather than the development of a sustained guiding methodology. Moreover, our understanding as practitioners of their real effectiveness and impact on diverse audiences (specialists and lay publics alike) is still limited. While, in the last decade, a growing body of literature has been addressing how visitors cognitively and emotionally engage with interactive digital heritage experiences (see Di Giuseppantonio Di Franco et al. 2015; Damala et al. 2016; Perry et al. 2017; Kidd 2019 to cite a few), we still know relatively little about the short and long-term impact of these digital encounters and how the digital resources we produce are re-used and re-interpreted by or audiences (Economou 2017). We often design and develop digital resources without critical reflection on who are our core audiences and what needs and expectations they have; and we often do not invite our intended audiences to take part in the process and collaborate in the creation of these resources.

However, within the field of Human Computer Interaction (HCI), several design processes and approaches have at their core a focus on users' needs, a concern for developing experiences that are meaningful and relevant to users, and a desire to explicitly design these resources in cooperation with individual users themselves. An example is provided by participatory design (hereafter PD), an approach to the product design process developed in Scandinavia during the 1970s that attempts to actively involve all stakeholders (e.g., employees, partners, customers, citizens, end users) in the creation process to help ensure that the final product meets their needs and is usable. The core values of PD are democracy and empowerment of end users, who are treated as peer co-designers and given a more responsible role in the development of systems or products that will impact their life, sharing decision-making power in the design process (Robertson and Simonsen 2012). The design thinking process is a human-centred approach to design that has been slowly developing since the 1960s and has become increasingly popular over the last few decades. It seeks to understand users, challenge assumptions, redefine problems and create innovative solutions (meant as products, processes or systems) to be then prototyped and tested. The design thinking process is centred around empathy: designers are obliged to set aside their own assumptions about users' needs, to some extent, and, instead, gain insights into what users feel and think by immersing themselves in the user experience (Woolery 2019).

Engaging with these design practices and developing digital resources in collaboration with who we identify as our core audiences (i.e., the group of people for whom we design such resources) offers us meaningful opportunities for knowledge production and mutual exchange. Moreover, it can lead us to create digitally mediated experiences (i.e. experiences where people interact with digital devices) in archaeology that are not guided by our own assumptions about our audiences' needs and can really affect people's engagement with the past.

In order to address these issues, my own research proposes to integrate User Experience Design (UXD) - the process used to create products that deliver meaningful and relevant experiences to users - and PD practices in archaeology through two distinct iterations of design and assessment of digitally mediated experiences. The overall aim is to provide practical guidelines to devise a co-design methodology for the interdisciplinary creation of digital experiences for the cultural heritage sector, in order to allow end users and

stakeholders to be involved in the design process from the outset and develop experiences tailored to their needs and expectations.

The first iteration of this research project has been focused on evaluating the impact that interactive 3D models, i.e., digital models that can be accessed and explored through a User Interface (hereafter UI), of archaeological sites can have upon archaeological research, academic and public dissemination. Using both quantitative and qualitative methods, my aim is to understand how different audiences (experts, non-experts, students) perceive and interact with this specific form of digital visualisation. The study is based primarily upon data from the Middle Bronze Age Cypriot settlement at Erimi-*Laonin tou Porakou* (2000-1450 BC). This site-specific focus has been chosen because it constitutes an interesting and challenging case study: its poorly preserved architecture and lack of visible and understandable features makes it difficult for people outside a restricted circle of experts to conceptualise and relate to. Using insights gained from my first round of evaluation (focused on different audiences' needs and expectations), the second iteration of this research shifts the focus from the assessment of the final product to the evaluation of the design process behind its creation, using a PD approach (Sanders and Stappers 2008; Simonsen and Robertson 2012) wherein end users are involved as co-creators. Through a series of workshops aimed at the co-creation and user testing of digitally mediated experiences geared at archaeological and heritage sites, I argue that the collaborative process enabled by the adoption of co-design practices promotes meaningful ways of knowledge production and sharing. It also leads to a more critical reflection on what motivates us, as practitioners, to design digital resources and deeper understanding of our audiences, who they are and what they feel and need.

This chapter introduces the research background, identifies the research problem, and discusses my research questions, aims and the significance of the study in terms of contributions to knowledge. It also summarises the research design before providing an outline of subsequent chapters in the thesis.

1.1 Background

Archaeology is a visually rich discipline: it has always used images to record material evidence and document the excavation process, as well as to present interpretations of the past. The earliest recorded illustrations of archaeological sites and artefacts arguably occur in medieval manuscripts from northern and western Europe (Adkins and Adkins

1989). However, the styles of archaeological illustration most people are familiar with today have their roots in the Renaissance period, when the rise of scientific studies led to the realisation of a need for measured drawings as aids for classificatory systems (Adkins and Adkins 1989). By the mid eighteenth century, following an increasing interest in classical antiquities, drawings and paintings of classical architecture were quite common. However, with the rise and peak of Romanticism in the early nineteenth century, many of these images retained the somewhat picturesque characteristics of landscape paintings. Illustration for archaeology really matured as a practice through pioneering work in sections drawings by Giuseppe Fiorelli at Pompeii, Alexander Conze at Samothrace and Ernst Curtius at Olympus, as well as the publication of General Pitt-Rivers' work in the late nineteenth century (Piggott 1965; Adkins and Adkins 1989; Trigger 1989).

During the twentieth century modes of graphic representation in archaeology diversified as the discipline itself grew and became subject to the influence of new ideas and techniques. The modern approach to archaeological illustration first appeared in 1922, with Mortimer Wheeler's Section from Segontium, which according to Adkins and Adkins (1989) represented the standard of perfection combining both clarity and aesthetic. After World War I, aerial photography was recognised as a valuable archaeological tool, while the application of analytic techniques from the geography field produced a new range of distribution maps. Moreover, technological developments in printing and reproducing photographs meant that drawings and paintings were no longer the only method to create archaeological illustrations.

The mid 1980s and early 1990s saw the rapid uptake of digital technologies for the analysis and presentation of archaeological data and information. The advent of spatial analysis and Geographical Information Systems (GIS) enabled modelling of real-world processes in an attempt to simulate and gain new insights into the interaction between humans and their environments (Evans and Daly 2006). During the 1990s and early 2000s the continuous development of digital technologies led to the application of three-dimensional (3D) modelling techniques and VR in the creation of 3D architectural models of archaeological sites (Rahtz and Reilly 1992; Forte and Siliotti 1997; Moltenbrey 2008). More recently, the field has continued to evolve, moving from the earliest applications of VR in archaeology, which essentially aimed to illustrate ancient monuments, to projects carried out over subsequent decades which have been

undertaken with various purposes, such as field recording, analysing and interpreting stratigraphic sequences (Callieri et al. 2011; Dellepiane et al. 2013; Dell'Unto 2014; De Reu et al. 2014; Forte et al.2015; Galeazzi et al. 2015), publishing excavation reports and monographs (Opitz 2018) or creating 3D digital replicas of artefacts (Di Giuseppantonio Di Franco et al. 2015).

Nowadays digital tools and approaches are widely used in the discipline and digital archaeology is an established research area lying at the intersection of archaeology and digital technologies, used for facilitating documentation, interpretation and communication practice (Averett et al. 2016). Moreover, digital technologies have become common and widespread in the cultural heritage sector, as museums and other cultural heritage institutions are increasingly enriching their offers to visitors by providing immersive and engaging experiences. Virtual reality and augmented reality (AR) installations, 3D prints, mobile apps and games and other interactive digital media are permeating our lives and changing the way people engage with cultural heritage (Hupperetz et al. 2012; Kenderdine 2015; Pietroni et al. 2013; 2015; Damala et al. 2016; Roussou et al. 2015; Economou 2017).

1.2 Research Problem

Design, used in its broadest definition as the process of envisioning and planning a product or resource, is deeply and often implicitly embedded in archaeological practices and in the way archaeologists and heritage professionals produce and share knowledge. Design is about crafting solutions to real issues. It is a process wherein, according to Bolton's definition (2016, par. 22), "we work our way through, initially understanding the problem, whatever that may be, thoughtfully considering the client, the business, the market, the goals, the audience and users, and then find ways of telling the right story". The design process, in fact, does not only concern the 'what' and 'how' but most importantly the 'why' of the design, i.e., the reason and purpose of a product or resource. Rather than just focusing on the end product, the design process starts with identifying a problem or opportunity that needs to be addressed and then gradually develops into the creation of a final product through a cycle of data and information acquisition, evaluation and decision making. However, design has historically been considered a late add-on stage in the development process, where designers were only involved to make products and technologies more aesthetically pleasing. It is only relatively recently that it has been recognised that the value of design resides in its

ability to generate ideas that better meet users' needs and desires from the outset of the development process (Brown 2008).

As digital archaeology has grown as a field of practice, so too has the number of digital resources developed for specialists and non-specialists alike. In the last decade, the number of digital heritage encounters in the form of virtual worlds, AR, gaming, mobile apps, online collections and more has been growing exponentially. However, the creation of such outputs is seldom accompanied and informed by design theory and practices. The consequence of this lack of engagement with core design approaches, is that digital resources have been developed without a thoughtful consideration of the purpose of their creation, the intended audiences of these resources and how variegated and unspoken are their needs. Accordingly, we continue creating digitally mediated experiences that are guided by our own assumptions about our audiences' interests rather than being led by reflection on what impact they might have and what our audience might take away from such experiences. Moreover, by not involving our audiences in the creation process we are missing meaningful opportunities to include different voices and perspectives that can help generate new forms of archaeological knowledge production and sharing. As exemplified by Monteiro (2019, 21), "design is the intentional solution to a problem within a set of constraints. To know whether you are properly solving those problems you need to meet the people who are having them [...] even better your team should include those people".

Moreover, the UI and User Experiences (henceforth UX) we create to interpret, use, and share the archaeological record often do not benefit from critical reflection on why and for whom we are designing them. This issue around the lack of critical reflection is embedded in a broader debate in the field about the role of digital technologies in archaeological practice. Several scholars have in fact voiced their concerns about digital archaeology being often viewed as an under-theorised field with little theoretical impact on the discipline (Dallas 2015; Huggett 2015a; Huggett 2015b; Jeffrey 2015; Perry and Taylor 2018). This lack of theorisation and the increasing affordability and usability of 3D technologies has very often led to the creation of digital resources motivated mainly by technological availability rather than informed by reflection on their purpose and intended audience. Such reflection in many cases has come as an afterthought, rather than preceding and guiding the design process. As stated by Dallas (2015, 177), echoing sentiments voiced by Huggett (2015a), "it is not accidental that digital archaeology is

thus laid open to critiques of being technocratic, apolitical and indifferent to social and cultural concerns and of relating poorly with theoretical orientations currently found in archaeology". As Jeffrey (2015, 149) puts it "digital representations of the past continue to struggle to overcome the perception that they are either purely scientific tools for analysis and management or flashy and unnecessary demonstrations of technological prowess offering no real insight into or connection with the past". According to Jeffrey, digital heritage practitioners are perpetuating this perception, by valuing mainly the aesthetic and technological aspect of such representations.

Problematic, according to Perry and Taylor (2018, 11), is that the focus on the applications of digital technologies tends "to eclipse meaningful critique of their implications [...] this trend to value the technical above the theoretical is one that is seen across many fields and it is made worse by the fact that it tends to betray itself again and again as any new piece of equipment is added to disciplinary toolkits". They then continue pointing out that, while some so-called new technologies have in fact been adopted for decades, a more critically engaged approach to their application has yet to be developed. Similarly, in her discussion on visualisations and visual media, Watterson (2015) asserts digital archaeology needs to establish new approaches to the creation of archaeological visualisations, ones that reflect on the impact of such images in creating new knowledge. In order to do so, Huggett (2015b) argues for the need for a more self-aware digital archaeology, whose 'grand challenge' is to better understand how the application of digital technologies has impacted all stages of knowledge creation – from data collection and analysis to interpretation and publication.

While there is no argument around the value of digital technologies within archaeological practice, the main criticism in the field revolves around their outputs, the way in which they are designed and the impact they have on users. As pointed out by Perry (2018, 219) "captured by visual and other technologies, the resulting (usually 3-D) models of the archaeological record that are produced from these [digital] projects are often popped straight into exhibitions, on websites, in mobile apps, and in articles, magazines, and other media, with little to no critical intervention by creative specialists—let alone by their own makers". In relation to this topic, Opitz and Johnson (2016) focus on the impact of design choices in the creation of GUIs (Graphic User Interfaces) on theoretical discourse around the creation and consumption of archaeological knowledge, specifically the interface developed within the Gabii Project

integrating a 3D model of its Tincu House with other visual and textual information. They argue that well designed GUIs provide an engaging way to interact with archaeological data, one that encourages a slower and more reflexive exploration and that allows users to critically examine the archaeological record. According to Opitz and Johnson (2016, 4) "by including in their development and dissemination a discussion of design principles and goals, these exercises in design can explicitly link their interfaces with specific archaeological questions". Such comments fit within a wider and growing call for a more reflexive, open and participatory archaeology (Morgan and Eve 2012; Dallas 2015; Caraher 2016; Kansa 2016).

A collaborative process of design, in fact, can theoretically engender a more democratic process where multiple voices, perspectives and experiences are included. Moreover, co-production forces people involved to address each other's agendas in a way that can stimulate critical reflection and awareness of unconsciously held assumptions (Asaro 2000). In their discussion around reflective design approaches, Sengers et al. (2005, 2), define reflection as "referring to critical reflection, or bringing unconscious aspects of experience to conscious awareness, thereby making them available for conscious choice". According to them, identifying unconscious assumptions not only helps avoiding design choices that can have negative impacts on the UX but also engenders a more socially responsible technology design practice.

Similarly, within museums and other cultural institutions, digital technologies have become increasingly pervasive over the last few years and they are seen as actively changing and shaping how people experience cultural heritage. As stated by Economou (2015, 225), while the application of digital technologies in archaeology and heritage has evolved, so our response and relationship with such technologies has changed, moving away from mere wonder to a more critically engaged and open approach to heritage interpretation. Within this discourse, several scholars argue for the need to move past the authoritative approach (i.e., a didactic unilateral way of information transfer) towards experiences that encourage reflexivity and critical meaning-making, more open to users' contributions. In doing so, they advocate for a more inclusive and participatory approach focused on the multidisciplinary co-creation of meaningful and emotionally engaging digital experiences (Mazel at al. 2012; Roussou et al. 2015; Ciolfi et al. 2016; Jones et al. 2017; Perry 2019).

As many scholars have pointed out, in order to assess the real effectiveness of digitally mediated experiences in archaeology and heritage, as well as their impact upon diverse audiences, an iterative design workflow and design evaluation methodology are needed (DiGiuseppantonio DiFranco et al. 2015, 244; Pujol 2017; Galani and Kidd 2019, 13). By iterative workflow and methodology, I mean a process in which these experiences are tested and evaluated with users and subsequently improved using users' feedback. This also true for the creative processes behind such outputs: it has, in fact, been argued that more studies are needed to assess the efficacy of PD approaches in terms of participants' professional and personal gains, alongside their efficacy in promoting and supporting meaningful forms of knowledge production and exchange (Bossen et al. 2010; 2012; Garde and van der Voort 2014; Ciolfi et al. 2016, 13-14).

1.2.1 Research Question and Aims

Within archaeological discourse at present there are a multitude of digital products and experiences geared at academic and public audiences alike. However, the way we, as practitioners, develop such resources does not fully exploit the benefits of design theory and collaborative design practices. In other words, we are creating resources that are not informed by a process centered around the concern for the overall UX rather than just the final output, and for explicitly designing it in collaboration with end users.

This research seeks to address such issues by incorporating UXD and PD processes into archaeological practice. Through two distinct iterations of design and assessment of digitally mediated experiences, this research explores key themes around UXD in archaeology by investigating the following research questions:

- What is the impact of interactive 3D models upon a diverse range of audiences, specifically how do different users (specialists and non-specialists alike) engage with these specific forms of (re)presentation of the past?
- How can we integrate evaluation frameworks and iterative processes into our methodologies in order to more meaningfully incorporate users' feedback into the design and improvement of digital resources?
- How can we incorporate UXD and PD processes into archaeological practice to create digital products tailored to the needs and expectations of our intended audiences?

This research is premised on the notion that design is an integral part of how we work with data, how we design publications, how we design research questions, and how we

communicate information and interpretation of the archaeological record. Design shapes how we develop and share our work and engage with our audiences. While not positioned in relation to existing design literature and practices, the application of design to archaeology has already been discussed by Carver (2011, 33), as a way for archaeologists to develop project plans in which the research agenda, the terrain and social context in which such projects are carried out are "matched to one another in the form of a design". In his work, Carver counters the dogma of default systems adopted in field archaeology with design, meant as a process of conceiving and planning excavations that is tailored to the specific research questions, geographic and social context of each research project. According to him, in fact, design offers the flexibility necessary to appropriately deal with the unique circumstances of each excavation and is the key parameter against which the value and validity of a research project should be evaluated.

In contrast to Carver, within my own research, the focus is on design itself and the application of design practices that allow us to guide the development of archaeological digital resources aimed at diverse audiences by consideration, and evaluation, of users' experiences. In other words, this research investigates how archaeological practices can benefit from embedding design theory and PD practices into the creation of digital resources, firstly by examining the impact of such resources, specifically interactive 3D models, on different audiences. Then, by assessing the design process behind the creation and development of digital experiences using PD methods and resources, through hands-on collaborative and multidisciplinary design activities. The research aim is to provide practical guidelines for archaeologists and other practitioners on incorporating UXD and PD approaches and actualising co-creation of digital resources in their own workflows.

1.2.2 Research Design

This research process unfolded across two iterations, both of which I briefly outline here, before discussing in further detail in Chapter 4.

I began the research by investigating and evaluating different audiences' perception and engagement with interactive 3D models of a particular archaeological site. This first iteration is based primarily upon data from Erimi-*Loanin tou Porakou* (Limassol, Cyprus), which was occupied from the end of the Early Bronze age to the beginning of Late Bronze Age period (2000-1450 BC). The site was first identified in 2007 by survey

in the middle and lower Kouris Valley and has been investigated since 2008 (Bombardieri 2017). The settlement is located on a high plateau on the eastern riverbank facing the Kouris Dam in a northward direction, on the border between the villages of Ypsonas and Erimi (Fig. 1.1). Different functional areas have been identified within the site, such as domestic and working spaces and three funerary clusters. The hilltop area is occupied by a workshop complex (Area A). The architectural evidence and residual associated material assemblages found in the lower terrace immediately downwards from the hilltop seem to indicate the presence of household complexes (Area B, Trench 2). Two distinct funerary clusters (Area E, upper and lower terraces) have been identified in two terraces south of the domestic area, whilst one other (the Ypsonas *Vounaros* cluster), situated east of the settlement, was rescue-excavated by the Department of Antiquities in 2012 (Christofi et al. 2015). A massive wall structure (Trench 1) that limits the settlement to the west lies in a minor terrace south of the domestic quarter and immediately north of the upper funerary cluster in Area E (Fig. 1.2) (for a detailed description of the site see Chapter 4, sections 4.2.1 and 4.2.2).

Figure 1.1: The Kouris River Area and the settlement of Erimi- Laonin tou Porakou (Bombardieri et al. 2018).

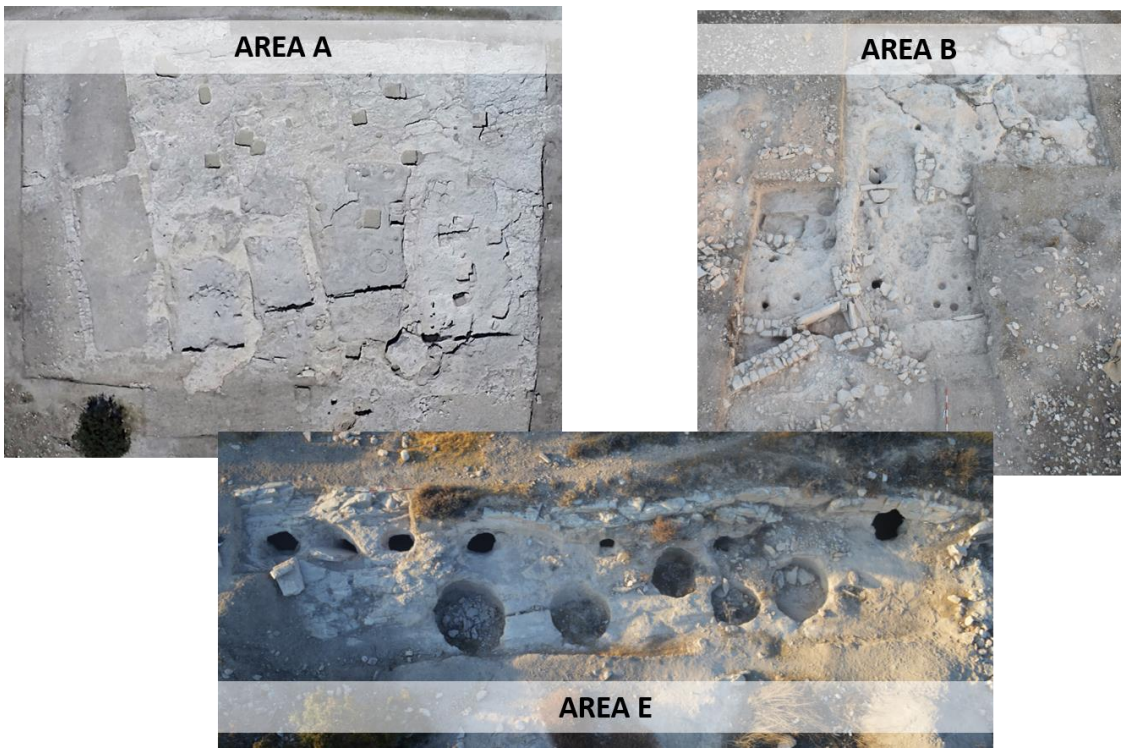


Figure 1.2: The Middle Bronze Age settlement of Erimi-Laonin tou Porakou (Bombardieri et al. 2018).

The site was digitally surveyed in 2010 and 2014 by the Geomatics and Communication for Cultural Heritage Laboratory (University of Florence) in order to generate a 3D model for each excavated area. From there, I used the 3D model of the workshop complex (Area A) as a base for the first stage of my research project. The visualisation process involved the creation of an interactive 3D model presenting the workshop complex's imagined built environment, as well as information about this specific area and the site in general. The evaluation process for this PhD entailed multiple stages, in which the model was presented to different audiences and users' feedback was gathered using quantitative and qualitative methods: surveys, interviews and focus groups. I chose to focus on Erimi-*Laonin tou Porakou* because of its historical and environmental characteristics, as it represents an interesting case study in the field of 3D visualisation of archaeological heritage. Its poor state of preservation (due to natural and anthropogenic processes such as erosion, bioturbation and grazing) is problematic in terms of achieving a comprehensive interpretation of the site's architecture and more broadly in terms of communication to academic and public audiences. Erimi, in fact, presents challenges similar to many, if not most, archaeological sites, as in its present state it does not have features that are easily recognisable and understandable by people outside a restricted circle of experts. This is what makes their 3D visualisation so

challenging in terms of dissemination – that is, how do we find a meaningful way to present them as both engaging and understandable? Moreover, my prolonged professional involvement in this site's excavations is beneficial for the visualisation process as it gives me a deep insight into all the intricacies, reasoning and discussions that lie behind the interpretation process. In this specific case, I believe my involvement actually enables me to bridge the gap between the modelling work of the site's-built environment and hypotheses made over the years by the research team about how it could have looked like in the past.

In order to better contextualise the results of my evaluation process within the broader discourse around assessing the impact of digital technologies in archaeological and heritage sectors, I concluded the first iteration by interviewing digital heritage practitioners and museum curators working on the development and evaluation of digitally mediated experiences for various audiences. The second iteration of my research took the knowledge gained in iteration one and focused on the process behind the creation of digital resources, to investigate ways in which archaeologists can design them more meaningfully and relevantly to their audiences, by co-creating practical solutions together with users. Adopting collaborative practices and extending participation to various audiences can be challenging, as it requires shifts in practice and tools to actualise such changes. We, as practitioners, might not be aware of the means by which we can effectively integrate PD in our design processes. For this reason, I coordinated two workshops on the co-design of digital resources - carried out at the University of York between February and April 2019 - to engage archaeology and heritage sector practitioners in testing the benefits of co-design practices and finding practical ways to incorporate such practices into their own workflows. The evaluation framework for both events applied mixed-methods - observations, open-ended surveys and focus groups - in order to triangulate data collected and obtain a deeper understanding of the efficacy of the co-design techniques and resources adopted, in terms of participants' professional and personal gains as well as fostering meaningful ways of mutual leaning (see also Chapter 4).

The first workshop was a one-day pilot session involving eight participants. It aimed at testing the overall workshop procedure, in terms of the structure and planning, as well as the co-design techniques and resources that were to be adopted for the following event. To provide participants with a case study for the co-design process, I decided to

use a project I have been working on alongside my PhD, as content curator and project manager for the design of a museum visitors' experience. Specifically, the project focused on one of the thematic sections of the exhibition on Cypriot history and archaeology titled "Cipro. Crocevia delle civiltà", which will be held at the Royal Museums in Turin (the launch date is yet to be determined due to the COVID19 pandemic). Within this section, the interactive 3D model I created for the first iteration of my project will be displayed alongside other tangible and screen-based digital installations as part of the visitors' pathway. As per the brief provided by both the museum curators and the director of the Erimi Archaeological Project, the section is meant to integrate interactive digital media with traditional displays into the pathway in order to offer visitors an immersive visit to Erimi-*Laonin tou Porakou*.

I chose this case study for the first workshop as it presents interesting challenges that I believe are emblematic of a persistent issue in digital heritage and the way digital resources are designed. It relates, in fact, to the assumption that digital resources do not need to be curated nor their design informed by considerations of different audiences' needs (see the discussion of the results of my interviews with heritage practitioners and museum curators in Chapter 6). The design of the visitors' experience, in fact, requires meaningfully integrating within the exhibition a digital product that was not specifically conceived and developed for a museum setting and audience. Moreover, it entails embedding a digital product that was originally designed as a stand-alone feature, within the gallery space with other digital and physical exhibits in a way that offers visitors a coherent narrative enhanced by the application of digital technologies. Integrating this project into my research allowed me to use users' feedback gathered through the first iteration to improve the experience with the interactive 3D visualisation of the site. It also offered the possibility to design a more articulate multimedia UX with the benefit of a co-design approach that was not adopted during the first stage of my research.

The second workshop was a two-day event attended by eighteen participants from across Europe, recruited among scholars and practitioners with research expertise and interest in designing digital resources for both the archaeological and museums sectors. The workshop was funded by the EU Cost Action ARKWORK (Fig. 1.3), as the aim of this network is to sponsor networking events (conferences, workshops etc.) to bring together the multidisciplinary work of researchers in the field of archaeological

knowledge production and use.

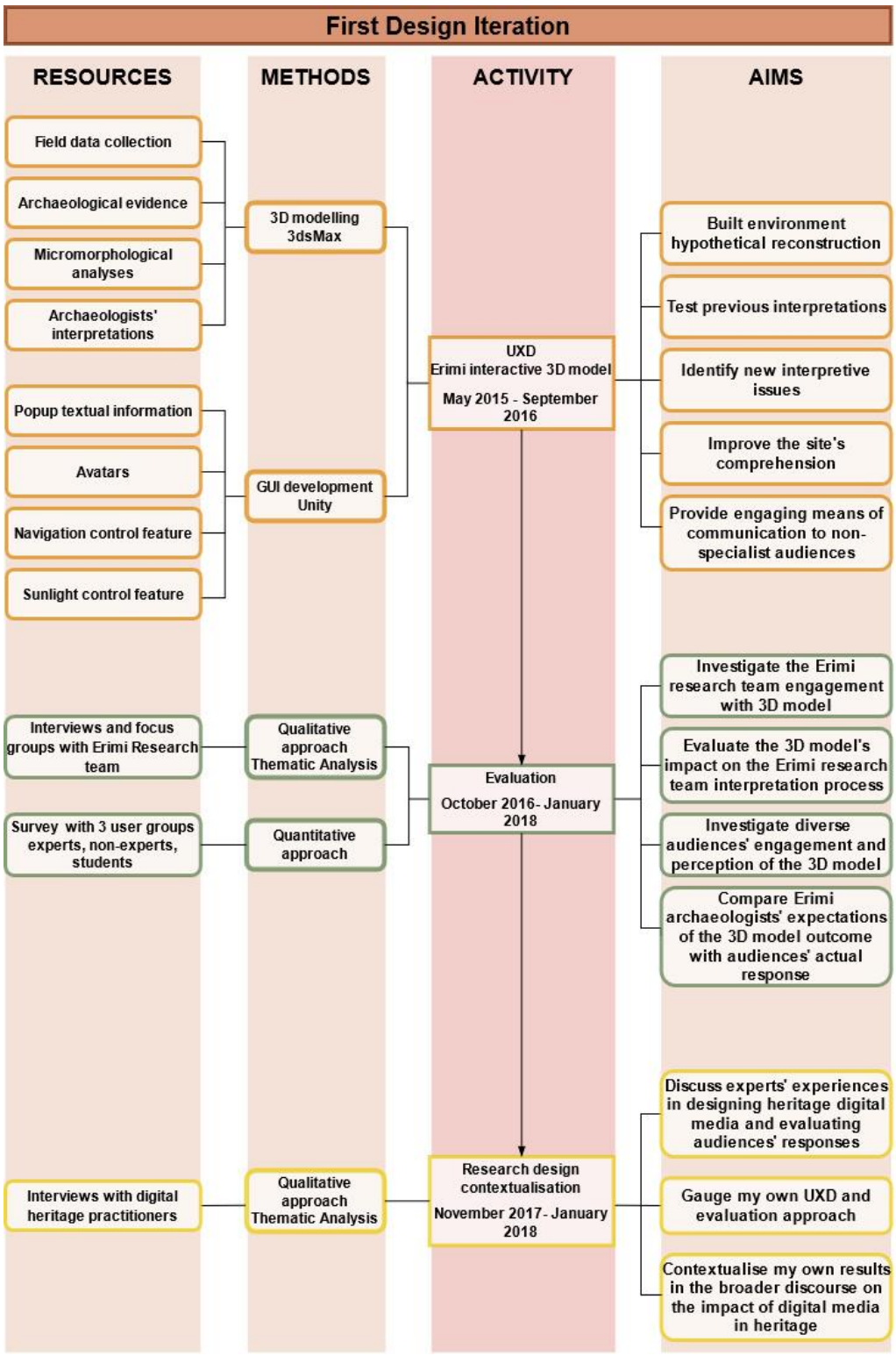
Figure 1.3: Participants at the ARKWORK Workshop (1-2 April 2019) working on the User Experience Design (credit: Sara Perry).

For this event, participants were divided into four groups, each one assisted by a facilitator whose purpose was to guide group members throughout the co-design process

of a digitally mediated experience. Facilitators were recruited amongst researchers and practitioners with experience in UXD in both archaeological and heritage sectors (e.g., digital archives, video games, interactive experiences, mobile apps, etc.). As for the first workshop, each group was assigned a project provided by the facilitator. The projects were focused on the co-design of one of either: a digital archaeogame based on an Anglo-Saxon village; a web-based interface for prehistoric themed events; a heritage experience based on historic environment of the Eye of York; and an online interface for the Southampton Library Special Collections and Archives.

Such projects provided an interesting and variegated array of online and in-person digital experiences, geared at archaeological and heritage sites and targeted to different types of specialist and public audiences. These projects differ from one another in terms of aims, target audiences and technologies required: consequently, each one presents a set of challenges that are representative of the ones usually encountered within everyday practice. For this reason, they represent valuable case studies for better understanding in what way the application of design theory and co-design practices cannot only inform the creation of digital resources, but also lead to collaborative and meaningful processes of knowledge production and exchange

The thesis therefore examines the theoretical implications surrounding the creation and adoption of digital products like 3D models in the discipline and their impact on our practices and audiences. This thesis also identifies design approaches and tools that provide practical means to rethink archaeological practices and digital resources in a way that creates truly critically engaged outcomes both for designers and for users of such resources (Fig. 1.4)


First Design Iteration
RESOURCES
METHODS
ACTIVITY
AIMS
Field data collection
Archaeological evidence
Micromorphological analyses
Archaeologists' interpretations
3D modelling 3dsMax
Popup textual information
Avatars
Navigation control feature
Sunlight control feature
GUI development Unity
UXD
Erimi interactive 3D model
May 2015 - September 2016
Built environment hypothetical reconstruction
Test previous interpretations
Identify new interpretive issues
Improve the site's comprehension
Provide engaging means of communication to non-specialist audiences
RESULTS: CHAPTER 4
Interviews and focus groups with Erimi Research team
Survey with 3 user groups experts, non-experts, students
Qualitative approach Thematic Analysis
Quantitative approach
Evaluation
October 2016- January 2018
Investigate the Erimi research team engagement with 3D model
Evaluate the 3D model's impact on the Erimi research team interpretation process
Investigate diverse audiences' engagement and perception of the 3D model
Compare Erimi archaeologists' expectations of the 3D model outcome with audiences' actual response
RESULTS: CHAPTER 5
Interviews with digital heritage practitioners
Qualitative approach Thematic Analysis
Research design contextualisation
November 2017- January 2018
Discuss experts' experiences in designing heritage digital media and evaluating audiences' responses
Gauge my own UXD and evaluation approach
Contextualise my own results in the broader discourse on the impact of digital media in heritage
RESULTS: CHAPTER 6

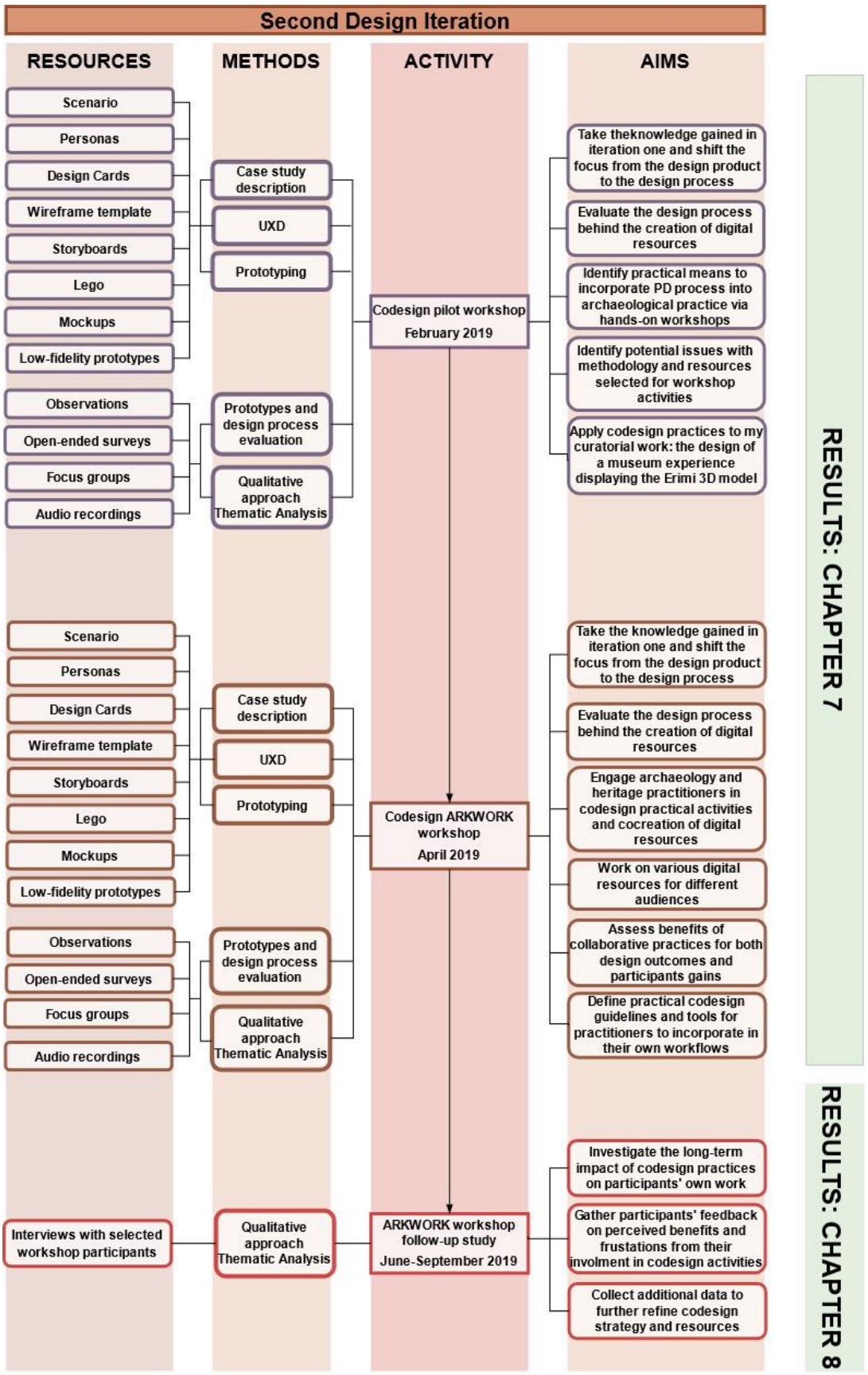


Figure 1.4: Diagrams illustrating the sequence of activities (i.e., distinct pieces of work associated with the design process) conducted for each iteration of the research project. From the left each column illustrates: resources (techniques, software, design tools) used, methods adopted, timeline and specific aims of each activity and the chapter where the results of each activity are discussed (credit: Francesca Dolcetti).

1.3 Thesis Chapter Outline

This thesis is divided into nine chapters, summarised as follows:

Chapter 2 introduces 3D visualisation in greater depth, outlining the history of 3D modelling and visualisation in archaeology and its present-day role in the field of research. I discuss the historical background to VR and 3D modelling applications in archaeology, as well as how they have been used in terms of both research and communication of cultural heritage. My intent here is to review past and current practices around 3D technologies in archaeology and 3D visualisation and to establish arguments for critiquing persistent issues with their application.

Chapter 3 provides an overview of the history of visitors' studies in museums and outlines the development of museum trends around the application of interactive digital media. It demonstrates that, even in the ambit of museum studies, where the evaluation of visitors' experiences is a well-established practice and the increasing application of digital technologies is reshaping heritage encounters, there is still an important gap in understanding how the digital is affecting people's engagement and the short and long-term impacts of digital heritage experiences.

Chapter 4 presents a detailed account of the research design where methods and techniques adopted for the two iterations of my project are discussed and justified, as well as the key research problems that emerge from my review of the literature in the previous chapters. Firstly, I document the Erimi-*Laonin tou Porakou* case study conducted as part of the first iteration of this research, exploring themes regarding the application of digital technology to the archaeological data recording and visualisation process, as well as the evaluation of interactive digital media's efficacy and impact upon different audiences. Secondly, I document the process of devising a methodology and resources for my workshops on the co-design of digital experiences in archaeology and heritage. Here I examine in depth how PD practices and approaches are applied and how my evaluation strategy is structured.

Chapter 5 presents the results derived from the first iteration of the research project, focused on evaluating the impact that interactive 3D models of archaeological sites have upon variegated audiences. By discussing the results from interviews, focus groups and a multistage survey conducted with various user-groups, this chapter argues that it is

paramount to assess the efficacy of interactive 3D models of archaeological sites in order to deepen our knowledge about how different audiences perceive them, as well as what purposes and interests drive people to use and interact with them.

Chapter 6 presents the results of my interviews with museum curators and digital heritage practitioners working on the creation, development and evaluation of digital interactive media in museums and heritage settings. I aim to discuss interviewees' experiences within audience research studies as well as the lessons learned from their research and evaluation studies on how digital technologies shape and affect the way visitors experience and engage with heritage. Themes that emerged from these interviews are also discussed in relation to the results of my own case study presented in Chapter 5.

Chapter 7 presents the results of the second iteration of this research project. It aims at assessing the benefits of integrating PD approaches into archaeological practice through co-design workshops. The chapter reports on the activities carried out at both of the events that I organised, aimed at providing practical experiences on how to integrate archaeological data, storytelling and digital platforms to encourage professional and wider public engagement with the past. Moreover, these events were meant to foster critical reflection on the importance of UX evaluation and on adopting an iterative approach of prototyping, testing and refining the product to meaningfully incorporate users' feedback throughout the design process.

Chapters 8 and 9 form the discussion and conclusion chapters of this thesis, whereby the implications of my research findings are considered and evaluated in light of the research questions outlined in Chapter 1. In Chapter 8, results and lessons learned from the two iterations of my research project are appraised in the context of the current literature and suggestions are made around practical guidelines for integrating UX and co-design methods into archaeological practice. Chapter 9 suggests future research directions and states final conclusions, arguing for the transformative potential of UXD-led practice for archaeological research and engagement. Specifically, it suggests that ensuring such practice is given priority in our workflows, with the support of resources such as the value-led design cards introduced in Chapter 8 (section 8.3.1), encourages the exploration of different and more creative ideas and avoids resorting to default solutions. Moreover, it makes us more aware of our role in the design process and the

biases we embed in the digital resources that we develop and circulate. This research concludes with the observation that it is vital for the discipline to continue developing a more critically self-aware and value-driven approach to digital archaeology if we are to create more sustainable, ethical, inclusive and empowering digital encounters with the past.

2 3D Modelling and Visualisation in Archaeology

This chapter outlines the history of 3D modelling and visualisation in archaeology and its present role in the field of archaeological research. Starting from a series of key debates and scientific studies, I intend to demonstrate how the widespread and pervasive use of 3D modelling and visualisation in archaeology contrasts with the relatively small, albeit rapidly growing, amount of publications engaging in a critical reflection on the application of digital technologies in the sector. Throughout the chapter I move from discussing the historical background of 3D modelling and VR applications in archaeology (section 2.1) to the current applications of 3D technologies in documenting, interpreting and communicating the archaeological record, by reviewing the current body of literature and providing relevant examples from both the archaeology and heritage sectors (section 2.2).

2.1 Historical Background

The history of 3D modelling and VR applications in archaeology starts in the 1980s, when a small group of archaeologists began exploring the application of computer graphics to the creation of visualisations of archaeological remains.

In 1983, the IBM United Kingdom Scientific Centre started developing the WINchester SOlid Modelling system (WINSOM) that differed from other existing solid modelling systems (focused on the creation of solid geometry models conforming to a truly enclosed solid object), for its ability to efficiently handle large models. One of the applications of WINsom was archaeological reconstructions, such as the Minoan palace of Knossos on Crete and the Viking settlement of Jorvik in York. The very first use of WINSOM in an archaeological context was the reconstruction of the Saxon minster of Winchester, demolished at the end of the eleventh century. In this case an animated tour of the Old Minster model was developed for the 1987 British Museum's exhibition “Archaeology in Britain” (Burridge et al. 1989).

A few years later, Reilly and Shennan (1989) proposed the application of 3D computer technology to archaeological problems, especially the creation of three-dimensional models as tools for testing theories or confirming observations, recording excavation data and presenting archaeology to the public. As they put it (1989, 162), “the exercise of making such models has several benefits to the archaeological analyst. Apart from their aesthetic appeal and the intellectual curiosity they provoke about the technology

employed in their construction, they encourage the user to think more deeply about how the various archaeological components relate to one another […]. Clearly, such modelling also has a great role to play in presenting archaeology to the public".

The term "Virtual Archaeology" appeared for the first time in *Towards a Virtual Archaeology*, a paper presented by Reilly (1991, 133) at the Computer Applications and Quantitative Methods in Archaeology Conference in 1990, in which he defines virtual archaeology as follows: "the key concept is virtual, an allusion to a model, a replica, the notion that something can act as a surrogate or replacement for an original. In other words, it refers to a description of an archaeological formation or a simulated archaeological formation". In his contribution, Reilly (1991, 137) also talks about solid modelling as a new tool for the management and analysis of archaeological records "that raises many interesting avenues which need to be explored in order to make the one archaeological record acceptable to those interested in preservation through recording, research, education and presentation". In fact, according to him, such a tool allows archaeologists to gain new insights into archaeological formations (i.e., events that created and affected an archaeological site before, during and after its occupation) through the construction of detailed models of the excavated materials. Reilly's idea of Virtual Archaeology was focused on excavation recording and the possibilities of virtual re-excavation using technologies such as hypertext, multimedia and three-dimensional solid modelling: "reconstructing archaeological sites is just one aspect of archaeological research […] By constructing detailed models of the excavated material, archaeologists can re-excavate the site and search for evidence which escaped attention during the actual dig" (Reilly 1991, 135). His belief about the potential of virtual reality stemmed from the concept that the adoption of computer-based technologies would change the way in which archaeological excavation and interpretation is performed at an epistemological level.

The field of virtual archaeology gradually advanced and widened in order to extend the application of visualisation and presentation methods to the reconstruction of the past, including landscapes, buildings and artefacts. The volume *Imaging the Past. Electronic Imaging and Computer Graphics in Museums and Archaeology*, published by the British Museum in 1996, included some contributions by practitioners and computer scientists such as Ryan (1996) and Chalmers and Stoddart (1996) that followed up on

Reilly's suggestion about the use of computer-based visualisations for the reconstruction of archaeological sites.

During the following decade, computer graphic modelling markedly improved with advances in hardware and software capabilities, along with improvement in the skills of the modellers, making it possible to create ever more realistic visualizations of past places, peoples and artefacts (Frisher et al. 2000). As a result, several projects were undertaken with the purpose of virtually reconstructing past environments: 3D models of archaeological sites were created with a high level of photorealism, including surfaces' textures, colours, and geometrical details (Forte and Siliotti 1997). However, the increase in the number of these projects raised many concerns about the methods employed and the reliability of the contents: the growth of the 'heritage industry' and the influence of industrial sponsorship were identified as factors that took control out of the hands of archaeologists.

As Miller and Richards (1995, 20) state, these computer-based projects, due to the substantial cost of software employed, were the result of "sponsorship by a large commercial organisation, such as IBM, Fiat, or BNFL who had quite cynically targeted archaeology as a discipline in which they could gain public relations points […] at relatively little cost to them". They point out that, in most cases, archaeologists did not have access to the visualisation software or direct control of the modelling themselves. Daniels (1997) also argues that archaeologists were subjected to the interests of the computer graphic industries looking for projects outside their field to test their software. Similarly, Ryan (1996) notes that influences coming from industrial sponsorship often led to a misguided pursuit of realism, with scarce interest for the uncertainty of the data sources.

By the end of the 1990s, a large number of publications summarised theoretical aspects and practical work in virtual archaeology. In *Virtual Archaeology: Re-creating Ancient Worlds,* Forte and Siliotti (1997, 10) presented a catalogue of virtual reconstructions of archaeological sites built from the first half of the 90s, in order to "offer to the reader the most faithful re-presentation of the ancient world possible: highly realistic information and with a high scientific content". The intent of their work was to illustrate to a general audience how significant archaeological sites around the world once appeared by combining aerial photography and high-resolution three-dimensional

computer renderings with clear, informative site descriptions. However, despite its value, this publication has been criticised for the paucity of information regarding the authors of the models and whether the elements of each model are certain or hypothetical (Frisher et al. 2000).

Meanwhile several scholars attempted to delineate standards and methodologies for the use of 3D modelling techniques and VR in archaeology. Particularly, they tried to define how to communicate data by means of these techniques, such as providing interfaces of data sources to identify their uncertainty and enable the exploration of alternative interpretations (Ryan 2001). Others, instead, raised theoretical concerns about the historical credibility and the accuracy of virtual reality and 3D products (Forte and Siliotti 1997; Frischer et al.2000; Kantner 2000) or the need to present data in a transparent way (Barcelò et al. 2000). Nevertheless, a great number of early archaeological computer modelling projects were undertaken merely "as vehicles for demonstrating advanced graphics techniques" (Ryan 1996, 107) and for the most part, during the 1990s, archaeologists were not involved in many of the archaeological reconstructions. As Frisher et al. (2000, 10) describe it, "rarely, if ever, are we told who made the model, whether there was any consultation between the model maker and the archaeologists, and what elements of the model are known with certainty and which are hypothetical".

The first decade of the twenty-first century has been characterised by the spread of VR projects, as can be seen in the hundreds of papers on VR topics presented to the numerous conferences dedicated to or offering sessions concerning 3D modelling and visualisation in archaeology, such as the International Symposium on Virtual Reality, Archaeology and Cultural Heritage (VAST), the Computer Applications and Quantitative Methods in Archaeology conference (CAA) or the Conference on Cultural Heritage and New Technologies (CHNT) to cite only a few. Among these projects, two major currents can be identified: the communication of cultural heritage to the public and the presentation of computer graphic innovations or technological improvements for 3D modelling tools.

At the same time, several scholars started raising their concerns about the lack of a proper methodology for the use of VR and 3D visualisation, advocating the need for transparency and documentation of the visualisation process by means of metadata and

paradata in order for the visualisation outcome to be recognized as the product of a scientific process (Hermon 2008; Bentkowska-Kafel et al. 2012; Pletinckx 2012). Numerous initiatives, such as The Virtual Archaeology Special Interest Group (VASIG) and the Cultural Virtual Reality Organisation (CVRO) started underlining the importance of transparency and intellectual integrity in computer-based visualisation methods and outcomes. EU-funded projects and networks such as The European Network of Excellence on Information and Communications Technology Applications to Cultural Heritage (EPOCH) were developed with the specific aim of providing frameworks and guidelines to improve the quality and effectiveness of the use of Information and Communication Technology for Cultural Heritage by increasing the effectiveness of work at the interface between technology and the cultural heritage of human experience represented in monuments, sites and museums.

In 2006 a group of scholars initiated the project of the London Charter (Beacham et al. 2009) with the purpose of defining internationally recognized guidelines for the intellectual integrity of the 3D models used to represent the past. The London Charter is a list of principles aimed at establishing the basic objectives and manner of use of 3D visualisation methods in relation to intellectual integrity, reliability, transparency, documentation, standards, sustainability and access. Intellectual transparency, defined as "the formal representation of the reasoning process generating a visualization outcome, along with the primary data used and its transformation process" (Hermon and Niccolucci 2018, 37), is one of the main notions addressed by the London Charter. According to some of its authors, the aim is to ensure that compliance with the principles of the Charter guarantees accountability and reproducibility of digital visualisations (Hermon and Niccolucci 2018).

Moreover, the Spanish Society of Virtual Archaeology (SEAV) started in 2008 the elaboration of standards and recommendations devoted specifically to the field of Information and Communication Technologies (ICT) and cultural heritage, resulting in 2011 in an international document called the Seville Principles (Grande 2011). The Seville Charter aims "to increase the conditions of applicability of the London Charter to improve its implementation specifically in the field of archaeological heritage". Its principles focus on establishing criteria specific for archaeological heritage to measure the quality of projects carried out in the field of virtual archaeology, as well as

promoting a responsible use of new technologies in heritage management (López-Menchero 2013)

Likewise, the updated version of Archaeology Data Service's Guides to Good practice (Archaeology Data Service 2011) aims at providing information on the best way to create, manage, and document digital material produced during the course of an archaeological project. These guides stress the importance of ensuring firstly that computer-based visualisation methods are applied with scholarly rigour, and secondly that the outcomes of computer-based visualisation research should accurately convey to users the status of the knowledge and uncertainty they represent (Denard 2012).

However, the efforts made by the above-mentioned projects seem to have led to an unnecessary superimposition of yet more guidelines rather than defining and establishing unanimous best practices with assessable impacts. In fact, compelling examples of its implementation in archaeological research practices are still few and even more scarce is the body of critical discussions about its utility (Perry 2015). According to Watterson (2015, 122), best practices frameworks such as the London Charter while encouraging practitioners to be reflexive about their visualisation processes, also "aim to bring quantification to a creative process by masking subjectivity behind scientific rubric which only serves to generalise, objectify and distance, shying away from the creative qualities and potential these types of expressive visuals offer to archaeology". She argues that despite practitioners have been using metadata and paradata to ensure the transparency of the visualisation process, it is still difficult to assess the success of archaeological visualisations by using traditional evaluation techniques because of the subjective nature of these visualisations.

Both Perry's and Watterson's arguments are positioned within the debate developed in the early 2000s around the lack of critical theoretical discussion of 3D technologies' application in archaeology. As Chrysanthi et al. (2012) argue, archaeologists should discuss more critically how computing approaches shape archaeological interpretation and influence the construction of the archaeological discipline itself. As computational approaches are not just media but thinking processes, they argue that archaeologists need to think beyond the tool and start theorizing the approach. According to Earl and Wheatley (2002, 6) VR in archaeology, instead of moving through the three stages of adoption, examination and critique, as in many other computer-based approaches, remains suspended in a middle stage where "as a technique it has had a head start since

so much work has already been completed on the topic of static or animated reconstructions. Still, the theoretical ramifications of the technology remain relatively little explored, despite a number of publications and demonstrations of their value".

As Gillings (2006, 226) points out, ground-rules adopted during the initial uncritical stage of VR applications have then become so embedded in the current practice as to potentially act as constraints to the second, more reflexive stage. According to him, such issues stem from valuing VR models merely on their level of realism and accuracy and considering VR as a theoretically neutral tool. In Gillings' view (2006, 230), the importance of verisimilitude should not be refuted but decentred "casting visual approximation as but one factor influencing the faithfulness of any representation". The same concerns were later expressed by Huggett (2015b, 87), who argues that within digital applications in archaeology "the lack of a meaningful dialogue about the intervening digital technologies and their influence on the outputs has left archaeologists open to accusations of technological fetishism". Similarly, Jeffrey (2015) points out the potential pitfall of the pursuit of accuracy and realism in digital archaeological visualisations becoming an end in itself.

According to Pujol (2017), from the 1990s until the first decade of the 2000s the main aim of VR applications has been to present the past by means of photorealistic architectural models. However, she notes a change during the second decade of the 2000s when virtual reconstructions stop being conceived as just 3D models and start getting closer to UXs. In the past few years, in fact, a growing body of literature has been advocating for a more critically-engaged and reflexive approach to digital archaeology, shifting the focus from the effective production of accurate 3D models to the application of design (and evaluation) workflows that enable the creation of more engaging and rewarding UXs (Dallas 2015; Huggett 2015b, 2015a; Caraher 2016; Opitz and Johnson 2016; Perry and Taylor 2018; Perry 2019).

2.2 3D Visualisation in Archaeology: Criticisms and Applications

Visualisation in archaeology is not merely an illustration depicting the past; it is, instead, a fundamental part of the data interpretation process (Ryan 2001; Gillings 2005; Hermon 2008). 3D models and visualisations can be successfully employed as tools to investigate and interpret archaeological data and to turn them into information and knowledge. However, while the application of these techniques is nowadays a well-

established practice, 3D models are still quite often uncritically adopted as attractive photorealistic images that virtually replicate the past, mistakenly assuming that there is no need for our critical intervention in terms of their interpretation (Pujol 2017; Perry 2018a).

It has been often suggested that the reason for these drawbacks is connected to the fact that most 3D models and visualisations are built just as end-products of the research and without clear archaeological questions and goals (Gillings 2005; Morgan 2009). Hermon (2008) points out that the potential of 3D applications in archaeology is considerably underestimated and 3D outcomes are still considered merely as nice toys. He suggests that the reason for this scepticism could be related to the fact that not many archaeologists present new results obtained through 3D research tools. Regarding this discussion, although in relation to all different VR applications in archaeology and not specifically 3D models, Gillings (2005, 224; emphasis in original) argues that currently archaeologists are not taking advantage of the potential of VR and hence are restricting its development, because they "have to date tended to *apply* VR techniques first and then *think* about them later". According to Pujol (2008, 105), the main issue is "an incongruence between the potential of VR proposed in some publications (interactivity and discovery of the past) and its implementation, especially for dissemination purposes". In her opinion, this leads to a merely descriptive form of VR application thus under-using the potential of 3D technologies in archaeology and heritage.

In the following section I discuss the existing critique around archaeological 3D visualisation and present various examples of how 3D technologies have been used, from data recording to presentation of archaeological interpretations.

2.2.1 3D Visualisation: Realism, Transparency and Authenticity

Regarding the application of 3D models in archaeology, one of the main criticisms has been directed against the high level of realism or photorealism of visualisations, considered potentially misleading for the viewer. Such issues extend also to the photorealistic depiction of human figures, considered problematic because of the 'uncanny valley' issue, a phenomenon observed by Mori (1970) wherein the familiarity that a viewer experiences with a robot decreases as robots are built with more human-like features (Murgatroyd 2008; Frankland 2012) (see also Chapter 5). Because of photorealism, some scholars have argued that archaeological visualisations often communicate a deceptive sense of 'authenticity' and 'truth' (Killebrew 2004, 127) to a

non-specialised audience. As a result, the viewer might misinterpret these visualisations as faithful reconstruction instead of an interpretation of the past (Frankland and Earl 2011). Concerning this matter, it is worth considering the study conducted by Frankland (2012) about the application of non-photorealistic rendering techniques in virtual reconstructions. His findings indicate that, though non-specialist users are generally uncertain about the inferences made in reconstructions, they are aware of the issues connected with photorealistic visualisations, hinting to a need for more empirical data to prove if and to what extent archaeologists' concerns with photorealism are justified.

According to other scholars, such as Roussou and Drettakis (2003), the main issue with pursuing visual realism is that it has distracted the focus from what they consider to be important for a virtual experience to be perceived as realistic, namely interaction, sound and touch. Similarly, Gillings (2005) suggests that the constant search for photorealism and verisimilitude not only constrains the potential of VR applications but is also based on Western conceptions of vision as the main vehicle for perception. More recently, Jeffrey (2015) has argued that what digital visualisations really need to be compelling are creative responses such as a good narrative. In his opinion, if a narrative strongly engages an audience, then the realism (or unrealism) of these visualisations does not matter. As he puts it (2015, 150), "if the struggle for realism is tempered with creative responses to the past, we can create a deeper engagement than a photorealistic image itself might do".

Other common issues cited by scholars in the past two decades have been related to the intellectual integrity, the reliability and the transparency of archaeological visualisations. According to Frisher et al. (2000, 8) accuracy and authenticity are "two sides of the same coin; accuracy pertains to the way the archaeological data is used to create a visualisation; authenticity to the way the viewer experiences this archaeological data". Many archaeologists have often been worried about the potential for visualisations to transmit a misleading sense of 'truth' and are concerned that visualisations gain authority as a result of being presented without alternative possibilities (Frankland and Earl 2011). Contrarily Pujol (2008, 106) argues that virtual reality, by showing the archaeological interpretation process, evidences that "archaeology does not provide truths […] and help[s] non-expert users, especially the younger audience, to adopt a critical attitude".

Concerning this matter, it is worth considering the results obtained by Watterson (2015) within her project on the Neolithic site of Skara Brae, which entailed the production of a short interpretive mixed-media film and its presentation in three different venues. The feedback given by academic and public audiences about Watterson's film and exhibition *Digital Dwelling* indicates that a large portion of people "harbour particular expectations and presumptions about the role of visualisation within archaeology" (Watterson 2015, 127). In fact, comments from academic audiences seem to suggest that there is an expectation that a visualisation should present all the aspects of the site along with alternate possibilities. Conversely, it appears from several comments left by a more general audience that general publics want to see archaeological visualisations as conclusive answers, rather than interpretations. The results of Watterson's study seems to confirm that both practitioners and general audiences still have preconceptions about the role of digital visualisations in archaeology. However, in her opinion this is not surprising considering the prevailing use of visualisations as means to present answers rather than interpretations. To address this issue, Watterson suggests rethinking the purpose of archaeological visualisations by using them as a vehicle for inspiring reflection on and discussions around the interpretation of archaeological evidence.

Miller and Richards (1995, 20) were the first to observe that frequently visualisations are presented as a single, static view of the past without alternative possibilities and completely separated from the academic discussion related to their development. Likewise, Ryan (1996, 107) argues that the "misguided pursuit of 'realism' with little or no concern for the inherent uncertainty of the data sources" could lead to producing too optimistic and even false conclusions about the past and about the premises and possibilities of archaeology as a discipline. Frischer et al. and Goodrick and Gillings (2000 both cited in Frankland and Earl 2011, 63) suggest that "the reason this (i.e., archaeological visualisations presenting only a single, static view of the past) has occurred is because virtual reconstructions are likened by archaeologists to the traditional 'artist's impression', which attempts to encapsulate the past in a 'single moment' from one perspective". Moreover, as highlighted by Frankland (2012), 3D photorealistic renders are usually presented as single illustrations because of the amount of time needed to generate them. However, even if these concerns are understandable in so far as some expectations on what visualisation should or should not present about the past still remain at present, it is likewise true that there is a lack of effective evidence

regarding how and to what extent visualisations have led to false conclusions about the past.

Others, instead, have pointed out that the problem is connected to the inappropriate concept of ‘reconstruction’, often used referring to depictions of the past based on archaeological material and results, either/or made virtually, drawn, imagined and built in full-scale. According to Clark (2010), the term is misleading, implying an idea of actually having the possibility of re-constructing the past just as it was, when in fact it is impossible. Since the idea of creating a single reconstruction of the past is inconsistent with the post-processual notions of interpretation, multivocality and agency. Clark suggests that archaeologists emphasize the uncertainty and ambiguity of interpretation using more appropriate terminology such as the term 'model'. Pletinckx (2012), as well, has criticised the reconstruction concept, pointing out that the aim of 3D visualisation is not to reconstruct the past, since it is not possible to do, but to visualise the process of bringing together available sources.

Concerning the problem of transparency, Forte (2000, 249) observes that “noticeable gaps are represented by the fact that the models are not ‘transparent’ in respect to the initial information […] and by the use of the peremptory single reconstruction without offering alternatives”. Similarly, Clark (2010) criticises the lack of declaration of the level of accuracy and authenticity of different parts of many 3D visualizations, as well as the importance of accounting for the sources that influenced the creation of the virtual model. He suggests that modellers should provide some mechanisms for specifying the level of accuracy to legitimise virtual reconstructions as expressions of archaeological reasoning. However, as Jensen (2018) argues we, as archaeologists, might be underestimating the audience’s ability to deal with uncertainty and the only thing that matters is to ensure transparency and accountability by facilitating access to raw data.

As previously discussed, the London Charter (Beacham et al. 2009) attempts to address issues of intellectual integrity and transparency by recommending that “it should be made clear to users what a computer-based visualisation seeks to represent, for example the existing state, an evidence-based restoration or a hypothetical reconstruction of a cultural heritage object or site, and the extent and nature of any factual uncertainty” (paragraph 4.4). Specifically, in relation to the issue of transparency, the Charter introduces the term ‘paradata’, distinct from the concept of ‘metadata’ which is related

to the properties of data (Baker 2012, 169), to describe the data which documents the interpretative processes associated with the creation of the visualisation. The Charter also suggests that such documentation "should be disseminated in such a way that the relationship between research sources, implicit knowledge, explicit reasoning, and visualisation-based outcomes can be understood" (paragraph 4.6). Regarding this paragraph, a critique could be raised about the fact that it is not clear how to put this into practice, especially the way in which it is supposed to make explicit the implicit knowledge.

According to DiGiuseppantonio DiFranco et al. (2018b, 3), the London Charter is an essential set of guidelines for "both the specialists that study and try to reconstruct heritage from scientific cues, and those people that 'live' heritage through performance. This is because some societies (especially in the Western world) see metric digital reproductions of heritage as a crucial baseline for the 'authentic' experience when accompanied by a transparent description of the data making and interpretation processes". In other words, these guidelines are important because they ensure that digital replicas are 'authentic' (at least according to Western views of heritage) in the sense that they are reliable, i.e., based on reported evidence, and metrically accurate.

In their volume *Authenticity and cultural heritage in the age of 3D digital reproductions* (DiGiuseppantonio DiFranco et al. 2018a), a few contributions present examples of how to integrate these methodologies and the guidelines of the London Charter into the archaeological interpretation process, to develop effective operational procedures. Hermon and Niccolucci (2018), who were involved in the creation of the London Charter more than a decade ago, present how the charter's principles were adopted for the case study of the church of the Christ Antiphonitis (Cyprus), to guarantee the authenticity of the projects' digital (2D and 3D) outputs by ensuring the intellectual accountability of the visualisation process. Jensen (2018, 71), in describing his research carried out at three archaeological sites in Denmark (Skelhøj, Jelling and Alken Enge), emphasises how meta- and para-data as defined by the London Charter support the transparency of the interpretation process of the archaeological record, by hinting at practices for "navigating the grey zone between archaeological documentation, hypotheses and public dissemination". According to Jensen, as authenticity is partially a subjective concept that concerns the reliability of 3D interpretive visualisations, the accessibility and transparency of data is pivotal as it shows how such visualisations evolve and change as new data and interpretations

become available. However, in the same volume Beale (2018, 93) argues that while guidelines such as the London Charter encourage us to codify the relationship between the representation and the data it is based upon through metadata and paradata, "it is not possible to describe, least of all in narrow formal terms, the full breadth and subjectivity which accompanies the production of archaeological visualizations". In Beale's opinion (2018, 92), the London Charter principles and their formalist notion of authenticity as inherently objective and measurable are not designed to include more subjective and dynamic definitions of the term.

Such critique is embedded in the broader debate around the notion of authenticity, as determined by the Western European concept of heritage that established what Smith (2006) defines as Authorised Heritage Discourse (AHD): a hegemonic approach to heritage that relies on the institutionalised authority of heritage specialists and "a top-down relationships between expert, heritage site and 'visitors'" (Smith 2006, 34). While this definition of authenticity has been formalised by organisations such as ICOMOS and UNESCO, conflicting views have been foregrounding a different concept of authenticity, as the culturally and socially situated product of the "relationships between people, objects and places" (Jones 2010, 200). According to DiGiuseppantonio DiFranco et al. (2018b, 4), 3D technologies and digitally mediated experiences can potentially incorporate these conflicting views of authenticity and challenge the AHD by extending the intervention of non-experts in creating alternative discourses around the meaning and use of heritage (see also Chapter 7, section 7.2.4.2).

2.2.2 3D Visualisation and Field Archaeological Investigation

Along with the criticisms presented in the previous section, the application of 3D technologies at the trowel's edge - or the lack thereof - has been a subject of concerns. Almost two decades ago, Ryan (2001) called for a more significant use of virtual archaeology within the entire archaeological process, rather than just in the final stage of presentation of interpretations. Echoing Ryan's concern, Barcelò (2001, 242) notes that "Virtual Archaeology means much more than 'shape reconstruction' and […] should go beyond 'picturesque' reconstruction", by simulating the archaeological interpretation process. Similarly, Gillings (2000) stresses the need to develop methods able to incorporate Virtual Archaeology in all the stages of the archaeological process. Since then, more and more excavations have integrated 3D technologies and visualisations in the entire archaeological workflow (from research in the field to publication), for recording, interpreting and sharing the archaeological record.

Compelling examples are evident in a series of projects developed during the last decade of the 2000s. For instance, the AHRC-funded Portus Project (Ostia, Rome) has efficiently employed digital models of the harbour district of Ostia to better understand the development of its topography, the interrelationships between the different components of its urban form, as well as its relationship to Ostia and the rest of the Mediterranean. In this case, 3D models were applied as adaptable tools for dissemination on site and post-excavation analysis, and integrated into other media (project website, documentaries and a Massive Open Online Course) to engage with a broader audience (Earl et al. 2011; Mladenovic et al. 2014).

Similarly, the Çatalhöyük Research Project, centred on the Neolithic Town of Çatalhöyük (Turkey), has used digital models of the Shrine of the Hunters (Fig. 2.1), one of the most decorated houses ever found at the site, to visualise wall paintings in context and under varying conditions. In this case, the models were used for visual simulation, as a "conflation and reasoned extrapolation of archaeological data designed to stimulate thought" to provide new forms of space within which to build interpretations and convey interpretation and debate in the present (Earl 2013, 234).

Figure 2.1: Çatalhöyük Shrine of The Hunters Looking South (Grant Cox, ACRG).

A further effort in the application of 3D techniques in the field at Çatalhöyük is represented by a digital experiment conducted at the site's Building 89, aimed at recording every phase of excavation. In this case, 3D technologies were applied with the

goal of bringing information to the trowel's edge, monitoring the decay of the building and providing a tool for collaborative analysis and reflective engagement with the interpretation of captured data (Forte et al. 2015; Berggren et al. 2015). This approach proved to be efficient, despite having to acquire and process a large number of pictures on site every day: 3D data, in fact, were available on a daily basis on site, fostering discussion among archaeologists and other specialists. Also, interactive 3D visualisations have been employed for education and public outreach using mobile devices with the ultimate aim of creating virtual simulations that promote multiple viewpoints on the past (Lercari 2017).

Another example is provided by the archaeological site of Uppåkra (Sweden), where 3D modelling techniques have been systematically used to create 3D replicas of the site integrated within the excavation procedures (Dellepiane et al. 2013) (Fig.2.2).

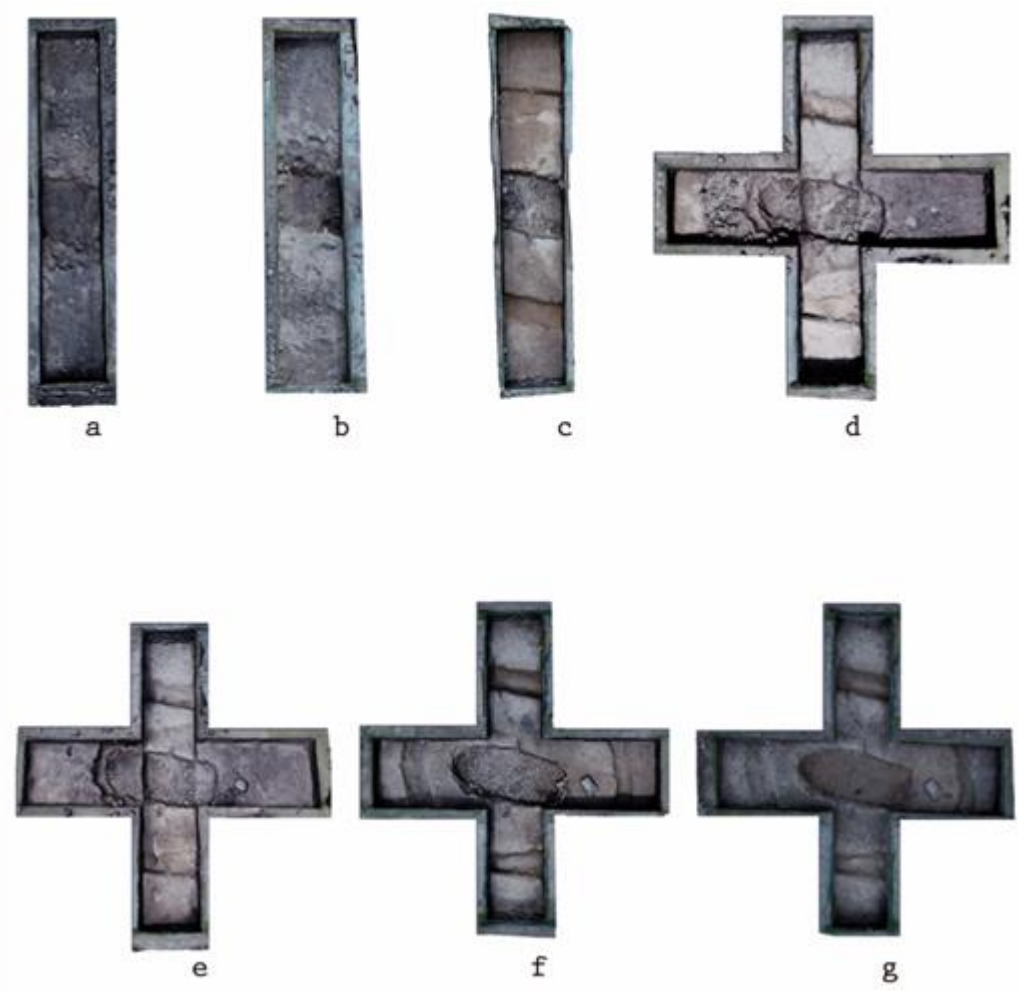


Figure 2.2: The sequence of the excavation process recorded in Uppåkra (Dell'Unto 2014, 63).

This approach not only proved to be sustainable and easy to combine with traditional documentation methods, but has also enhanced the possibility for the archaeologists to achieve a more complete overview of the on-going investigation process (Dell'Unto 2014). 3D digital documentation has also been adopted within the archaeological excavation of Kämpinge (Sweden), were a 3D GIS platform customized for field investigation was developed to provide archaeologists with onsite access to the 3D material and the contexts generated during fieldwork (Dell'Unto et al. 2017) (Fig. 2.3).

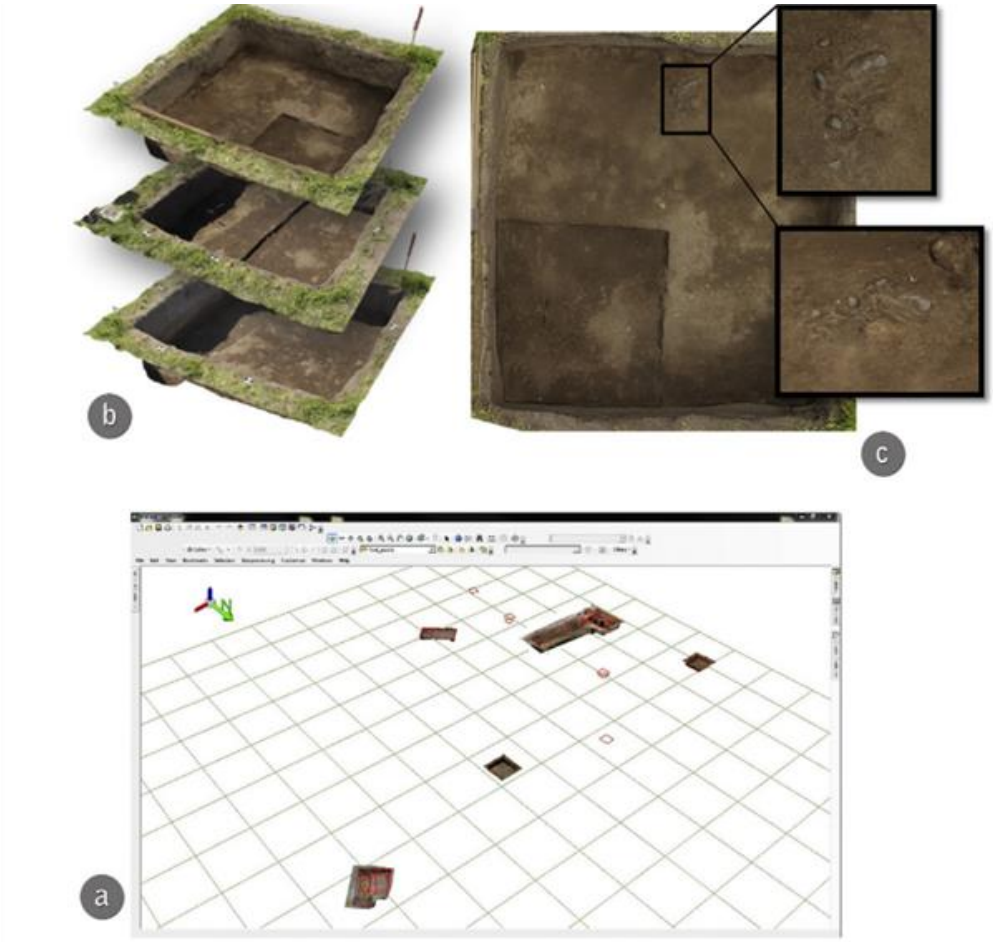


Figure 2.3: 3D GIS platform developed for Kämpinge (Dell'Unto et al. 2017, 634).

Lastly, the Gabii project, focused on the Latin City of Gabii (Italy), decided to incorporate all the digital outputs generated within the project - from the database to 3D models of architecture and stratigraphy - into the digital publication of the excavation reports series. Aimed at rethinking the way excavation monographs are published and to design them around the reader experience, this digital platform was developed by integrating a searchable database and an interactive 3D representation of the site with a multi-layer textual narrative geared at different audiences (Opitz and Johnson 2016; Opitz 2018) (Fig. 2.4).

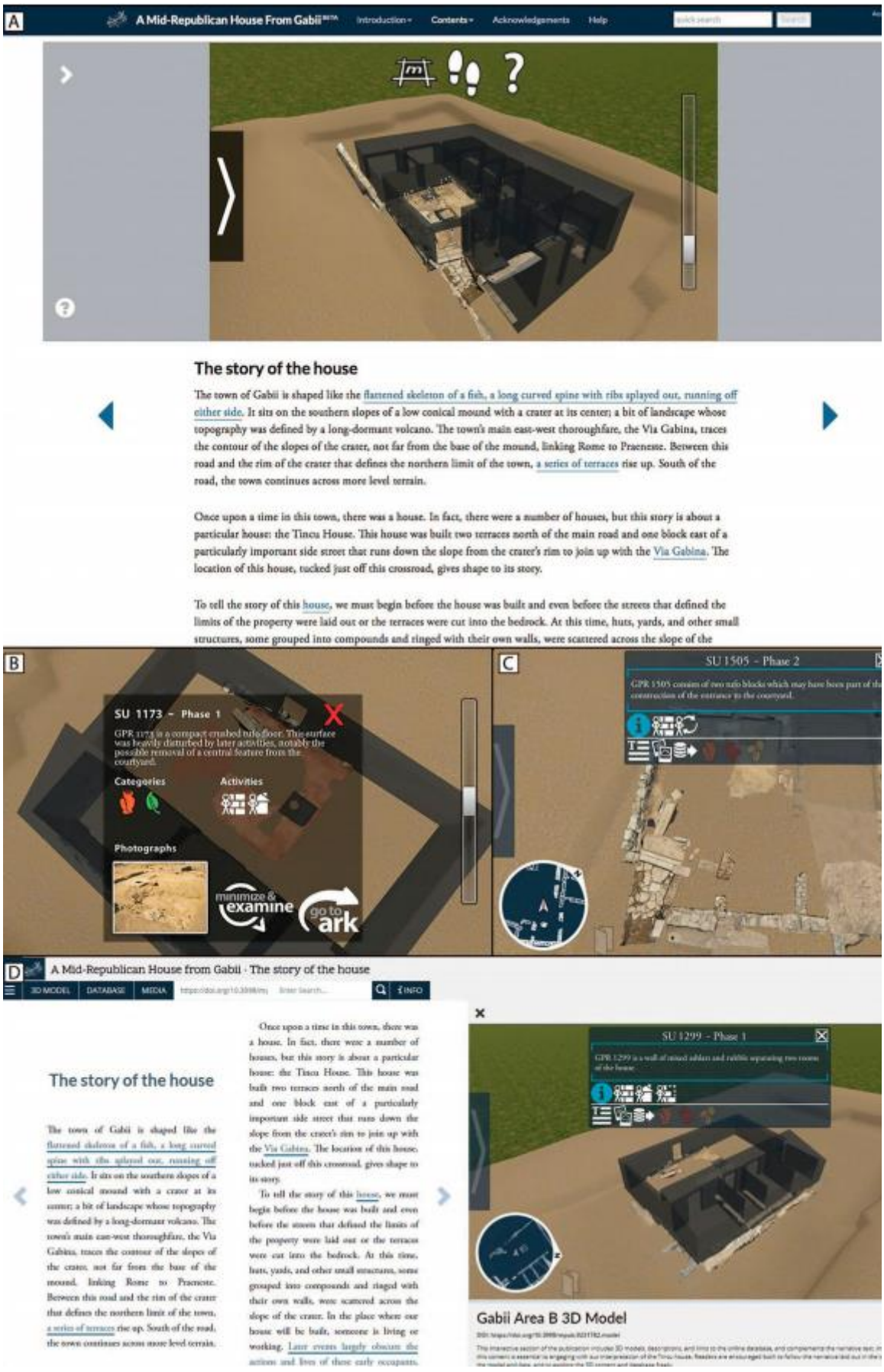


Figure 2.4: Gabii project digital platform interface (Opitz 2018, 570).

2.2.3 3D Visualisation and Cultural Heritage Dissemination

As for archaeological excavations, 3D models and visualisations have also become widely used to broadcast cultural heritage to both specialised and general users, for education and sustainable promotion of museums, historical monuments and archaeological sites. VR and 3D modelling techniques have been employed to visualise and present archaeological sites and monuments to a wider audience, providing 'virtual access' to places and sites that are unreachable, geographically remote or that no longer exist (Kantner, 2000; Economou 2015, 216-218). They have also been used for conservation plans, preserving heritage monuments and sites through virtual replicas or reuniting dispersed remains (Jeffrey 2015, 144), and for educational purposes, providing a more engaging and meaningful tool for learning experiences (Roussou 2004; DiGiuseppantonio DiFranco et al. 2019). Within the field of public communication and engagement, there is a vast number of examples of how 3D modelling has been used in cultural heritage contexts. Among them, I have selected a few case studies, presented below, that I believe are important in representing different ways to communicate archaeological information to a wider audience.

One of the most famous examples from the first decade of the 2000s is the Rome Reborn project (Flyover Zone 2020), an international initiative whose goal was the creation of 3D digital models illustrating the urban development of ancient Rome from the first settlement in the late Bronze Age (ca. 1000 B.C.) to the depopulation of the city in the early Middle Ages (ca. A.D. 550). It was developed as an online tool for research and dissemination, and its latest free accessible upgrade was presented in 2008 with fly-through presentations of a populated virtual reconstruction of Rome in 320 AD (Fig. 2.5), downloadable as 3D Google Earth layer (Dylla et.al 2010). Interestingly though, the application of fly-through viewing, previously applied within the Virtual Pompeii project (Public VR 2012), had been already criticised by Frisher himself (2000) as disturbing and uncanny.

As regards projects such as Rome Reborn, several scholars have often criticised the fact that they appear somewhat 'monolithic', without the possibility of interpretation, communicating a misleading sense of 'authenticity and 'historical truth' (Killebrew 2004; Frankland and Earl 2011). The main criticism of these virtual representations is that they are too realistic and could give the impression that archaeologists know more than they actually do, making it difficult to appreciate that the model is only a

visualisation of a hypothesis (Sylaiou and Patias 2004; Morgan 2009). However, as far as I am aware, a specific study to explore audience reaction to Rome Reborn has never been undertaken. Moreover, the 3.0 version released in 2018 as VR apps and web resources has been copyrighted under Dr. Frischer's own company (Flyover Zone Productions) and it is now only available in paid format.

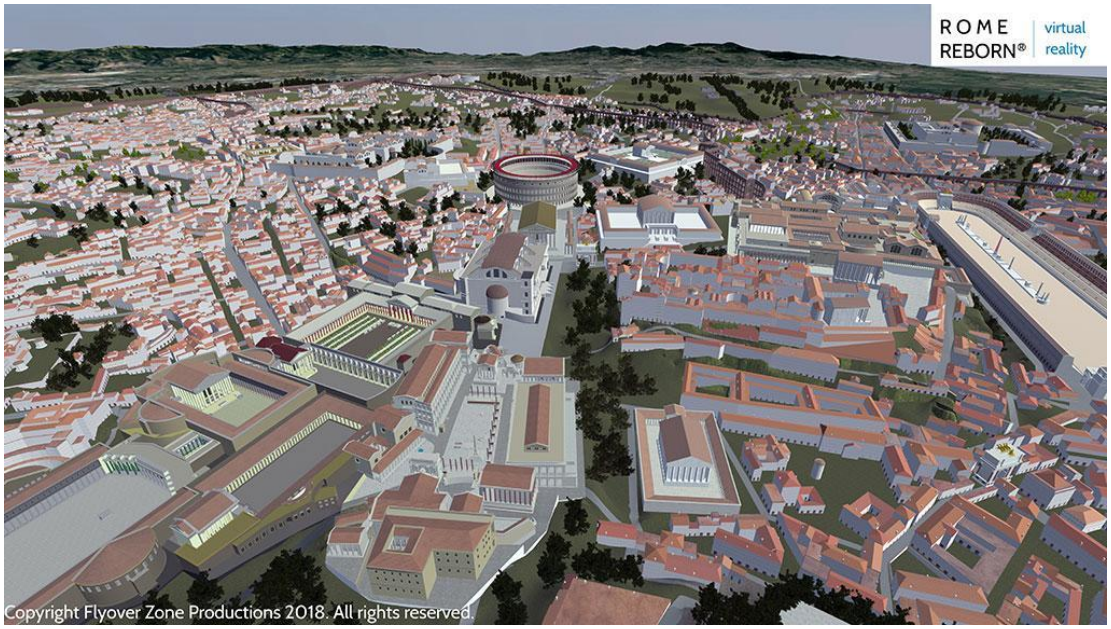


Figure 2.5: A view of Rome from the air within Rome Reborn (Flyover Zone 2020).

More recently, within the Swedish Pompeii Project (National Bank of Sweden Tercentenary Foundation and Swedish Research Council nd*),* a 3D movie presenting the House of Caecilius Lucundus was produced for an exhibition held at the Millesgården Museum in Stockholm in 2015. It was made using 3D data primarily acquired for scientific purposes, such as architectural interpretation (Dell'Unto et al. 2014; Demetrescu et al. 2016). The movie was aimed at providing visitors with an immersive experience about Pompeian domestic space and presents the house in its current state, using 3D laser scanner data, as well as the suggested reconstruction, created from the study of a vast number of different sources (Fig. 2.6). This approach was specifically adopted to improve visitors' experiences and present research results in a transparent way, making the reconstructed parts easily recognisable from the original remains. However, in this case too, I am not aware of studies conducted to evaluate visitors' experiences and responses to the movie.

Figure 2.6: House of Caecilius Lucundus, simulation of the architecture (Dell'Unto et al. 2013, 627).

The Ename project, based at the medieval rural village of Ename situated in the Province of East-Flanders, represents an example of transformation of previous 3D models from virtual reconstructions into more elaborated UXs. The old "Ename 974" developed in the early 2000s was a pioneering project in the reconstruction and communication of archaeological and historic remains with multimedia and virtual reality technologies. Displayed at the Ename Archaeological Provincial Museum, the 3D model was part of an interactive installation aimed at showing the chronological evolution of the site (Pletinckx et al. 2000). In this case, an evaluation study was conducted to explore the real effect of high-tech exhibits on the visitor's experience, showing that the application was particularly appreciated as a resource for learning because it helped visitors to better contextualise and understand the archaeological remains (Economou and Pujol 2011). In 2015 the 3D visualisation was implemented in terms of UX and became "Ename 1280", a gesture-based interactive game that allows visitors to explore the abbey and interact with objects to unlock descriptions about them (Ename 2015). To my knowledge, though, the improved Ename UX has not been evaluated.

Within the Digital Documentation of Ksar Said Project, aimed at the digital preservation of tangible and intangible aspects of heritage associated with the 19th century Said

Palace in Tunis, interactive 3D panoramas of the palace have been produced as part of learning resources geared at fostering Tunisian students' critical engagement with their heritage (DiGiuseppantonio DiFranco et al. 2019). The panoramas, integrated in a web portal (Open Eye Media nd), have been associated with educational activities exploring diverse historical influences on modern Tunisian society (Fig. 2.7). In this case the development of such interactive visualisations has been based on a co-design approach and included both a mid-term assessment and a final user trial. The results of this evaluation suggest that the combination of inquiry-based learning activities and an online VR heritage platform, actively engaged the students with the complexity of the history of their nation.

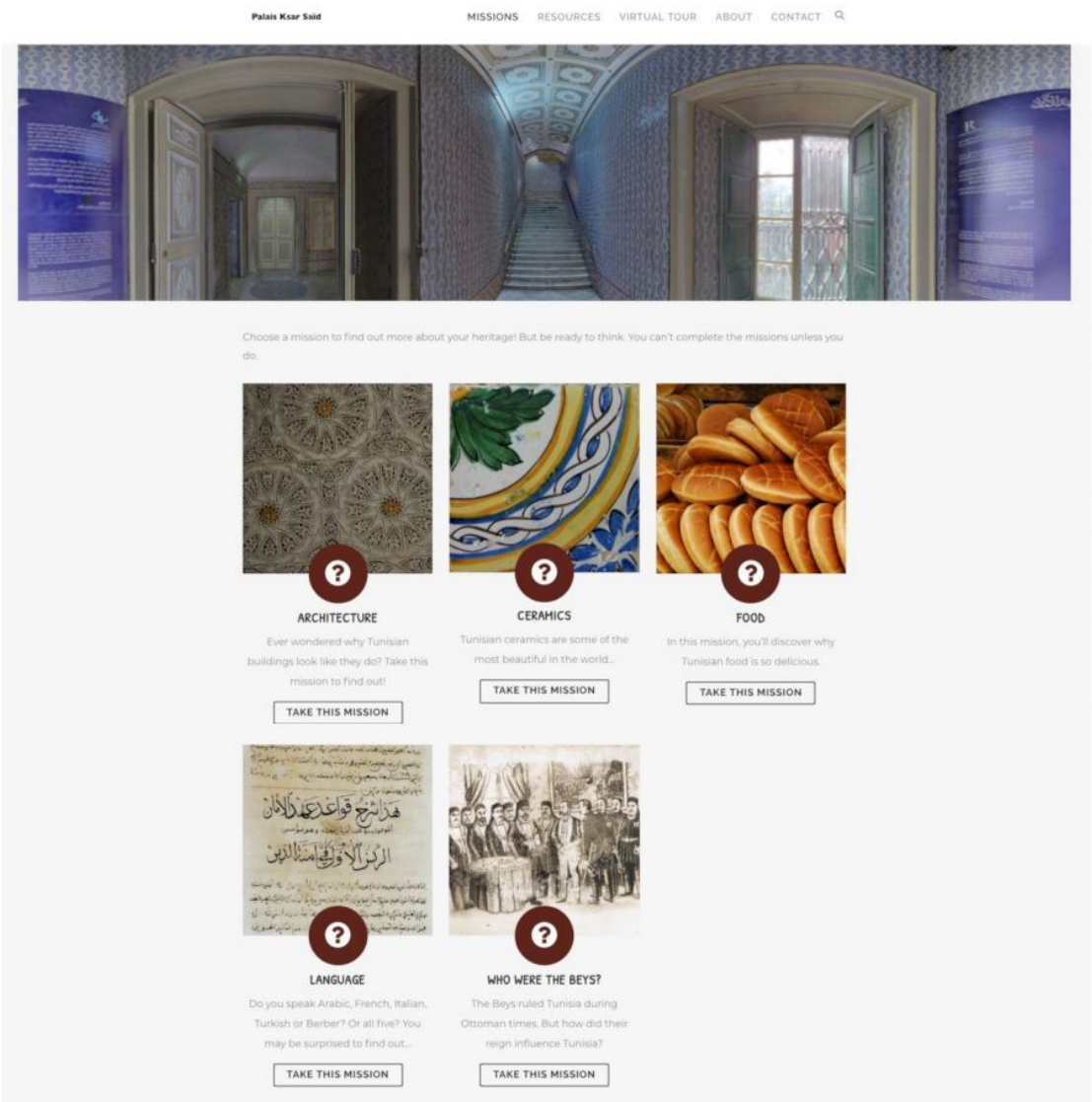


Figure 2.7: Ksar Said Project, interactive 3D panoramas with related learning activities (DiGiuseppantonio DiFranco et al. 2019, 11).

Several scholars have pointed out that archaeology and its publicising still remain closely linked to objects and monuments and their artistic value. In her book *Uses of*

Heritage, Smith (2006, 18) argues that this is due to the dominant AHD rooted in Western European elite cultural values, which privilege monumental forms of heritage "as physical representations of national identity and European taste and achievement" (see also section 2.2.1). In Smith's opinion the AHD established heritage practices in which archaeological and heritage sites are mostly valued for their aesthetic qualities and can only be passively observed from afar by the public while they uncritically consume information provided by experts.

According to Pujol (2008, 106), the confluence between artistic and 'romantic' notions of archaeology and economic interests has produced VR applications which "use very sophisticated interfaces to present spectacular discoveries or famous monuments", mainly because this is the most popular and lucrative side of archaeology. She claims that this is the result of the predominating concept of Virtual Heritage, supporting the application of 3D computer models mainly for the creation of virtual replicas of monuments and artefacts, where "the monument (not history) constitutes the central element, because archaeological remains are valued only as witnesses of the past" (Pujol 2008, 106). In Pujol's opinion, at present the application of VR in the archaeological field has mainly been focused on buildings and artefacts and their artistic value, instead of on the social and natural agents which lie behind the archaeological process. This is to a considerable extent a convincing opinion, especially concerning the fact that the general public is still rarely involved in the archaeological interpretation process.

Similarly, Silberman (2005, 10) argues that, within the process of re-creating and understanding the past, the communication of cultural heritage is often oversimplified and only superficially democratic. In Silberman's opinion, the past has too often been presented as a theme park to attract heritage consumers and, as a result, heritage interpretation can rarely afford to engage with difficult histories that might drive holiday visitors away. As he more recently put it, "twenty-first-century heritage interpretation must be an informed and inclusive group activity, and expression of evolving community identity, facilitated by professionals and non-professionals alike" (Silberman 2013, 30). According to Economou (2015, 225), archaeologists and heritage practitioners are in fact moving away from the quest of realism toward a more critical reflection on value and ownership of digital heritage. In her opinion, the increasing availability of digital cultural content that is open for reinterpretation and reuse, for

example by local communities, is making us rethink our core practices, shifting the focus on issues of authenticity and identity of digital heritage. New strategies are in fact needed for digital heritage in order to provide accessibility to a wider audience while also ensuring local community ownership.

In line with Economou's opinion, more and more practitioners during the past few years have been contributing in a growing call to give more attention to the overall UX rather than focusing on the technology components of digital archaeology and in doing so, to develop more engaging experiences centered around users' needs (Pujol 2017; Perry et al. 2017; Opitz 2018; Perry 2019).

2.3 Summary

This chapter has presented the history of 3D modelling and visualisation in archaeology and introduced its role in the field of archaeology for both research and public dissemination. I have aimed to show that for the past two decades outside of the demonstration of novel techniques and technologies, a substantial body of literature concerned with visualisations in both archaeological research and communication of cultural heritage has been wrestling with issues of validity and intellectual integrity, the perceived misleading power of 'realism', the representation of uncertainty, documentation, sustainability and access (for example see Ryan 2001; Hermon 2008; Clark 2010; Chrysanthi et al. 2012; Hermon and Niccolucci 2018 and various proceedings and papers including Barceló 2000; Frisher et al. 2000; Pujol-Tost 2007 and Frankland and Earl 2011 among others).

The solution offered by the field of archaeological visualisation has largely come down to methodologies of best practice which advocate intellectual and technological scholarly rigour as employed by the wider field of archaeology and heritage, with the aim of promoting transparency of process and giving validity to the outcomes of computer-based visualisation practices (see for example the London Charter 2012 and Archaeological Data Services' Guides to Good Practice 2011). However, the compliance with such best practices, while ensuring intellectual accountability for 3D models and visualisations, addresses their quality and value only from a technical point of view and does not encompass the subjective and emotive components of these visualisations.

I have also aimed to highlight that, in the past few years, an increasing number of researchers and practitioners has been advocating for a more critically engaged approach to digital archaeology and the adoption of evaluation frameworks and design systems focused on users' needs and expectations. While not denying the usefulness of digital applications in archaeology, they argue that these applications should not be limited to the pursuit of realism, but employed more expansively to create more complex user-centred experiences relying on storytelling and reflecting the human character of archaeological data (see Jeffrey 2015; 2018; Caraher 2016; Opitz and Johnson 2016; Pujol 2017; Perry 2019 to cite a few).

The following chapter (Chapter 3) builds on the ideas explored in this chapter by providing an historical overview of visitors' studies in museums and the application of interactive digital media in heritage settings. It will also discuss the importance of evaluation strategies for achieving a deeper understanding of how digital technologies impact and shape people's engagements with the past.

3 Interactive Digital Media in Heritage: a Review of the Field

While Chapter 2 outlined the historical background of VR and 3D modelling applications in archaeology, Chapter 3 discusses the importance of assessing the real efficacy and benefit of these technologies. This chapter reviews the development of museum trends regarding the application of interactive digital media, as well as highlights the value of evaluation methods for better understanding how these media affect people's engagements with the past. I start this chapter by introducing the historical background of visitor studies (section 3.1); then I move from discussing interactive digital media applications in cultural heritage settings and their criticalities (section 3.2) to presenting studies where different evaluation approaches were adopted to investigate how digital technologies shape heritage experiences (section 3.3). The aim of this chapter is to demonstrate that, while the evaluation of visitors' experiences in museums and heritage sites is a well-established practice, the specific evaluation of how people perceive and engage with interactive digital media is still a less explored field. Indeed, still little is known about how the digital is actually affecting heritage encounters.

3.1 Visitor Studies: Experiences in Museums and Heritage Sites

"Visitor studies" is an umbrella term for a range of different forms of research and evaluation involving museums and their actual, potential, and virtual visitors which collectively might be termed the "audience" for museums (Hooper-Greenhill 2006, 363). These studies are focused on people's experiences and opinions in and about all types of museums. The study of museum visitors started at the beginning of the twentieth century, even if during the first half of the century, very limited and unsystematic work was conducted on visitors' experiences (Hein 1998; Hooper-Greenhill 2006). A series of observational studies of how visitors used museum galleries was carried out between 1928 and 1936. Hein (1998) compares the work of Robinson and Melton, two Yale psychologists, carried out in several science and art US museums, with a study conducted at the University Museum of Archaeology and Ethnology in Cambridge (England) in the late 1940s by Alma Wittlin. The former observed the behaviour of museum visitors, treating museum galleries as research laboratories, while the latter asked visitors open-ended questions, considering museums as learning settings.

Specifically, Robinson and Melton monitored how much time visitors spent in a gallery (room time), the time devoted to individual exhibit objects (object time) and the number of stops by visitors. The merits of their research were the definitions of 'attracting-power' (to what extent visitors stopped to look at an object) and 'holding-power' (how much time visitors stay looking at an individual object or an entire gallery). Equally important was their finding that the majority of visitors spend very little time in any gallery, on the order of a few minutes, and only brief seconds examining any individual object (Melton 1935). Separately, Wittlin set up experimental galleries and tested visitors' reactions to two different forms of presentation of an exhibition on money. Her conclusions were that visitors find museums stimulating and exciting, they appreciate the emotional experiences offered by exhibitions, and prefer syntheses-oriented arrangements to miscellaneous groupings of objects (Wittlin 1949). Overall, these studies introduced different ways of theorising museum experiences and launched an interesting debate in museum studies about appropriate research paradigms: a 'positivist' approach focused on gathering factual knowledge through quantitative methods, or an 'interpretivist' approach aimed at gaining understanding of phenomena via qualitative analysis (Loomis 1987; Hein 1998). Towards the end of the twentieth century, such debate had been settled, as most practitioners of visitor studies recognised that both qualitative (Wittlin) and quantitative (Robinson and Melton) approaches are required to better understand learning in museums (Hein 1998).

Exhibition evaluation, as opposed to visitor survey (meaning data collection of visitors' demographic characteristics and their feedback on the museum experience), was one of the earliest forms of visitor study, and was based on observations, aiming to study visitors' behaviours and track their movements in the exhibition space. In the US, exhibition evaluations were widely adopted and fostered by concerns for accountability and the need to measure outputs for funders and sponsors, such as government funding agencies and private foundations. Especially in the case of government funding, many museums started to carry out exhibition studies to monitor the attainment by visitors of previously specified educational objectives, as a requirement of their funding sources. Museum visitor surveys, instead, became common in North America and the UK by the end of the 1960s. Work on sampling techniques done, for example, at the Royal Ontario Museum (Canada) and at the Milwaukee Public Museum (US), was fundamental for the development of museum-based research. The survey reports of David Abbey, psychologist, and Duncan Cameron, museologist, for the Royal Ontario Museum, in

fact, were the first systematic visitor surveys undertaken in museums and are considered pivotal in establishing "visitor description as a viable evaluation topic" (Loomis 1987, 25). Similarly, surveys conducted by Arthur Niehoff at the Milwaukee Public Museum highlighted several interesting topics, such as the importance of comparing audience characteristics during winter and summer seasons. Niehoff's surveys, in fact, reveal interesting patterns where repeated visits happened during autumn and winter while one-time visits where more frequent in summer and mostly involved tourists (Loomis 1987).

Meanwhile, the sociologist Pierre Bourdieu conducted an extensive survey of museum visitors across Europe (France, Greece, Spain and Holland), which has been fundamental for sociologists and cultural theorists. His research, in fact, suggests that different social classes have differences of 'taste' in art, which lead to different museological approaches. Influenced by Karl Marx's theories, Bourdieu argued that capital forms the foundation of social life and dictates one's position within the social order. He also expanded this term beyond the economic - into the more symbolic realm of culture. Bourdieu's concept of 'cultural capital' refers to the collection of symbolic elements such as skills, tastes, clothing, mannerisms or material belongings that people acquire because they are part of a particular social class. Based on this premise, he then theorized the concept of 'habitus' as the physical embodiment of cultural capital, which also includes preferences for cultural objects, such as art, that manifest in museums and heritage settings. According to Bourdieu, visitors of higher social class possess a higher cultural capital and so are more likely to appreciate the art objects, using schemas that locate the work in a system of artistic meaning, while working-class visitors struggle to apprehend artwork beyond their mere physical properties and perceive museums as exclusive places which confirm their sense of inadequacy. This is because upper-class individuals are exposed to and trained to appreciate it from a very early age, while working-class individuals have generally not had access to 'high art' and thus have not cultivated the appropriate habitus (Bourdieu 1984; 1993). Even though carried out during the 1970s and 1980s, Bourdieu's work still remains one of the few that addresses questions of social class and exhibition reception, highlighting how museums by reproducing the structural inequalities of capitalist societies are experienced by certain audiences - specifically the working classes - as places of 'symbolic violence' where they feel not only excluded but also responsible for their own exclusion (Fyfe 2006, 38; MacDonald 2007, 151).

While, during the 1970s and 1980s, visitors' studies in the UK were limited to a few larger national museums, in the US, several different studies were carried out and a new approach based on constructivist learning theory was emerging. In the 1980s and 1990s several large-scale quantitative studies were conducted on museums' social use, presenting demographic details such as age, gender, ethnicity, degree of education and social class of museum visitors. However, these studies provided a very limited account of the socio-cultural meaning of the data, as collecting demographic data of those who used the museums could not give any insights on why others did not. For this reason, methods from the market research field started being adopted, using interviews and focus groups to collect more in-depth data about people's perception and attitude towards museums (Hooper-Greenhill 2006).

During the last three decades, the development of museum visitor studies has emphasized the active role of visitors in museums and exhibitions. As Hooper-Greenhill (2006, 32) points out, there has been a shift "from thinking about visitors as an undifferentiated mass public to beginning to accept visitors as interactive interpreters and performers of meaning-making practices within complex cultural sites". Similarly, in the field of educational studies, a shift is evident from 'behaviourist' approaches, which follow the notion that a predictable response arises when stimuli in museums are applied to visitors, to 'constructivist' approaches, which emphasize the complex, relative and highly personal processes of learning (Falk and Dierking 2004; MacDonald 2007). The constructivist perspective recognises the active nature of the individual and the collective construction of learning. It views knowledge as a process created by the knower, which varies according to social differences, such as cultural and educational background, gender, age and ethnicity (Hooper-Greenhill 2006; MacDonald 2007).

This constructivist concept of learning is embodied in Falk's and Dierking's framework called the 'Contextual Model of Learning', in which learning is conceived as a "contextually-driven effort to make meaning […] a continuous, never-ending dialog between the individual and his or her physical and socio-cultural environment" (2004, 12). According to the authors, learning in free-choice settings, such as museums, is influenced by multiple factors, such as visitors' prior knowledge or motivations, and requires different methods of investigation to evaluate the quality of visitor's learning rather than just its quantity (Falk et al. 2004). Similarly, other scholars advocate the need for a more nuanced and interpretive research approach to museum visitor studies, which takes into consideration the emotional response and acknowledges that learning

in museums is not restricted to cognitive gain, always intentional and temporally confined (Finnegan 2002; Hooper-Greenhill 2006).

Several studies have been undertaken, combining quantitative and qualitative analyses, to understand the variable ways museum content is approached by visitors and to try to identify patterns in learning outcomes. In a study of visitors at two heritage sites in the northwest of England (the Museum of Science and Industry in Manchester and Wigan Pier in Wigan), Bagnall (2003) shows that visitors' responses are mediated by personal memory and experience. During the museum experience, in fact, visitors selectively use the materials and media resources provided according to their personal background. This is particularly evident at Wigan Pier, where the use of live performances and tangible reconstructions evoke a sense of nostalgia, making a more direct appeal to visitors' emotions. Visitors design their visit in terms of physical experience, which enables them "to map and perform their consumption emotionally and imaginatively so they could endow the versions of the past offered by the sites with meaning" (Bagnall 2003, 88). The emotional engagement, the reality of the emotions felt by visitors, contributes to their ability to actively perform a form of reminiscence at the sites and promote the process of remembering.

The increasing interest in understanding visitor perception and a growing emphasis on the outcomes of learning have stimulated new evaluation approaches, focused on socio-cultural explanations of learning. They have also promoted new museum practices, aimed at more interactive presentation. According to Pujol and Economou (2006, 81), in fact, museographic trends are moving towards "more experiential ways of presentation, in which the visit is understood as a physical, cognitive and emotional immersion in a social and multimedia environment with which visitors establish a dialectical relationship". On a parallel level, public expectation has been changing and visitors now expect access to a wide range of information sources and to actively participate with museums. As Simon (2010) puts it, "the cultural and technological shifts that accompanied the rise of the social Web have changed people's expectations of what makes experiences worthwhile or appealing. People assume the right to co-opt and redistribute institutional content, not just to look at it". She suggests that the only way to fulfil these expectations is to adopt participatory techniques, which personalise and change content produced in participation with visitors, rather than provide the same content to everyone. Participatory approaches can bridge the gap in communication between museums and visitors, seeking a more dialectic and enduring relationship, and

bringing cultural institutions closer to their fundamental aims and mission statements as they engage visitors with heritage and foster critical thinking.

However, some practitioners argue that these approaches present some weaknesses, especially if they fail to find the proper way to integrate and combine museum knowledge, essential to understanding and appreciating the exhibits, and visitors' subjective interpretations of cultural content. As stressed by Yannoutsou and Avouris (2012), the process of personalisation, aiming to adapt the cultural experience to visitors' interests and previous knowledge, can lead to a reproduction of visitors' passive roles. As they have observed in their studies, engagement with the cultural content can remain superficial and what visitors take away from such experiences is often still factual information.

3.2 Museums and Heritage Sites in the Digital Era

As a result of these new museographic trends, interactive digital media have been increasingly adopted in museums and exhibitions as they offer visitors the possibility to have a more active role within the museum visiting experience. As Roussou (2004, 5) points out, constructivism has led to the development of interactive and participatory environments, "where the user is able to modify, build, appropriate elements, test ideas and actively engage in problem-solving and critical thinking". According to her, these approaches have influenced the development of interactive and virtual environments, "which seem to tie in well with "the learning by doing" and "hands-on" practices of modern museums". Falk et al. (2004) cite some studies that, although relatively few and limited to short-term measurement of learning, support the notion that visitors benefit and learn from interactive exhibits. They show that visitors perceive interactive tools as opportunities to communicate, receive personal feedback and engage in "learning by doing". The experience with interactives not only changes visitors' perceptions of museums and exhibits, but also positively affects their learning outcomes, such as the ability to apply the acquired knowledge to everyday life.

With their increasing interest in evaluation, museums have started turning their attention to interactive digital media as part of their efforts to democratise their practices, reconnect with the public and transform what is usually a passive learning process into a more active performance (Simon 2010; Pujol and Economou 2011; Yannoutsou and Avouris 2012; Economou 2015; Damala et al. 2016). VR, AR, games and 3D replicas have become a meaningful medium for museums and exhibitions, since they offer a

wide range of possibilities for a more dynamic, interactive and emotionally engaging museum experience. As Economou (2015, 218) puts it, “AR allows organizations to engage in conversation with their audience, as AR links up easily with social media […] AR can assist heritage institutions to tell stories about their collections, sites, and exhibitions, enhancing the visitor’s experience”.

Schell (2003 in Roussou 2008, 273) defines a successful entertainment experience as when visitors’ interest, empathy and imagination are maintained throughout the entire experience. By creating compelling narratives, museums have the ability to create such successful experiences and engender a deeper connection between visitors and the objects displayed. According to Roussou et al. (2015), digital storytelling represents a powerful resource that museums can adopt to enrich visitors' experiences and meet with the evolving needs and expectations of visitors. As the authors put it, the main challenge for museums in the digital era is to understand “how to successfully turn their institutional knowledge and authority into meaningful, engaging emotional experiences by leveraging the appropriate technological media in the context of their physical settings, and for heterogeneous audiences" (Roussou et al. 2015). It has been argued, in fact, that despite their potential digital technologies have often been adopted merely as means for delivering factual information, with visitors still relegated to the role of passive recipients of knowledge.

Moreover, certain types of interactive and immersive technologies, such as touchscreens and VR headsets have been accused of isolating visitors and distract them from the rest of exhibits (Yannoutsou and Avouris 2012; Damala et al. 2016; Perry et al. 2017, 1). Furthermore, as pointed out by Katifori et al. (2020), while best practices and methodologies to evaluate digital experiences are common in fields such as gaming, they are yet to be developed for digital cultural heritage experiences. According to the authors, this is probably due to various challenges posed by these experiences, from uncontrollable factors affecting the overall UX (such as weather or interaction with other visitors), to the developers intended purposes of the experience (which can vary between learning, engagement or just offering a pleasant visiting experience).

Notions of Cultural Presence and Embodiment, for example, are considered invaluable for a meaningful UX, but their multifaceted nature makes them difficult to assess. The term Cultural Presence implements the concept of Presence, conventionally defined as the feeling of ‘being there’ in virtual environments (Witmer and Singer 1998; Slater

1998; 2004), with the understanding that virtual heritage environments should also evoke the feeling of 'being then', defined as the awareness of being in an environment occupied by people belonging to a specific culture (Champion 2005). However, the concept of Cultural Presence is still considered difficult not just to evaluate but to actually put into practice, even by its creators (Pujol and Champion 2012; Champion 2015). Related to the feeling of presence is the notion of embodiment, the process in which the body, and its spatial and material relation with the environment, influences mind, thinking and cognitive processes (Lakoff and Johnson 1999; Clark 2003; Malafouris 2004; Hutchins 2005). In Kenderdine's definition (2015, 37), "cognition is embodied when it is dependent upon features of the physical body - that is, when aspects of the person's body beyond the brain play a significant casual or physically constitutive role in processing". According to Morgan (2012, 127), "approaching virtual reconstructions while attending to a fully embodied experience can decenter previously established narratives about the past and contribute to a feeling of connection and participation in constructing the past". Providing users with customisable avatars and allowing them to act as their own guides to the past and interact with objects and spaces, adds another level of interactivity to virtual reconstruction and enhances users' feeling of immersion (Morgan 2009; 2012). However, as pointed out by Kilteni et al. (2012), a more precise conceptualisation of the sense of embodiment is still missing and there is not an explicit way to measure embodiment, due to its multifaceted nature. Similarly, Kenderdine (2015) highlights that attempts to evaluate bodily responses, such as heartbeat or facial recognition, to better understand emotional engagement have so far been proved not completely reliable According to Richards-Rissetto et al. (2012, 336), adopting natural (control-free) interfaces for digitally-mediated experiences seem to "create a sense of embodiment and spatial awareness that provides users with a better sense of space and consequently a better sense of place". While agreeing with this position, Pietroni et al. (2014) point out that it is still very difficult to assess the efficacy of this kind of interface due to the lack of evaluation parameters, as people have different coordination and awareness of their own movements.

For these reasons, it is essential to continue investigating the role played by these technologies in shaping encounters with the past. Below, I presented a select group of projects and studies focused on evaluating the impact of interactive digital media in heritage experiences.

3.3 Evaluation Studies of Interactive Digital Media

Since visitor experience is subjective, dynamic and related to context (Law et al. 2009), systematic research is fundamental to understanding the real effectiveness of interactive digital media in museums and exhibitions and to identify what evaluation methods to adopt for this purpose (Roussou 2008; Pujol and Economou 2009; Schnädelbach et al. 2010; Simon 2010; Carnwath and Brown 2014; Gartski 2016). In the 2015 New Media Consortium (NMC) Museum Horizon Report (Johnson et al. 2015), measuring the impact of new technologies has been identified as one of the most important challenges for museums and cultural heritage institutions. As Damala et al. (2016), point out, solutions for such challenges can be elusive as it is difficult to identify what evaluation methods are the most effective in assessing this type of experiences. Also, according to the authors, it is not entirely possible to evaluate interactive digital media and more 'traditional' museum displays separately, "as a truly multisensory, embodied, and tangible museum visiting experience will seamlessly merge the digital with the physical, […] allowing the visitors to get the best of both worlds and to smoothly make use of all exhibition components they are provided with" (Damala et al. 2016). Moreover, as argued by Economou (2017) we still need to better understand the short and long-term impact of digital heritage encounters and how digital resources are-used and re-interpreted by users.

According to Kidd (2018), as the impact of immersive heritage experiences is difficult to quantify, "we should be working toward robust methodologies for understanding responses to such experiences 'in the wild' beyond simple quantitative metrics which are the bread and butter of user evaluations and impact studies". In Galani and Kidd (2019), the authors present and reflect on evaluation challenges that have arisen in their projects, including *With New Eyes I See,* an itinerant and immersive digital heritage encounter in Cardiff city center (Kidd), and *Rock Art on Mobile Phones,* a set of dialogic web apps that aimed to explore the potential of mobile devices in delivering heritage interpretation in rural Northumberland (Galani). Based on their experiences, traditional evaluation approaches, such as device data analytics and qualitative observational techniques "alone lack the ability to represent the transmedial nature of the experience, and hybrid methodologies are required in this field to enable researchers to understand technology use in actual practice while affording participants the capacity to exercise their agency over their experience" (Galani and Kidd 2019). According to the authors, analysing and understanding the value of mobile digital heritage resources

in situ is a complex endeavour and requires more longitudinal studies and collaboration across multiple case studies.

Economou and Pujol (2011) carried out an extensive evaluation study aimed to understand how VR applications were used, and the type of learning supported by different systems, as well as to provide guidelines on evaluation methodology. For this purpose, the authors used three case studies: the exhibition "Immaginare Roma Antica" at the Trajan Markets, Rome; the permanent displays at the Ename Museum, Belgium; and the VR displays at Hellenic Cosmos, Foundation of the Hellenic World, Athens. In their research they combined qualitative and quantitative methods and used triangulation to verify the data gathered through visitors' questionnaires and explain the information obtained by direct observations. The results showed that while ICTs are largely perceived as learning tools, and VR contributions proved to be useful in providing visual and spatial information, visitors still associated learning with 'real' object interaction and traditional means of interpretation, such as textual information. Therefore, Economou and Pujol (2011, 235) suggested that to be effective, VR applications need to "provide more than just visual information […], contain human active presence, presenting a subject that is relevant for visitors, have an intuitive and transparent interface, and finally, but not as importantly, be visually realistic".

Pescarin et al. (2014) conducted an evaluation study during the exhibition 'Archaeovirtual 2011' in Paestum (Italy), showing 14 worldwide projects on VR and Cultural Heritage. This study was part of the four-year European Commission-funded V-Must project (Virtual Museum Transnational Network, 2011-2015) (V-Must 2011), aimed at analysing various virtual museums (hereafter VM) projects and drawing guidelines to provide the heritage sector with the tools and digital workflows necessary to create educational, enjoyable and long-lasting VMs. Their research was aimed at comparing different digital applications, evaluating the usability of the interfaces and analysing user behaviour. They collected both qualitative and quantitative data via observations, visitor questionnaires, interviews with both users and developers of these VM experiences. The results showed that users found all the applications easy to use, captivating and demonstrating a high level of immersion, but they also perceived the level of interactivity to be quite low. However, contrasting results arose comparing data from VM developers who, instead, rated the sense of immersion medium-low and the level of interactivity medium-high. This study confirms the importance of evaluation to

identify whether or not the actual response of users matches the kind of experience the developers intended it to be.

Within this exhibition, they also carried out a further evaluation of the Etruscanning project, a VR application showing the virtual reconstruction of the Etruscan tomb Regolini Galassi (Pietroni et al. 2014), presented in association with an Etruscan exhibition in Amsterdam and Leiden (Fig. 3.1). The results of observations carried out in all the locations helped to better understand how the physical characteristics of each environment (Amsterdam and Leiden museums and the Archaeovirtual exhibition) and the way in which the VM application was integrated in each of them affected the overall UX. According to the authors, in fact, this evaluation was fundamental to "identify the impact that the physical environment had on the quality of the VM application, which may not have been fully understood if we had only conducted observation in one location" (Pescarin et al. 2014, 79). These results were confirmed by users' responses to questions regarding their experience in both questionnaires and interviews. While in this case the application of cumulative evaluation approaches generated overlapping result, it also allowed the acquisition of "a wider range of user responses, giving a more complete understanding of the impact of the application than just one evaluation method would have been able to provide" (Pescarin at al. 2014, 80). As such, this study also highlights the importance of adopting multiple evaluation methods to gain a more nuanced understanding of the experience users have when interacting with digital technologies.

Figure 3.1: Interface and main viewports of Etruscanning 3D (Pietroni et al. 2013, 656).

Di Giuseppantonio Di Franco et al. (2015) conducted a study aimed at assessing how interactions with 3D immersive virtual environments and 3D prints affect people's perceptions of past material culture, as well as the benefits given by these new technologies. Through a series of experiments, they investigated how experiences with 3D digital replicas in virtual environments and 3D prints differ from the visual experience with original artefacts displayed in museums. For this study, the authors selected our objects (made from different materials and coming from different geographic areas and chronological contexts) presented in three different modalities: visual examination of the original artefacts in a display case, interaction with 3D digital copies of the objects via an immersive stereovision system and physical manipulation of 3D replicas of the artefacts. Their findings seem to indicate that participants provided with these different modes of interaction were more inclined towards a sensory experience with copies of the artefacts, rather than just looking at the original in front of them. The results, in fact, show that "our sample of participants favoured a tactile or semi-tactile experience with replicas to the visual experience with original ancient objects" (Di Giuseppantonio Di Franco et al. 2015, 36). This study highlights how traditional museum displays, such as objects displayed in cases, limit visitors' experiences with past material culture and show the benefits of integrating interactive technologies within museum displays as a way to offer a more active, embodied and engaging experience. However, the authors argue that further investigations are needed to study if different factors (gender, ethnicity, education) influence the perception of authenticity in relation to objects (virtual and real), or "how people with particular affiliation [sic] with tangible heritage might interact with both authentic objects and their reproductions in different media states" (Di Giuseppantonio Di Franco et al. 2015, 38).

As part of the meSch (Material EncounterS with digital Cultural Heritage) EU-funded project, evaluations and audience research on two exhibitions in the Netherlands (Museon and Allard Pierson Museum) were conducted to assess the impact of digitally enhanced, tangible and embodied visitor experiences. Specifically, such studies focused on the use of smart replicas (i.e., objects augmented by digital technologies) of original artefacts displayed within the museums to interact with digital content. Results showed that the majority of visitors enjoyed visiting the exhibition using the replicas and did not find them difficult to use, indicating that the physical manipulation afforded by this type of interface, unlike for example screen-based interactives, offers a compelling and more

embodied way to control digital content in museums (Marshall et al. 2016). Moreover, lessons learned from these studies provide useful insights on evaluation strategies, with critical reflections on the efficacy of various evaluation methods (questionnaires, observations, interviews, video recording etc.) and how to combine them to effectively investigate the role played by interactive digital media within visitors' experiences (Damala et al. 2016).

Within the CHESS (Cultural Heritage Experiences through Socio-personal interactions and Storytelling) research projects, several studies were conducted in museums (Acropolis Museum, Greece; Cité de l'Espace, France; Stedelijk Museum, Amsterdam) and archaeological sites (Çatalhöyük, Turkey). The CHESS system is a research prototype developed under the CHESS project, aiming to provide personalized museum visits through an interactive storytelling application. It is based upon a PD methodology, implemented with both museum curators and representative groups of visitors, and involves an evaluation framework to test the validity of the design in real world experiments or through user workshops. The CHESS system uses personalized information to create customized stories that guide visitors with mobile devices through the exhibition, deploying simultaneously multimedia, games, and augmented reality (Roussou et al. 2015) (Fig. 3.2). CHESS utilizes the notion of personas, a description of imaginary people represented as specific human beings, in order to develop interactive stories customised to different visitor profiles (Roussou et al. 2013; Vayanou et al. 2014). The results of experiments with experts in archaeology and museum practices, digital media and storytelling authoring showed positive responses, as all participants found the experience positive and engaging. Participants "took advantage of the concept of story narrators in different and creative ways, ranging from a character telling a story […], to dialogue between characters. Personas also seemed to be very comfortably adopted and used in this design domain in order to better take into account the visitor perspective" (Roussou et al. 2015). However, as emerged during a workshop with various practitioners (archaeologists, museum curators, writers and educators) at the Acropolis Museum, most participants encountered some difficulties during the authoring process (for example deciding what ideas to keep and what to reject), evidencing that the creation of interactive digital storytelling requires proper training in authoring methodology. Experts involved in the workshop conducted at Çatalhöyük, archaeologists and heritage practitioners of different background, defined the collaborative authoring process "as a very constructive and reflective method not only

for crafting stories about the past in a creative way but also of making better sense of the data, and thus obtaining a better insight into and overview of certain aspects of their research" (Roussou et al. 2015). The digital story developed during this workshop, was then refined by the CHESS team and tested both on-site and off-site (Çatalhöyük's Visitor Center) with visitor pairs who explored a mobile-mediated (namely an app for iPads) storytelling experience (Fig. 3.3), communicating and interacting with each other at pre-set points along the visit. The results of these testing show that visitors found the experience socially and emotionally engaging and that the interactive prompts provided by tablets were not perceived as disruptive of the story flown. Moreover, these results indicate that this kind of storytelling-based digitally mediated experience not only positively impact visitors' engagement, but it also fosters conversations and "perspective-taking between users, leading to a more nuanced understanding of the relationship between people in the present and people of the past" (Katifori et al. 2020). Research conducted within the CHESS project is of particular relevance to my research as not only they demonstrate the importance of evaluation for better understanding the efficacy of digitally heritage encounters, but also highlight that in order to develop rich engaging experiences it is fundamental to adopt collaborative practice within interdisciplinary design teams.

Figure 3.2: CHESS workshop at the Acropolis Museum. Participants testing the digital storytelling experiences developed during the event (Roussou et al. 2015).

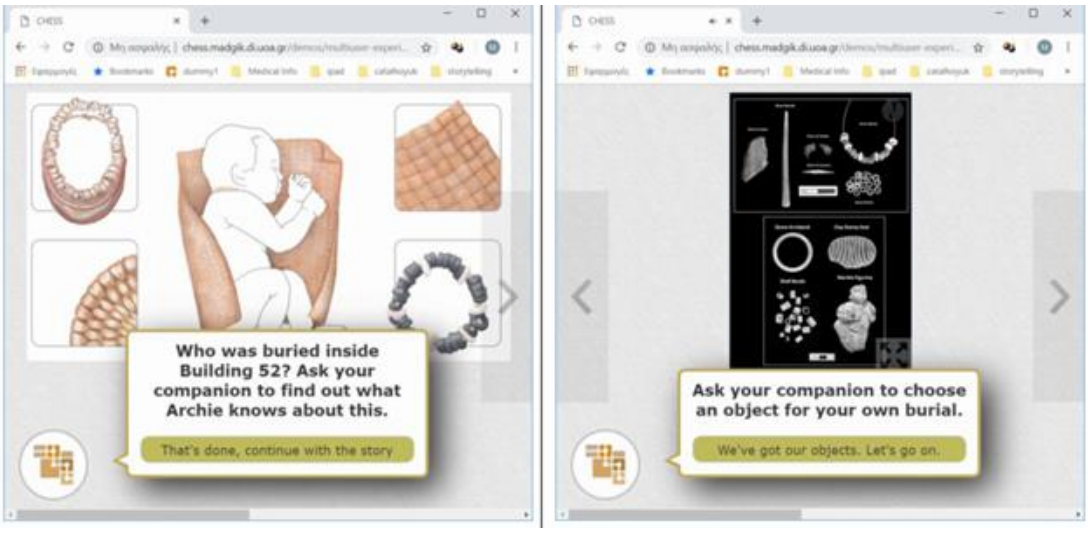


Figure 3.3: screenshots from the Çatalhöyük off-site digital storytelling experience (Katifori et al. 2020).

Another example is provided by the EU-funded EMOTIVE project (EMOTIVE nd), aimed at using emotional storytelling as a primary component of digital experiences at heritage sites including Çatalhöyük, the Antonine Wall display at the Hunterian Museum (University of Glasgow, Scotland) and the York Minster. As described in Perry et al. (2017, 4), the premise of this project is that museums are emotional places and "seedbeds not necessarily of knowledge alone, but of human connection, introspection and collective future-building, made possible via shared encounters". Within EMOTIVE UXs built around 3D-printed moulds, VR, chatbots and mobile apps were developed with the aim of promoting reflexivity and critical engagement among users, by challenging their expectations and exploring emotive and controversial themes (for example life and death, social structure and hierarchy, gender equality). The underlying approach for both the design and evaluation of these experiences is centred around the users' needs, by adopting individual and group personas or user-led content creation (Perry at al. 2017; Perry 2019; Roussou et al. 2019). Interestingly, as these UXs were designed to foster conversations and interactions between multiple users (both specialists and broader publics), findings from the EMOTIVE project, while promising in relation to non-specialist users, also highlight how specialists often struggle with the concept of participatory practices focused on emotive engagement, especially when negative emotions (such as discomfort or the uncanny) are involved (Perry 2019).

In the York Minster experience, where visitors were encouraged to engage in discussions on contemporary social issues, participants were moved to self-reflection and collaborative learning by such dialogues. However, other participants and in

particular one of the Minster guides were concerned about this approach and more inclined to avoid discussing difficult histories altogether (Garnett 2018, cited in Perry 2019). Moreover, in the Çatalhöyük mobile app experience, people were encouraged to collaboratively conduct activities based on the hypothesised egalitarian practices of the former Neolithic residents of the site (for example exchanging or leaving behind things for other users). Again, non-specialists felt very affected by this experience while archaeologists were not positively engaged and actually more concerned about the nature of the interpretation presented in the experience (Mirashrafi, 2017, cited in Perry 2019). These results highlight the need for the heritage sector to change current practices and move away from the temptation of indulging in approaches "that regularly breed disempowerment and underestimation of the renewability and resilience of the archaeological record" (Perry 2019, 370). Moreover, studies conducted for the EMOTIVE project confirm once again the importance of investigating how specialist and non-specialist audiences perceive the same experience, especially to confute misassumptions around broader public's needs and expectations.

3.3 Summary

This chapter has presented a brief overview of the development of museum studies and broad public expectations in regard to cultural heritage experiences (Falk and Dierking 2004; Hein 2006; Hooper-Greenhill 2006; MacDonald 2007; Simon 2010). I have aimed to show that digital technologies can positively affect people's encounters with the past, and highlight, as already pointed out by several scholars, that evaluation studies are needed to deepen the understanding of the impact of these technologies, how different audiences actually respond to them and whether this response matches the expectations of those who designed the experience (Roussou 2008; Economou and Pujol 2011; DiGiuseppantonio DiFranco et al. 2015, 261; Economou 2016; Roussou et al. 2015; Damala et al. 2016 ; Perry et al. 2017, 4).

In this regard, the contribution of my research project is firstly to provide a study focused on assessing the impact and the effectiveness of specific forms of interactive digital visualisation upon a different range of audiences. I aim to do this through the analysis of cognitive and emotional responses of different user-groups (see Chapter 4, section 4.2.4 for a description of these groups) to an interactive 3D model that shows an archaeological site in its current state and the interpretive visualisation of the settlement in the past, as well as study their level of appreciation and engagement with a locally situated culture: the Middle Bronze Age settlement at Erimi- *Laonin tou Porakou*

(Limassol, Cyprus). Secondly, my research aims to explore practical ways in which to implement PD and UXD approaches in archaeology to develop more meaningful digital experiences tailored around the needs of users. In order to do so, I present and discuss lessons learned from a series of hands-on co-design workshops focused on UX in archaeology and heritage.

The following chapter (Chapter 4) will discuss the research approach, techniques and software, as well as data collection methods used within the two iterations of this thesis. It will reflect on the application of mixed-method evaluations, combining quantitative and qualitative data collection, and outline the thematic analysis approach used to code and explore the collected data.

4 Research Methods and Data Collection

Through the previous chapters I have introduced the main aims of this research project in relation to the creation and use of digital products, such as 3D models within the archaeology sector and the need to integrate design theory and co-design practice in order to critically tailor these digital resources to the needs and expectations of their intended audiences (see Chapter 1). Then, I have outlined the history of 3D modelling and digital visualisation in archaeology and its present role in this research field (see Chapter 2). I have also presented the development of museums and heritage institutions trends in relation to interactive digital media application, moving from discussing the historical background of visitor studies to the application of evaluation methods for digitally enabled museum visiting experiences (see Chapter 3).

Chapter 4 outlines and discusses the methodology and overall research design of this thesis, as well as the key research problems presented in the previous chapters. I start by presenting the research questions that this research seeks to address (section 4.1). From there, the chapter documents the two iterations of design and assessment of digitally mediated experiences conducted as part of this research, providing a detailed account of techniques, methods and evaluation strategies adopted for each iteration. Firstly, section 4.2 introduces the archaeological site used as the case study for the first iteration, the excavation project and my role within the research team. It also discusses the application of digital technologies to the creation of an interactive 3D model and UI and the subsequent evaluation of the model's efficacy and impact upon different audiences. Then, it presents how the results of such evaluation were contextualised within the broader digital heritage discourse by interviewing experts in the field (Fig. 4.1). Secondly, section 4.3 discusses how results and lessons learned from this first iteration informed iteration two and led to the decision of investigating the practical incorporation of co-design approaches within archaeological practice through a series of workshops on the co-creation of digitally mediated experiences geared at archaeological and heritage sites. Here, I discuss the theoretical framework of the second iteration, the rationale for these co-design events and the evaluation strategy adopted (Fig. 4.2). Finally, sections 4.4 and 4.5 present how data analysis has been conducted, as well as ethics and access of data collection and analysis.

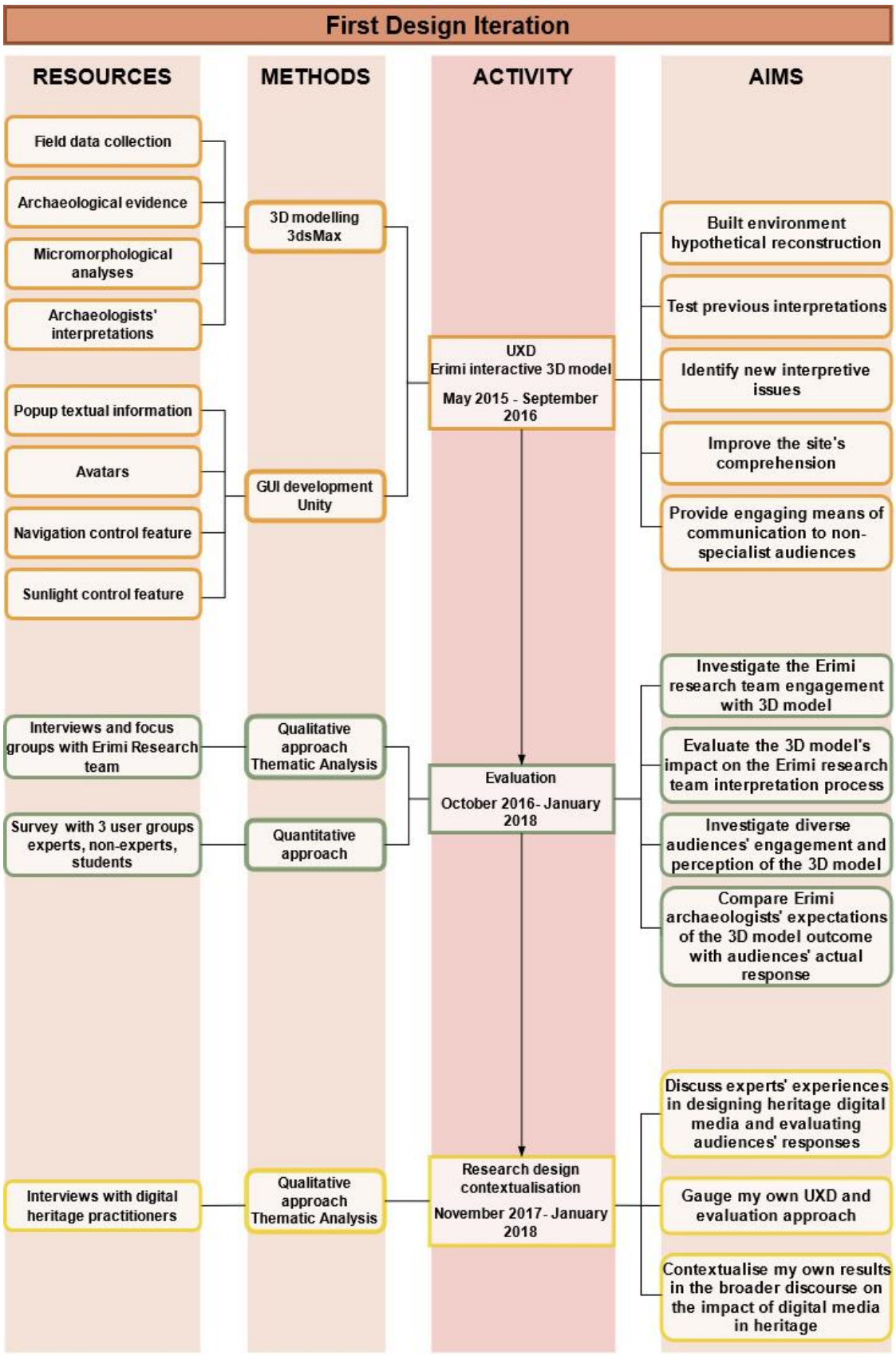


Figure 4.1: Diagram illustrating the sequence of all the activities conducted for the first iteration of the research project (credit: Francesca Dolcetti).

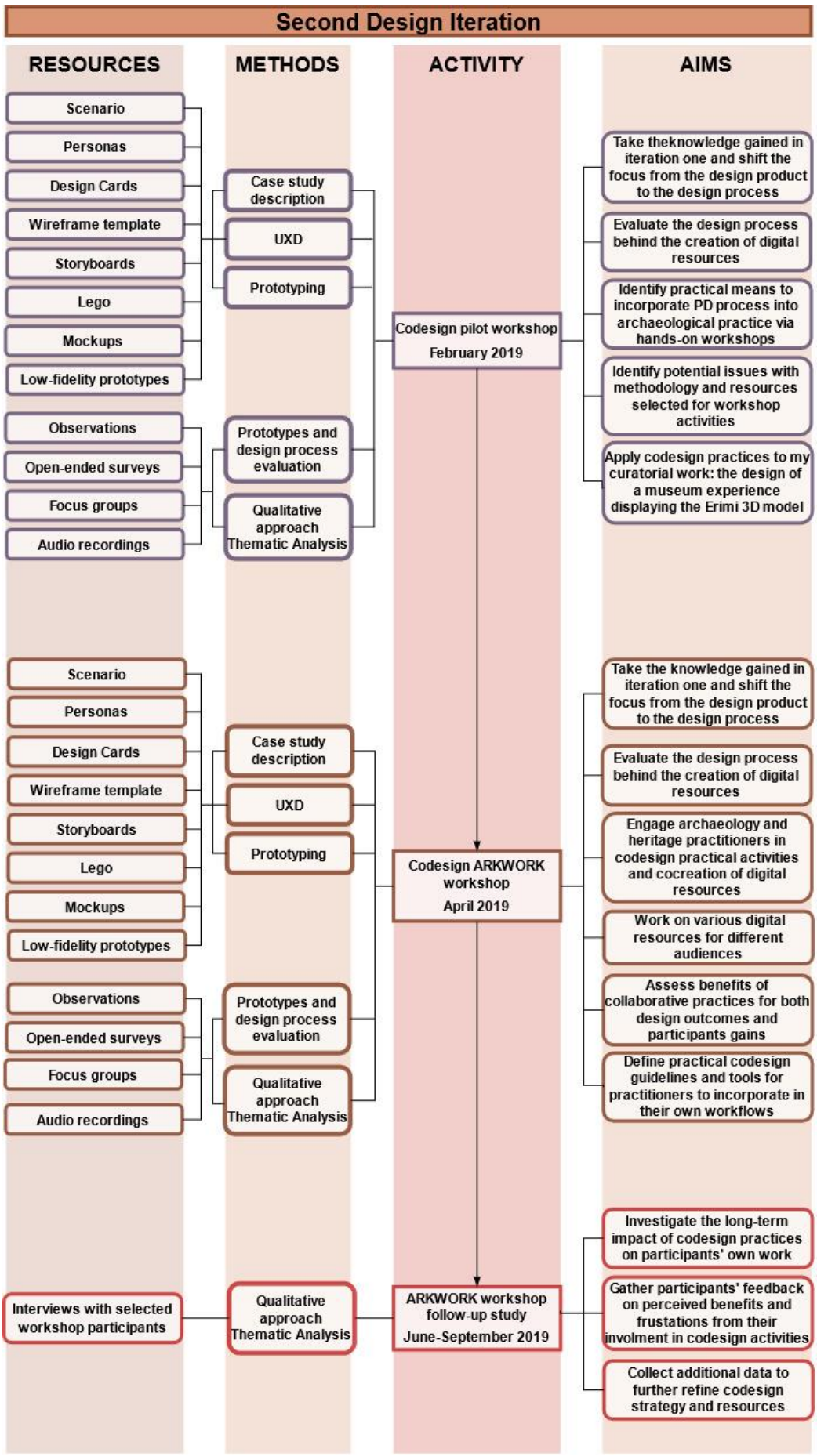


Figure 4.2: Diagram illustrating the sequence of all the activities conducted for the second iteration of the research project (credit: Francesca Dolcetti).

4.1 Research Questions

In the past few decades, the application of digital technologies has become firmly embedded within archaeological practice for recording, visualising and communicating interpretations of the archaeological record. This process has led to a rapid uptake of digital resources geared at delivering different experiences for diverse types of specialist and public audience. A growing number of excavations are incorporating a 3D documentation workflow, using laser scanning and photogrammetric techniques to create detailed and accurate 3D models of stratigraphy and structural remains on the field. Such 3D models have proven to be invaluable tools for monitoring the excavation progress, analysing spatial relationships and interpreting stratigraphic sequences (e.g., see De Reu et al. 2014; Forte et al. 2015; Dell'Unto et al. 2017). Moreover, and as previously discussed, digital technologies have become common and widespread in the cultural heritage sector, as museums and other cultural heritage institutions are increasingly enriching their offers to visitors by providing immersive and engaging experiences.

With this context in mind, and as already outlined in Chapter 1, the following research is focused around three main questions:

- What is the impact of 3D visual media upon a diverse range of audiences, specifically how do different users (specialists and non-specialists alike) engage with this specific form of (re)presentation of the past?
- How can we integrate evaluation frameworks and iterative processes into our methodologies in order to more meaningfully incorporate users' feedback into the design and improvements of these digital resources?
- How can we incorporate UXD and PD processes into archaeological practice to create digital products tailored to the needs and expectations of our audiences?

4.2 The Erimi-*Laonin tou Porakou* Interactive 3D Model

The first iteration of this research focuses on evaluating the impact that interactive 3D models have upon different audiences, specifically the 3D model I developed at the beginning of my PhD research using the case study of the Middle Bronze Age Cypriot settlement at Erimi- Laonin tou Porakou (Fig. 4.3). The site offers an emblematic case study in the discussion about archaeological visualisations, because the nature of its interpretation addresses many of the issues present in the field of 3D visualisation of

archaeological sites.

Until recently, evidence for the Cypriot Middle Bronze Age (2000-1450 BC) was largely based on old excavations conducted during the first half of the 20th century, as well as on single or partially exposed funerary or settlement contexts. Updated relevant data from a few industrial communities on the island have enabled us to draw a better picture of what appears to be a significant phenomenon of increasing 'industrialisation', culminating during the late phase of the Middle Bronze Age. In this view, Erimi-*Laonin tou Porakou* is currently the sole on-going project focused on the investigation of a multi-functional extensive site where a workshop complex, a domestic quarter and two cemetery areas are being excavated, evidencing a long stable occupation throughout the Early to the end of the Middle Bronze Age. It is located in the Kouris River area (Limassol District), which was a vibrant region, rich in ancient remains (Bombardieri 2017).

This site represents an interesting and challenging case study for my research for several reasons. From a strictly research-related point of view, the scarce preservation of the settlement structures limits a comprehensive interpretation and makes 3D visualisations of the built environment a valuable tool for a better comprehension of the site's architecture and the use of spaces. In terms of dissemination, the same issue of preservation threatens the visibility of the site and makes it incomprehensible to audiences unfamiliar with this specific context. An interactive 3D model that presents the site as it is now, alongside the hypothetical reconstruction of the built environment, providing information about the site's history, can potentially overcome these issues and offer a more engaging approach.

Figure 4.3: The Middle Bronze Age settlement at Erimi-Laonin tou Porakou (Department of Antiquities of Cyprus 2019).

4.2.1 History of the Project

The site is located on a hill on the east side of the Kouris Riverbank, north of the modern villages of Erimi in the area called *Laonin tou Porakou*. It was identified in 2007 as the result of a survey project focused on the middle and lower Kouris valley, with the aim of outlining the landscape use, the sequence of ancient occupation in the valley and further possible elements for a wider analysis of settlement patterns in the Kourion region (Bombardieri 2017). The data processing of the surface material collections and the analysis of the cartography, satellite and aerial photographs allowed the identification of 13 sites distributed on the two slopes of the middle and lower Kouris valley. Two basic aspects coincided in encouraging further investigations at this site rather than the others: the high density of surface finds and the fact that the site showed interesting topographical peculiarities with regard to both its position in terms of the geomorphology of the wider valley system, and its internal spatial arrangement. The position of the site, in fact, suggested a possible function as a sighting point overlooking the network system of the valley. Moreover, its topographical layout, naturally characterised by a plain hilltop area surrounded by a series of terraces sloping southward, suggested a favourable location for settlement.

This preliminary evidence laid the foundation for further investigations and focused excavations in the site area, aimed at greater clarification of the occupational sequence and an increased understanding of the function and use of the different areas of the site. These excavations have been carried out since 2008 by the Italian Archaeological Mission, as a project coordinated by the Universities of Turin (Dipartimento Studi Umanistici) in close collaboration with the Department of Antiquities of Cyprus. From the particular perspective of the excavations at Laonin tou Porakou, a major aim of the ten-year program was to attempt to understand something of the prelude to the island-wide urbanisation process which took place during the mature Late Bronze Age, in order to set this fundamental phenomenon within a wider chronological and cultural framework. Different analytical tools, methods and techniques have been adopted to approach this multiscalar dataset, by distinguishing three integrated levels in the discussion and interpretation of the archaeological evidence: the micro-data, the macro-data and the 3D visualisation of interpretive hypotheses.

Over the ten excavation seasons, teams of specialists, assistants and students have contributed to the fieldwork, as well as to laboratory and research activities. The research team is composed of archaeologists and specialists from different backgrounds (with research interests in building techniques, human and animal remains, artefacts, botany, etc.), who have been fundamental for my research as their insights and research results have supported and contributed to the creation of the interpretive 3D visualisation of the workshop complex. The current members are: Dr. Luca Bombardieri (director), Marialucia Amadio (field supervisor of Area A in collaboration with Andrea Villani, Flavia Pettorini and Paolo Tripodi; micromorphological analysis), Caterina Scirè Calabrisotto (radiocarbon, paleodietary and paleoenvironmental analyses), Giulia Muti (supervisor for the material assemblages processing and analysis), Alessandra Saggio (field supervisor of Area E and Area T3), Martina Fissore (field supervisor of Area T2); Daniele Radamante (archaeobotanical analysis); Giulia Albertazzi (archaeological illustrator); Martina Monaco (analysis of human skeletal remains) and Flavia Pettorini (social media manager). Personally, I have been a member of this research project since 2009 as assistant, then since 2011 as supervisor responsible for the documentation of Area B and as field supervisor of Area T1 since 2016. In 2014, as described below, I became the 3D modeller responsible for the 3D visualisation of the imagined architectural environment.

The idea of exploring the potential application of 3D modelling techniques occurred to me in 2013, mainly to create 3D hypothetical reconstructions of the site's architecture for a twofold purpose: on one hand, I wished to deepen our understanding of the site and validate some of the interpretations generated after many hours of discussion with my colleagues; on the other hand, I hoped to provide a means through which to present the site to academic and public audiences in a more comprehensible way. Since an on-going collaboration with a team of architects from the University of Florence (GeCo Laboratory), though with different purposes, was already aimed at providing us with 3D models of the site in its present state, obtained through laser scanner surveys, I decided to use them as a starting point for the reconstruction-focused modelling work (further details in section 4.2.3).

4.2.2 The Site and its History

The occupational sequence of Erimi-*Laonin tou Porakou* ranges from the very beginning to the end of the Middle Bronze Age (c. 2000/1950-1450 BC). Within the site, a planned organisation of the settlement spaces has been recognised by the research team with a clear separation between working, domestic and funerary areas located on adjacent limestone terraces.

On the top of the hill is located the workshop complex (Area A), which has been currently investigated to encompass an area of 30 × 30 metres. The first terrace downward the hilltop is occupied by household complexes (Area B, Trench 2), while in the second and third terraces are located two funerary clusters (Area E, upper and lower terraces). The foundation of a large wall was discovered during the fieldwork season of 2016, in a minor terrace south of the domestic quarter and immediately north of the upper funerary cluster in Area E. This peculiar location and the monumental dimensions of the structure have led us to hypothesise its function as a circuit wall separating the settlement from the cemetery clusters and the exterior. A peculiar building technique was used both in the workshop complex and in the residential area.

The built space of the settlement is characterized by a co-existence of 'negative features' cut into the bedrock through a quarrying process (emplacements and post-holes, flow channels, basins) and 'positive features', built and arranged over the bedrock reusing and customizing stone carved materials (kilns, thresholds, benches and walls). The rectangular rooms are carved into the limestone bedrock, creating slightly underground floors. A combination of earthen (mudbrick and daub) and carbonate

materials (plaster) were employed in the building process together with wooden material, coming from local wooded species. As far as the workshop complex is concerned, the structural elements (installations and workplaces) and residual artefacts (tools, containers, special purpose vessels) connected with storage and working activities, and their spatial distribution within the complex, have been analysed in order to characterise and understand the nature and development of this workspace. Installations include hearths/ovens/kilns, benches, basins and channels, while grinding equipment, chipped stone tools, spindle whorls and weights attest to various types of work-related activities. In particular, emplacements and bins, as well as *pithoi* (large storage containers) and large closed vessels, suggest a significant storage activity (Bombardieri 2017; Amadio and Bombardieri 2018; Bombardieri and Muti 2018).

The workshop complex (Area A)

The excavation of Area A (Fig 4.4) revealed a production complex, which currently extends over an area of 40x30m. This complex is functionally organised into 16 units: five open working spaces, identified as WA (working areas) that are characterized by the presence of rock-cut basins/pits of different shapes and sizes; seven big roofed units, named SAI-VI and SAX (storage areas), similar in their structural organization but different in their internal spatial arrangement. SA VI presents a different layout, maybe due to the fact that this unit was designed as an open-area in the early Phase B and it was turned into a roofed-unit only in the later Phase A. Moreover, there are four additional units/spaces that are yet not fully excavated, SAVII-IX and SAXI. Residual artefact assemblages, together with installation and paleobotanical data suggested that the complex could possibly be identified as a workshop for the production of textiles, in which activities including spinning, weaving and dyeing were carried out (Bombardieri 2017).

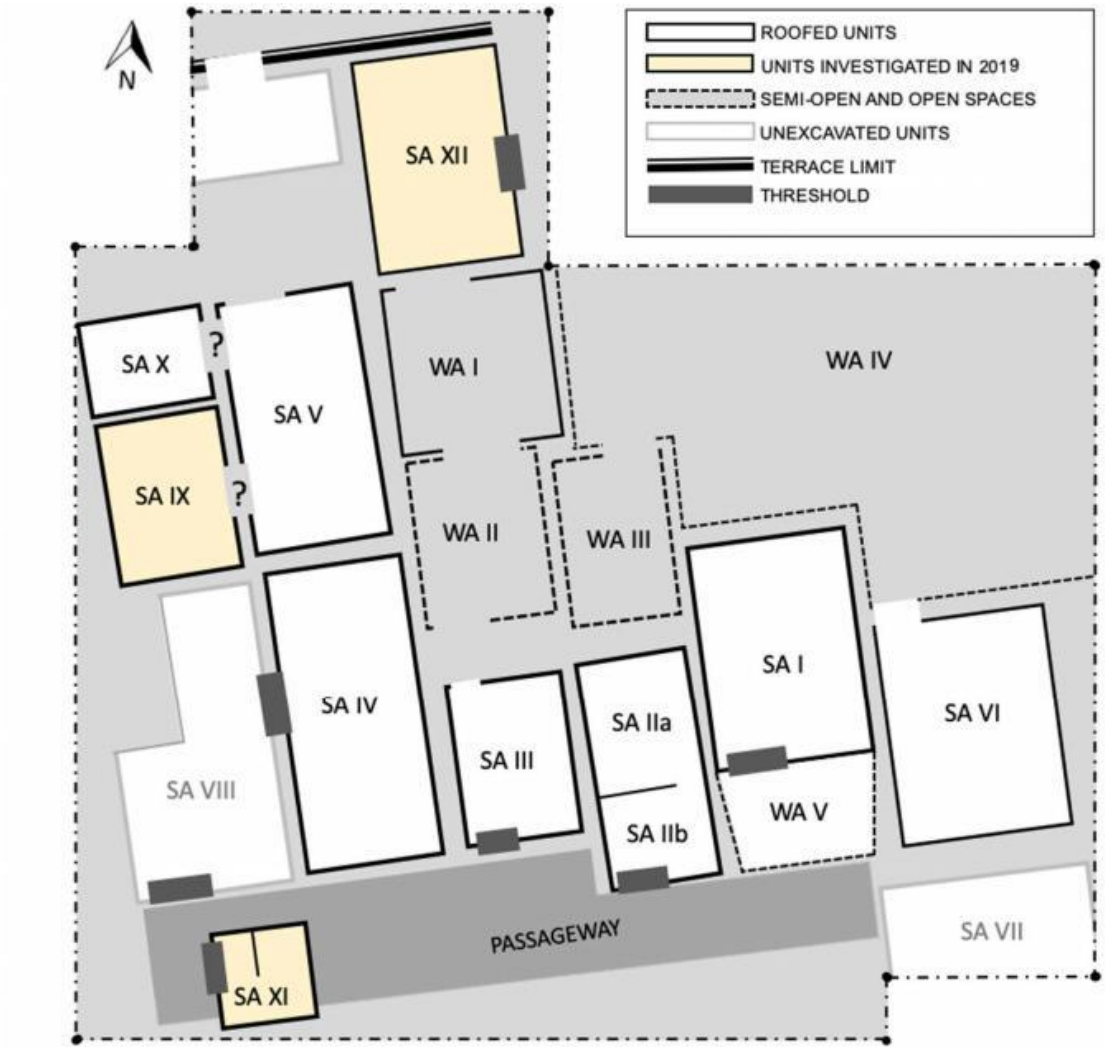


Figure 4.4: Workshop complex. Schematic plan (Department of Antiquities of Cyprus 2019).

The residential area (Area B, Area T2)

The investigations of the first lower terrace exposed the foundation structures of what appears as a large housing area, extending over 20x15 m, Area B. The area is functionally organised into ten discrete units/spaces (as currently excavated): three open-air spaces partially exposed (Spaces 4, 8 and 9), four roofed units (Units 2, 3, 6, 7), with three additional units not yet fully excavated, respectively to the south-east (Unit 5) and north-west (Units 1 and 10) of the actual extension of the complex. Moreover, the 2016 fieldwork investigation of the cross area between the top of the hill and the first lower terrace revealed another household complex, Area T2, which currently extends over 16x13 m and is organised into 2 roofed units (Unit 1 and 4) (Fig. 453).

Figure 4.5: Erimi-Laonin tou Porakou, residential areas. Area B (left) (Amadio and Dolcetti 2019) and T2 (right) (Department of Antiquities of Cyprus 2018).

The limiting settlement wall (Area T1)

Area T1 (Fig. 4.6) extends over 78m in the area located on a minor terrace in the western section of the settlement. The investigation in this area revealed a massive wall structure that fully limits the settlement to the West, following the natural edge of the terrace. The structure is 1.60/1.70m width, a cut within the bedrock of 0.60/0.70m deep was done to create the foundation of the structure and filled with rubble stones and large stone blocks with plaster mortar. Such a foundation structure would be able to support a wall in drystone masonry up to 1.80/2.00m in elevation. This wall structure can be presumably ascribed to the most recent phase of occupation of the settlement (Phase A), during the end of the Middle Bronze Age (ca 1700-140 BC).

Figure 4.6: Erimi-Laonin tou Porakou, circuit wall (Department of Antiquities of Cyprus 2016).

The funerary area (Area E)

The extramural cemetery area (Fig 4.7) extends east and south of the settlement and includes three distinct and contemporary tomb clusters. The two clusters located on the terraces south to the domestic area comprise 18 rock-cut tombs (Tombs 228-232, 240-241, 248, 328, 427-430; 464-467); whilst the third cluster is situated east to the settlement at Ypsonas-*Vounaros* (about 400 m for Erimi-*Laonin tou Porakou*) was rescue-excavated by the Department of Antiquities in 2012. As far as the funerary architecture is concerned, four major types of tombs have been identified at Erimi: pit tombs; chamber tombs; pit/chamber tombs and multi-chambered tombs. The burial goods uncovered here include a wide repertoire of ceramics and small objects. Both the small finds and ceramic assemblages are primarily of standard south coast type, and range in date from the late Early Cypriot to the end of the Middle Cypriot period (ca 2000-1450 BC) (Bombardieri 2017).

Figure 4.7: Erimi-Laonin tou Porakou, funerary area (Department of Antiquities of Cyprus 2016).

4.2.3 Excavation Research Questions and Perspectives

From a research perspective, a major aim of the of the excavations at Erimi-*Laonin tou Porakou* has been, and still is, to investigate the following research questions:

- How did this settlement become an organised production centre during the Middle Bronze Age?

- To what extent did the performance of industrial activity influence the identity and ideology of this community?
- Are there other elements suggesting proto urbanisation in the archaeological record of Middle Bronze Age Cyprus?

While these research questions have been partially addressed during the first five years of excavations 2009-2014; Bombardieri 2017), further data collection is required to provide more comprehensive answers to these questions. As such, the main aims of the 2016-2021 fieldwork seasons has and will be:

- open new trenches to verify the extension of the settlement;
- continue the investigation of the existing areas to better understand the spatial relationship occurring between them;
- conduct a broader investigation within the Kouris Valley area.

Alongside this broader research program, I investigated more specific aspects related to my project, such as how and to what extent the interaction with my model altered my colleagues' perception of the site and if it has been affecting their interpretation of the evidence (see also Chapter 5). Moreover, I developed the digital storytelling revolving around the influence that the textile industry had on the identity of the Erimi community, using archaeological evidence and interpretations developed throughout the years (see also Chapters 7 and 8).

4.2.4 Methods

The methodology proposed for the first iteration of this research aims to assess how people perceive interactive 3D models and to what extent they can broaden the understanding of an archaeological site to groups of both specialists and non-specialists unfamiliar with the specific case study's context (see also Fig. 4.1). It is defined by different stages along the following workflow:

1. Data acquisition and recording: gather all available data about the settlement history through a multidisciplinary approach, including material evidence and micro morphological analyses;
2. 3D modelling: create an interactive 3D model that shows the site in its current state as well as the interpretive visualisation of the settlement;
3. Evaluation: present the 3D visualisation to different user groups, composed of specialists and non-specialists, and use both qualitative and quantitative approaches (interviews and questionnaires) to collect their feedback.

4.2.4.1 Data Collection

The methodological approach applied within this study involves two stages of data collection. During the first stage, a 3D model obtained through a 3D laser scanner survey (Fig. 4.8) has been used as a base for the structural modelling and texturing process of the workshop complex, done in Autodesk 3ds Max. The primary survey data for Erimi-Laonin tou Porakou was collected in the field by the GeCo team (Università degli Studi di Firenze 2020) using the Leica Geosystems HDS 6000 phase-based laser scanner (Tucci et al. 2012). In 2010 the Archaeological Italian Mission at Erimi decided to start a collaboration with a team of architects from the University of Florence (Geomatics and Communication for the Cultural Heritage Laboratory), in order "to cross-check the application of new dedicated survey techniques to the analysis of archaeological evidence from the site" (Tucci et al. 2012, 1). The project involved the application of 3D survey methods and was aimed at obtaining:

- drawings able to render the complicated site morphology and which could be compared with the 2D traditional ones;
- a full-scale replica of a part of the excavation area (Tomb 231) for museological purposes.

The team of architects carried out all three stages of data collection, data processing and post processing. Two laser scanner surveys of the excavation site were conducted by the GeCo team members at the end of the fieldwork seasons 2010 and 2014, to perform an exhaustive data capture of the excavated areas. Both data acquisition campaigns were undertaken using a Leica Geosystems HDS 6000 scanner: targets were placed for the roto-translation of the range maps in the same coordinate system. Subsequently, the data processing was performed by using the following techniques and software (Tucci et al. 2012):

- point clouds, using Leica Geosystem Cyclone
- mesh shaded or texturized, using Geomagic Studio
- vectorization, using Bentley System Microstation.

The post processing work was done firstly aligning any unregistered point clouds to the master point cloud using Leica Cyclone 3D point cloud processing software. At this stage, the registered point cloud was 'cleaned', meaning that outlying irrelevant points were selected and deleted from the dataset. Subsequently, the cleaned point cloud was transformed into a solid model through the meshing process using Geomagic Studio software (Tucci et al. 2012). Processing a point cloud dataset usually introduces varying

margins of error as the scans are registered together and 'holes' in the data (caused by blind spots the scanner beam cannot reach and thus cannot gather spatial data for) are filled during the meshing stage.

Figure 4.8: Workshop complex 3D model obtained through laser scanner survey in 2014 (Università degli Studi di Firenze 2020).

In the case of Erimi-*Laonin tou Porakou,* the main problem with this data collection process has been the lack of a planned long-term data-acquisition workflow, aimed specifically at the 3D visualisation of the built environment. The three-year gap between surveys, in fact, proved to be a drawback during the modelling work: the 3D model of the excavated area, in fact, presents an overlapping of structures related to both phases of occupation, making it impossible to present hypothetical visualisations of each phase separately, as I had originally intended.

This is due to the fact that both surveys were conducted with different aims, such as monitoring the excavation progress over the years, and not for the specific purpose of 3D modelling. Since this issue was overlooked during the initial phase of the modelling work, it has been necessary to re-evaluate and partially change the visualization approach (as explained in the following section). Such problems could have been easily avoided via discussing, from the beginning, the main aims and the intended outcomes of the application of both 3D acquisition systems and modelling tools. Planning the entire

workflow in advance, in fact, could have helped to overcome eventual issues in terms of timing and costs, for example integrating the laser scanner survey at the end of the fieldwork season with a daily recording made using more economic and flexible techniques, such as dense stereo matching (Dellepiane et al. 2013; De Reu et al. 2014; Forte et al. 2015; Galeazzi 2016).

4.2.4.2 3D Modelling and UI Development

The process of reconstruction begins by modelling structures which have collapsed or no longer remain in their original form, due to the perishable nature of their organic components. I used the 3D models of the site obtained through the 3D laser scanner survey as a basis for the structural modelling and texturing process. This step involved speculative modelling of roofs, structural walls and features to be incorporated into the survey data 3D objects (Figs. 4.9, 4.10).

The structural modelling and texturing was done in Autodesk 3ds Max (Autodesk Inc. 2020), which is the industry standard software for most photorealistic architectural visualisation work, providing tools for measurements, three-dimensional polygon modelling, animation of cameras, objects and characters, texture mapping complex realistic materials, real-world lighting capabilities to create realistic environments and powerful rendering capabilities for images and animations.

It has been used in several studies focussed on 3D visualisation and reconstructive modelling of archaeological sites, such as the Neolithic settlement of Skara Brae, Orkney (Watterson 2015), Pompeii (Dell 'Unto et al. 2016) and the Neolithic settlement at Çatalhöyük, Turkey (Cox 2010; Forte et al. 2015). Although this software presents powerful modelling and texturing tools, it is not always easy to use and has a steep learning curve. The modelling process, in fact, requires long and intensive training that can be extremely demanding in terms of time and effort.

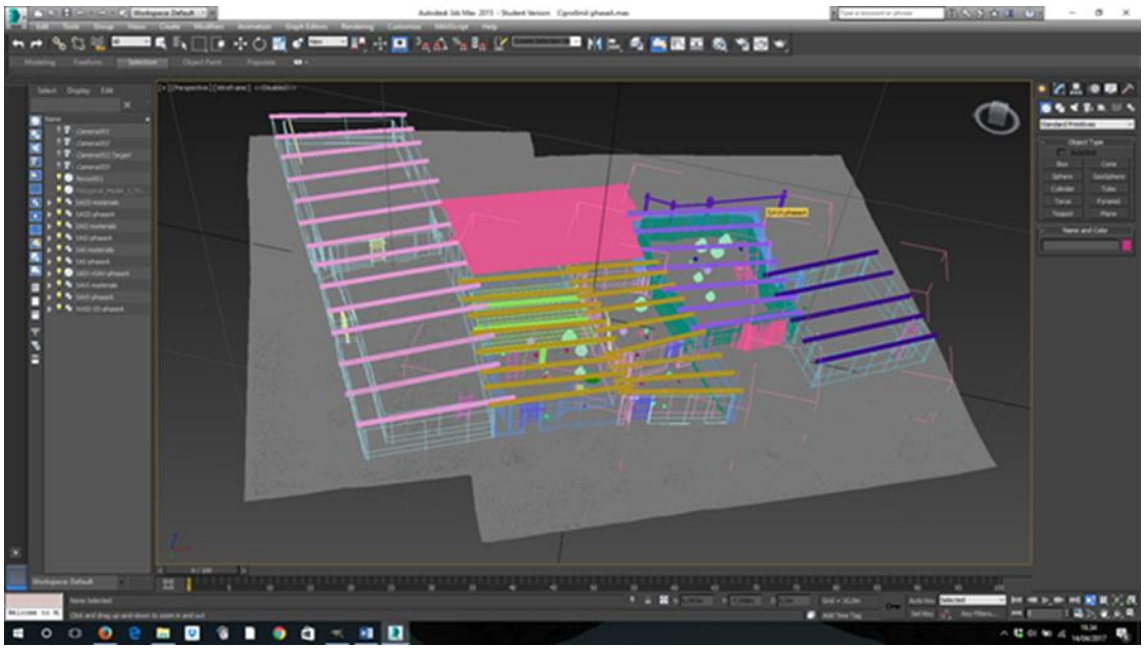


Figure 4.9: Wireframe view of the workshop complex visualisation in 3ds Max 2015 (Autodesk Inc. 2020) (credit: Francesca Dolcetti).

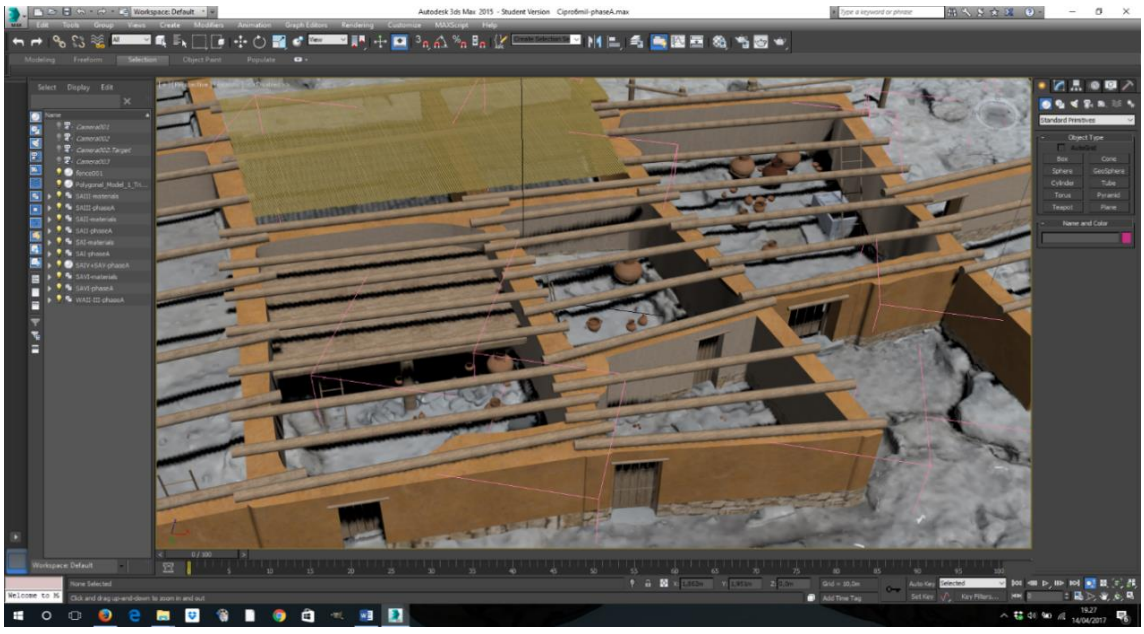


Figure 4.10: Realistic view of the workshop complex visualisation in 3ds Max 2015 (Autodesk Inc. 2020) (credit: Francesca Dolcetti).

Within the stage of data acquisition and processing, the validity of data visualisation can be determined against the site itself and its present-day condition in terms of error reading. However, the following stages in the modelling process cannot rely on straightforward measurement to determine their validity, as they are increasingly subjective, due to the speculative nature of the interpretation of how the site may have appeared in the past. In fact, for the visualisation of the built environment, information

is limited and hypotheses replace certainty. For these reasons, it is extremely important to rely upon a multidisciplinary range of data, such as material evidence, paleobotanical and micromorphological analyses, as well as comparisons with coeval sites. Moreover, it is essential to create a participatory process, where various experts are involved in the creation of the model and provide feedback according to their field of expertise, so that the modelling process can benefit from collaborative dialogues around interpretations. The intellectual process that lies behind the interpretation of source materials is, indeed, the result of a synergy, a constant dialogue among specialists whose specific expertise and insights help to contextualise single sources of evidence or analysis.

The first phase of my work (May 2015-May 2016) focused on the visualisation of the two occupation phases (Phase A and B) of the workshop complex, since it is so far the more intensively excavated area. This involved the hypothetical reconstruction of the vertical stratigraphy of units SA I-VI and open spaces WAII-III (Fig 4.11). Features of units SA IV and SAV are not present in the model, since the two units had not been investigated in detail when the 3D laser scanner survey was conducted. Units SAVII-SAXII (see Fig. 4.4) are not included in the 3D model, since in 2014 they were either entirely or partially lying over the limits of the excavated area.

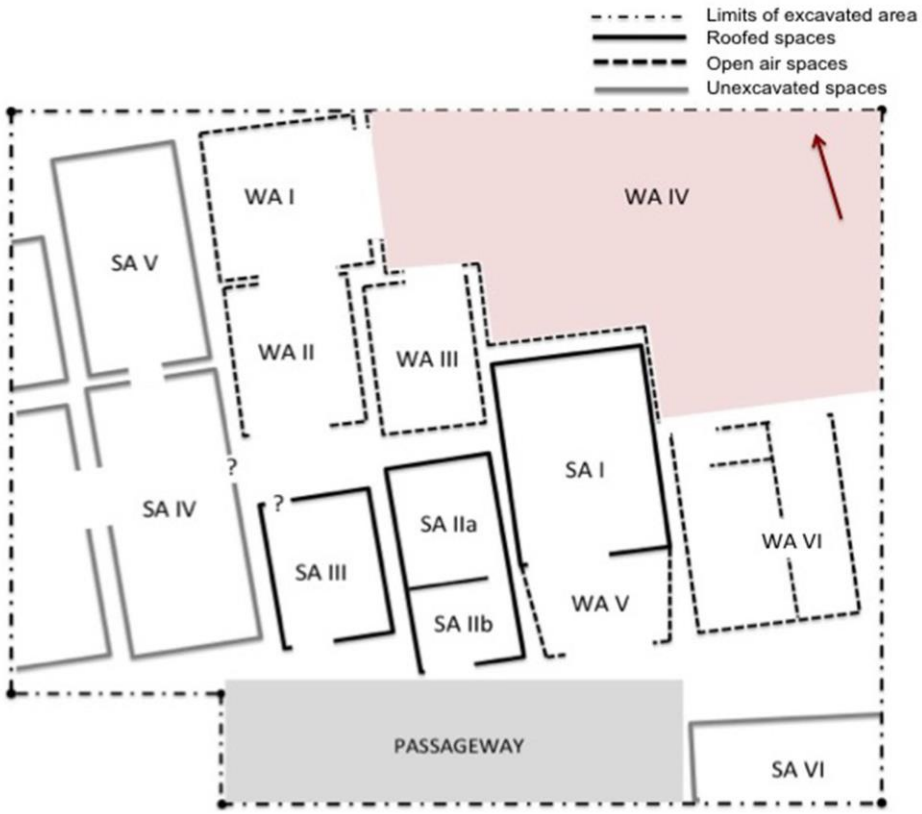


Figure 4.11: Workshop complex excavated area in 2014 (Amadio and Dolcetti 2019, 31).

The structure of walls and roofs was modelled according to several interpretive hypotheses, based on the study of architectural materials and building techniques, as well as on comparisons with other coeval sites such as Marki-Alonia (Frankel and Webb 2006) and Alambra-Mouttes (Coleman et al. 1996). The external and internal faces of walls have been shaped directly upon the foundation bedrock, using limestone basements as a reference to determine the length and width of walls. Evidence of underground features, such as post-holes, have been used to determine the location and the diameter of posts and beams used to build walls and roof infrastructures, as well as to delimit the space of the entrances.

In the case of Unit SAIII, the presence of a post-hole has been interpreted as part of a wooden structure, like a mezzanine. Architectural analysis of building materials, proportions and statics support this idea (Fig. 4.12). In WA IV, a cluster of post-holes forming straight or curved alignment was used as a reference to model a party fence, probably functional to textile drying activities). Micro-evidence and stratigraphic data were utilised to define the textures applied to the external and internal coating of walls and roofs, respectively a mud plaster and a white plaster. The analysis of wooden residues has been used to define the texture applied to beams, door jambs and doors. Specifically for Phase A, the size and distribution of circular settings carved in thresholds provided fundamental data for the hypothetical reconstruction of door structures and appearance. In addition, evidence from structural and material markers support the reconstruction of features and storing vessels, such as the hearth and the large *pithoi* in SAI, in order to present the spatial distribution of working and storing activities (Amadio 2017; Bombardieri 2017; Amadio and Dolcetti 2019; see also Appendix A).

Figure 4.12: Unit SAIII, circular post-hole (Bombardieri 2017, 31) (top); view inside SAIII visualisation (Autodesk Inc. 2019) (Dolcetti et al. 2017, 333).

As I mentioned previously, my original intention was to create a visualisation for each phase of occupation, in order to present the changes of the workshop area over time. However, as the modelling process proceeded, this approach proved to be unfeasible, especially for some roofed spaces where the superimposition of features pertaining to both phases was extremely intricate. For this reason, I decided to modify the visualisation approach and highlight the changes in building techniques between Phase A and B, detaching all the features as single meshes and marking them with two different colour layers, overlapping the original texture.

The creation process of 3D visualisations involves not only a vast amount of information about material evidence, but also the interpretation of such information, an intellectual process that entails constant collaboration, discussion and critical engagement between research team members. A proper recording system is essential to prevent the loss of any relevant information, but also to share this information in a transparent way (Pletinckx 2012). Therefore, I recorded the information related to metadata and paradata (data which document the interpretative processes associated

with the creation of the visualisation) to account for the archaeological evidence used and the decisions made during the visualisation process (see Appendix A).

The second phase (June-July 2016) of my work was then aimed at populating the 3D model with interactive hotspots, i.e., clickable areas with short text descriptions, that give information about material evidence, structures, building materials and techniques, as well as the interpretation process that lies behind the reconstruction. I chose to add these hotspots because they represent a widespread, fairly simple and effective method to integrate written texts into interactive 3D scenes, adopted by several 3D online viewers within and outside the heritage sector such as 3DHOP (Visual Computing Lab-ISTI-CNR 2020) or Sketchfab (Sketchfab 2020). The 3D model was imported as a. fbx file in Unity (Unity Technologies 2020), a cross-platform game-engine used to develop video games for PC, mobile devices and websites. I decided to use Unity instead of other 3D viewers as at that time it was the best option available in terms of interactive features and 3D file formats compatibility. Moreover, Unity offers the possibility to build a 3D viewer as a standalone application for different platforms, which allows users to navigate and interact with the 3D model. It has been previously used to present archaeological sites and the results of research projects, such as the prehistoric rock paintings at Abri Faravel (Southern French Alps) (Walsh et al. 2016), the Latin city of Gabii (Italy) (Opitz and Johnson 2016; Opitz 2018) or the Swedish Pompeii project (Dell'Unto et al. 2013). The design of the interface with Unity does not present particular issues, except for the fact that it requires programming and coding skills. However, the density of scan-based data can present challenges in terms of visualisation and manipulation on average computers and laptops, sometimes making a decimation process essential (Walsh et al. 2016).

The interactive model built with Unity presents a mouse-based navigation, which allows users to navigate around the model and click on luminous hotspots, to retrieve information about the site and the workshop complex. A further level of immersivity is provided by avatars, which allow a first-person navigation and provide scale for structures and the built environment overall (Fig 4.13).

Figure 4.13: Workshop complex interactive 3D model. View of Phase A in Unity (Unity Technologies 2020) (credit: Francesca Dolcetti).

I decided to use human figures in the form of silhouettes (Fig. 4.14), instead of human-like avatars, to avoid the 'uncanny valley' effect (see Chapter 2, section 2.2.1) (Dolcetti et al. 2017). Once the 3D model was completed with the hypothetical reconstruction of the site, the interactive user interface and textual information, I moved forward to the following phase of the first iteration of my research: the application of the evaluation framework to a sample group composed of expert and non-expert users in order to gather data about their engagement and perception of the digital model.

Figure 4.14: Workshop Complex interactive 3D model, view of avatars in Unity (Unity Technologies 2020) (credit: Francesca Dolcetti).

4.2.4.3 Participants and Data Collection

In terms of evaluation, and as documented in Chapter 3, several scholars have already pointed out the lack of systematic research and effective evaluation frameworks able to assess the impact of interactive digital media applications (Economou and Pujol 2011; Yannoutosu and Avouris 2012; Damala et al. 2016). As a part of my research, I designed and conducted a study using different user groups (composed of experts and non-experts in the applications of 3D archaeological visualisations) to identify the best way to present my 3D model to different audiences. I then collected, reviewed and used the feedback to improve this model (see Chapters 8 and 9). In order to address issues around audience needs I followed a method of triangulation, comparing data from different sources (interviews, questionnaires and focus groups) to obtain a better understanding of the subject (Economou and Pujol 2011). This qualitative approach, in fact, allows a richer and deeper analysis of phenomena than quantitative approaches, not least because its flexibility allows for changes and adjustments according to the needs of the research (Braun and Clarke 2013; Mann, 2016). On the other hand, the quantitative approach enables rapid data-gathering and straightforward analysis due to pre-coded questions that prevent dispersion in questionnaires' outcomes. As such it can potentially provide much more significant results in the subsequent statistical analysis. Both methods have been previously used in the field of digital archaeology for projects related to the evaluation of VR applications in exhibitions, the impact of 3D digital media upon material culture perception, or the level of cultural presence in digital heritage projects (Economou and Pujol 2011; Pujol and Champion 2012; Galeazzi 2016; Di Giuseppantonio Di Franco et al. 2015). My methodological approach therefore entails the application of both qualitative and quantitative approaches and an evaluation framework involving multiple iterations.

The first stage aims to gather qualitative data from members of the Erimi research team (archaeologists, anthropologists and micromorphology experts), in order exploit their knowledge of the specific research context to detect issues and topics, such as whether the model is suitable for them and other audiences, that can be then thoroughly addressed within the quantitative analysis through focused questions. Applying the triangulation approach is extremely useful, because it allows one to validate results from interviews and increases the data reliability. This first stage is also aimed at observing how these experts use and perceive the 3D model, and then comparing their responses to those of other users unfamiliar with the case study's particular context.

The interactive 3D model of the workshop complex was therefore presented to user groups composed of archaeologists and specialists working at Erimi-*Laonin tou Porakou*. Qualitative data about their experiences with this model have been gathered using five face-to-face interviews (average length 40 minutes), one focus group (one hour) and two email interviews conducted in September 2016 (Table 4.1). Both face-to face interviews and focus groups were audio-recorded. All participants were asked to interact with the 3D model while responding to nine open-ended questions (see Chapter 5, section 5.1; for the complete list of questions see also Appendix B) aimed at assessing:

- how and to what extent the participants think 3D visualisations broaden the understanding of an archaeological site;
- whether avatars may effectively help to better understand the 3D modelled environment as a reference scale for objects and spaces to be compared to and if they enhance the model appreciation as a whole by humanising the image;
- if and how the interaction with the model had an emotional impact upon participants (in this instance I kept the definition of 'emotion' broad, defined by the users themselves).

Since not all participants were fluent in English, the five interviews and the focus groups were conducted in Italian. As for the two email interviews, both participants sent me their answers in English. Furthermore, a year later in August 2017, I conducted a second focus group (30 minutes) with six of the previously interviewed participants, to evaluate if and how the interaction with the 3D model the previous summer had a long-term impact on them (see Chapter 5, section 5.2). To prompt the discussion, I asked participants their opinion on the following topics:

- if and to what extent the interaction with the 3D model altered their perception of the site;
- if the interaction with the 3D model had been affecting their interpretation of archaeological evidence.

As for the interviews and focus group conducted the previous year, this second focus group was audio-recorded and conducted in Italian. Since the translation of the records in their entirety is a time-consuming process, for both interviews and focus groups I translated only relevant extracts of the transcribed recordings (see Appendix B for the full transcriptions).

Table 4.1: Interview and focus group participants

Name	Profile
Lorenzo	Archaeologist; Mediterranean Prehistory
Greta	Archaeologist. Ancient textile study
Chiara	Archaeologist; Radiocarbon dating and Stable Isotope analysis
Marta	Archaeologist, Micromorphology and building techniques
Monica	Archaeologist
Marica	Anthropologist
Aida	Archaeologist

The following step of the evaluation framework entailed a multi-stage survey with different user groups composed of experts and non-experts, in order to gather both quantitative and qualitative data. The first stage of the survey was conducted in person on the 13th and 14th of February 2017 using an expert group of 15 participants, recruited amongst staff, Postgraduate Research (PGR) students and students in the Department of Archaeology at the University of York. I consider this sample particularly relevant, since it is composed of users, who are not only experts in the discipline, but also familiar, for study or work purposes, with the application of 3D models in archaeology. To prepare for this first stage, I ran a pilot study using a small sample of four non-expert users to test the survey's feasibility. From there, I decided to conduct a fuller, in-person survey at York in order to be able to supervise it personally and detect further potential issues. The second stage was then conducted online to reach a broader sample of users: from July 2017 to January 2018, I circulated the survey amongst both professional and lay users through the website dedicated to my case study (Dolcetti 2017a).

The website was created using WordPress (WordPress Foundation 2020), a free website builder and content management system (CMS) that offers a variety of customisable and easy to use templates and plugins. The interactive application created with Unity was embedded into the website main page and accompanied by a tutorial page which explains the UI features and shows how to explore the model, as well as a 'what to do' page with the link to the survey questionnaire (see Appendix A).

Once I completed the website, I circulated the survey amongst both professional and lay users using the following strategy:

- contacting via email my academic contacts, UK heritage organisations and members of conferences committees to asked them to take the questionnaire and circulate the survey amongst their colleagues and friends;
- writing a press release to present the preliminary results of my research and to recruit more participants. The release was posted on the Archaeology Department website and social media pages (16 October 2017). I also sent the same press release to archaeology magazines, such as Current Archaeology, World Archaeology and Archaeology, and it was posted on World Archaeology Magazine's social media pages (12 October 2017).

The online survey ran from July 2017 to January 2018 with a total of 34 participants. The limited number of responses could be ascribed to a series of factors, based on data from Google Analytics (Google 2020) related to that time span. The main issue seemed to be the average session duration (02:50 minutes): most users did not spend enough time on the website to interact with the 3D model and answer the questionnaire. Moreover 28.57% of the website visits came from mobile phones and 14.29% from tablets which made it impossible for visitors to actually interact with the model since the navigation is mouse-based, as clearly stated on the tutorials page. The fact that the tutorial page had only 10.44% of views seems to confirm the fact that most users were not aware of the navigation requirements for the model. In addition, the fact that the web application Unity WebGL takes a few minutes to load depending on users' system specs and network, although clearly stated on the 3D model page, could have been discouraging and made visitors leave the website. As far as the questionnaire is concerned, the fact that the Qualtrics system registered 11 additional unsubmitted questionnaires might indicate a questionnaire fatigue, probably caused by the format being too long and not suitable for an online survey.

All participants were asked to interact with the 3D model and fill out a questionnaire with twenty-five open-ended and closed-ended questions aimed at:

- collecting general demographic information;
- assessing the level of participants' expertise with 3D visualisation in archaeology to determine user groups;
- gathering participants' feedback and evaluating their perception of the model in terms of usability and comprehensibility as well as their level of engagement.

The questionnaire was created using Qualtrics (Qualtrics 2020), a web-based survey tool used to conduct survey research, evaluations and other data collection activities. Among the pilot study and the in-person and online surveys, 53 questionnaires were collected among, from three main user groups: 24 experts, 13 non-experts and 16 students. User groups have been identified based on participants answers to the following questions:

Q3. In what field are you employed?

Q4. Do you have any previous knowledge and/or experience with the application of 3D modelling in archaeology?

Question 4 was used to categorise experts and non-expert user groups, with the former defined as researchers or practitioners knowledgeable in the use of 3D modelling and visualisations in the archaeological and heritage sector. Question 3 was instead used to separate students from experts and non-experts, as they represent an interesting user group positioned at an intermediate level between the two others (see Chapter 5, section 5.3; see also Appendix C for the complete list of questions).

Once I completed the evaluation of the interactive 3D model of Erimi, and to conclude the first iteration of my research project, I conducted a series of interviews with digital heritage practitioners and museums curators whose field of expertise is the design, development and evaluation of digitally mediated experiences for different audiences (Table 4.2). These interviews were meant to discuss interviewees' research results on audiences reception of interactive digital media and to better contextualise the results of my research. Interviewees were contacted via email and once they confirmed their availability, they were interviewed either in person or via Skype. Altogether, between November 2017 and January 2018, I carried out eight interviews (average length 30 minutes). All interviewees were asked to respond to eight open-ended questions intended to:

- investigate what specific form(s) of interactive digital media the interviewees are studying and the reasons behind its (their) creation;
- explore interviewees' evaluation methodologies and identify the best evaluation strategy to assess audiences' experience and perception of 3D interactive media;
- discuss interviewees research results as well as practical guidelines for devising and carrying out audience research studies.

All interviews were audio-recorded and two of them were conducted in Italian, so only relevant extracts of these interviews' transcribed recordings were translated (see Chapter 6; see also Appendix D for the complete list of questions and the full transcriptions). Presenting results while treating interview data anonymously proved to be difficult as it prevented me from contextualizing interviewees' answers. For this reason, when allowed information about their background, their research case studies and the institutions where they are based was provided to better contextualise their responses. Written agreements to use this kind of information were obtained from participants via email. Pseudonyms have been assigned in cases where participants decided to remain anonymous.

Table 4.2: Interview participants

Name	Profile
Laia	Virtual Archaeology, UXD and evaluation
Eva	Virtual environments and virtual museums, digital heritage
Alfonsina	Virtual museums, UX evaluation
Erik	Digital heritage; critical gaming in archaeology, game-based learning
Maria	HCI, Immersive Virtual Reality, UXD and evaluation
Areti	Digital Cultural Heritage, UXD and evaluation
Sophie	Museum curator, public outreach
Luigina	HCI, cultural heritage technologies

4.3 Participatory Design Workshops

As mentioned in Chapter 1, the second iteration of my research project entails a series of workshops focused on assessing the benefits of collaborative practices for the design of digital resources in archaeology and heritage. The rationale for these workshops stemmed from the results of iteration one, highlighting the importance of involving end users in the design process and the meaningful possibilities offered by adopting a PD approach in the process of knowledge production and sharing (see also Chapters 5 and 6).

The idea for such event-focused work as an addition to my research on the co-design of digital experiences in archaeology was developed when I was invited to a workshop on "innovative approaches to publishing archaeological excavations" hosted by Dr. Rachel Opitz at the University of Glasgow (25-26 April 2018), to present my ongoing project

and the results of my UX evaluation. The Glasgow event aimed to discuss the benefits and challenges of innovating with digital formats for excavation reports and publications. The questions and themes debated during that workshop highlighted disciplinary shortcomings as regards understanding and catering to the needs of archaeology's diverse audiences, as well as the need for more robust UX assessment. One of the group actions defined during the workshop was, in fact, to promote more research studies on assessing how different audiences engage with digital resources that integrate narrative and data.

As I was already considering the possibility of adopting a PD approach for my own research, I proposed the idea of a follow-up event to put those resolutions into practice by exploring various design methods and co-creating practical solutions together with users. As a result, Dr. Sara Perry, Dr. Rachel Opitz and I asked the EU Cost Action ARKWORK to sponsor a two-day workshop to apply and test the use of PD approaches and UXD tools in our discipline, as it aligned with the network's interest in supporting training events for archaeologists and heritage practitioners. The workshop was organised as a two-day event at the University of York in April 2019 and preceded by a one-day pilot session in February 2019 (see also Chapter 7). In order to better contextualise the work carried out with the co-design workshops in the following paragraph I provide an overview of PD practices and their application within the heritage sector and, more broadly, the field of design.

4.3.1 Historical Background

As outlined in Chapter 1, PD originated in Scandinavia during the 1970s as a movement for the democratisation of workplaces and the empowerment of end users within the design of IT work systems (Nygaard and Terje Bergo 1975; Bjerknes et al. 1987; Floyd et al.1989; Bjerknes and Bratteteig 1995).

Robertson and Simonsen (2012, 2) define PD as a "process of investigating, understanding, reflecting upon, establishing, developing, and supporting mutual learning between multiple participants in collective 'reflection-inaction'" Within this process, designers can learn directly from users about their needs, while users can better understand what products or technologies are most suited to meet their requirements. The main aim is to create an equal opportunity design environment where end-users are given a more responsible role and treated as peer co-designers. At its heart are both

pragmatic and democratic values; pragmatic because the inclusion and engagement of more people leads to more ideas and, eventually, the creation of usable and empathetic design solutions. Democratic in the sense that end users, especially people whose lives will be affected by the product or service being designed, have a fundamental right to have a say in the project (Sanders and Stappers 2008).

The principles of PD generally entail the following (Simonsen and Robertson 2012):

- **Having a say is more than having your voice heard**: a fundamental principle in PD is the sharing of decision-making power between all participants in the design process.
- **Mutual learning**: the notion of mutual learning is a core part of PD and implies that designers learn about the use context from the users, but also that the users learn about technical possibilities from the designers.
- **Co-construction**: co-construction is another distinctive feature of PD where users take an active part in visualising and prototyping ideas and in learning about their qualities in use or in use-like settings, therein ensuring that users also have a say in the forming of the product

PD, along with User Centred Design (UCD), have been widely adopted in Human-Computer Interaction (HCI), a multidisciplinary field of study focused on the design of computer technology and, in particular, the interaction between humans (the users) and computers (see for example Scaife et al. 1997; Muller and Druin 2002; Bossen at al. 2012; Vines et al. 2013; Malinverni 2016 to cite only a few). UCD is a term coined by Donald Norman in his book *The Design of Everyday Things* (1988) and refers to the need to take the end user into account from the earliest stages in the design process. It is an iterative design process in which designers focus on the users and their needs in each phase of the design process. In UCD, design teams involve users throughout the design process via a variety of research and design techniques, to create highly usable and accessible products for them.

Within both the archaeology and heritage sectors, several projects have explored how the application of PD practices can be used to bring together archaeologists, heritage practitioners, educators, volunteers and visitors and incorporate their views and concerns into the design process (Taxén et al. 2004; Roussou et al. 2007; Mazel et al. 2012; Jeffrey et al. 2015; Ciolfi et al. 2016; Jones et al. 2017; Pujol 2017; Jeffrey 2018;

Avram et al. 2019). For example, the RAMP (The Rock Art Mobile Project) AHRC-funded project (International Centre for Cultural and Heritage Studies, Newcastle University 2011), aimed at enhancing public engagement with rock art in Northumberland using mobile digital technology, adopted PD approaches in a series of workshops to create a design space for Northumberland local communities and visitors to rock art sites. The purpose was to enable participants to share their experiences and relationships with the rock-art environment in order to develop content informed by participants' knowledge and experience with rock-art and the surrounding landscape encounters. The adoption of a PD process led, for example, to the decision of using existing websites, rather than developing a new app, to make interpretations of rock art more accessible to the older age of the usual visitors who were not comfortable with that kind of technology. Moreover, it allowed the integration within interpretive narratives of the audience's desires for more speculative and ambiguous interpretations and a deeper connection with the surrounding landscape (Mazel et al. 2012; Galani and Kidd 2019).

The meSch (Material EncounterS with digital Cultural Heritage) EU-funded project (meSch 2013) had the goal of designing, and developing tangible interactive experiences that embed digital contents with the physical dimensions of museums and exhibitions, such as smart replicas of objects displayed that allow visitors to access additional narratives about such objects, complementing the factual information usually provided in museums. The approach of this project is grounded in co-design practices and multidisciplinary co-creation of interactive exhibits: through a series of workshops museums curators, designers, developers and stakeholders were brought together into the process of creation and evaluation of the smart replicas as equal partners to incorporate their views and concerns into the design process. Evaluations carried out through focus groups and interviews, during and after the workshop, show that participants considered the co-design experience to be very valuable in terms of mutual learning, better understanding and appreciation of each other's roles and responsibilities, as well as gaining new skills (Ciolfi et al. 2015; 2016; Avram et al. 2019).

Another example is provided by the LEAP (LEarning of Archaeology through Presence) EU-funded project (Universitat Pompeu Fabra and Barcelona 2016), aimed at developing the notion of Cultural Presence into a conceptual and technological

framework for Virtual Archaeology. Here, co-design practices were applied to develop a new methodology for the design of VR-mediated experiences that integrate PD design strategies and tools, e.g., co-creation and low-tech prototypes, with basic archaeological information such as case description and specification of sources (Pujol 2017). Within this project, the approach was adopted in a workshop with members of the Archeological Service of the Catalan Government and proved to be successful in dismantling participants' scepticism regarding the efficacy of PD practices, as emerged during the focus groups conducted after the workshop. However, the approach failed to convey the value of a PD approach beyond the development of UX for general publics, as participants considered this method not entirely suitable for 3D models aimed at scientific research. In this case, participants belonging to a processual archaeological school probably resulted in a skewed perception of unusual and more creative design practices.

Finally, the ACCORD (Archaeological Community Co-Production of Research Resources) AHRC-funded project (ACCORD nd) seeks to investigate questions around authenticity in relation to 3D visualisation of historic objects and monuments. Within this project, a co-design practice was adopted to involve community heritage groups across Scotland to create 3D records and models of heritage places of significance to them and explore how participants experienced authenticity in relation to these 3D models (Jeffrey et al. 2015; Jones et al. 2017; Jeffrey 2018). Here, evaluations carried out via rapid ethnography (e.g. multidisciplinary teams working together in a short time frame, collecting data using qualitative methods) show that the adoption of co-design practices encouraged participants to select places that were meaningful for their community as associated with social values and sense of identity. Moreover, results of the ACCORD project show that being actively involved in the production of 3D digital replicas of places embedded with an emotional significance, positively affected and enhanced participants' sense of authenticity of such replicas (Jones et al. 2017).

However, as argued by several scholars, more research is needed in assessing PD approaches. As Robertson and Wagner (2012) put it, an evaluation of the design results and the design process by participants should be included in all PD projects. More specifically, participants should assess to what extent the design process offers opportunities for genuine participation. According to Bossen et al. (2010), in fact, few studies so far have focused on the evaluation of PD processes and outcomes, or

participants' gains from involvement in design processes. More recently, in their survey focused on existing literature addressing evaluation in PD, Bossen et al. (2016, 151) note that even when applied, PD evaluation strategies and frameworks often lack explicitness and clarity as methods and ways of analysis are not always made explicit in publications. Moreover, as highlighted by Garde and van der Voort (2014, 79), while mutual learning is one of the core values of PD, research on whether and how benefits from this process actually materialise are not common and rarely include participants' observations and opinions on the subject.

Within the existing body of literature, several studies have been conducted on the nature of participation in design, how the balance of power and the mechanisms of decision making operate in co-design teams, as well as the individual role played by different participants (see for example Vines et al. 2013; Bratteteig and Wagner, 2014; Gerrard and Sosa 2014 only to cite a few). However, according to Ciolfi et al. (2016) still little has been said about the collaborative process itself and the different ways in which it unfolds. Similarly, in Avram et al. (2019, 4) the authors point out the need "to be reflective about the co-design process in the heritage domain, rather than just examine its outcomes, by paying attention to how co-design unfolds and what kinds of impact it has in terms of skills, concerns and understandings". For this reason, I have decided to incorporate an evaluation framework within the workshop structure that assesses not only the products of the design process, i.e., prototypes, but also the efficacy of the PD approach adopted and to what extent participants benefited from it in terms of both personal and professional gains.

4.3.2 Methods

Growing out of this history of PD, the methodology proposed for the second iteration of my research aims to investigate how to integrate design theory and PD practices in archaeology. Drawing upon previous studies using co-design and PD approaches in archaeology and cultural heritage (McDermott et al. 2014), in particular the methodology developed by Dr. Laia Pujol within the LEAP EU-funded project (see above Pujol 2017), I organised two workshops (the pilot session and the ARKWORK workshop) structured around four activities in which participants worked in groups.

4.3.2.1 Activity 1: Case Study Description

During this activity each group is asked to work on a preselected case study, provided by the facilitator, by articulating key information and available sources. Moreover, the

facilitator outlines the design brief defining the intended audience, technologies available and the expected outcomes (Fig. 4.15).

Figure 4.15: Case study presentations during the ARKWORK workshop (credit: Rebeka Vital).

4.3.2.2 Activity 2: UX Design

Participants define how to structure an experience that matches the facilitator's brief (Fig. 4.16). During this activity, participants use some of the most common PD techniques (Simonsen and Robertson 2012; McDermott et al. 2014):

- Scenarios: description of a person's interaction with a system, from a user perspective. Design techniques help to define how the proposed design is likely to be used in real life situations.
- Personas: fictional characters created to represent potential users. Personas are used to shape the design focus and to identify opportunities and challenges in designing for different user groups.
- Cards: design cards help to visualise exactly how design ideas can be created, modified and re-purposed, breaking down the components of a design object and demonstrating what kind of media, gestures and functionality can be supported by the design object.

For the workshops, it was decided to use some of the design cards developed for the EMOTIVE project (EMOTIVE nd) (see also Chapter 3, section 3.3), as they had been created to structure and guide the design process of cultural heritage experiences,

specifically the creation of emotive storytelling. Thus, the EMOTIVE cards were considered to be a potentially useful design tool for these events.

Figure 4.16: UXD during the ARKWORK workshop (credit: Sara Perry).

4.3.2.3 Activity 3: Prototyping

Within this activity, each group creates mock-ups of the designed experience to visualise and make it tangible. Participatory prototyping using mock-ups and other low fidelity models is most often used during the early stages of the design process. These prototypes offer simple ways to make ideas tangible, to learn through making, and to quickly get key feedback on design concepts. The most common prototyping techniques adopted for co-design sessions and workshop are the following (Simonsen and Robertson 2012; McDermott et al. 2014) (see also Appendix E):

- interfaces: wireframe templates printed on paper that allow participants to prototype digital products and visualise contents and interactive elements.
- storyboarding: storyboards are illustrations of an interaction between a person and a product through a series of images or sketches. Storyboarding helps to develop an empathic understanding of users and helps participants to keep in mind the context of the solution they are designing.
- Lego prototypes and physical models: creating physical mock-ups helps to bring an intangible idea, or two-dimensional sketch, into a three-dimensional plane, making the designed experience/product more tangible.

4.3.2.4 Activity 4: Evaluation

I decided to incorporate within the workshop structure a two-stage evaluation of the design results (prototypes), process and outcomes (participants' gains from participation), as discussed in the following section. This strategy is based on existing evaluation frameworks for PD workshops which apply mixed methods: observations, open-ended surveys and focus groups (Bossen et al. 2016; Garde and van der Voort 2014; Pujol 2017). During the first stage, each group pitches their design to the other participants, by presenting features, components and intended audience of the experience. Then participants interact and evaluate the prototype by completing an open-ended questionnaire. The second phase includes observations carried out during the activities, and a focus group at the end of the workshop to gather participants' feedback and triangulate it with the observations previously made. To collect participants' impressions, I decided to structure the focus group discussion around their opinions on the effectiveness of the PD process and to what extent they benefited from their involvement.

4.3.2.5 Participants and Data Collection

As mentioned in Chapter 1 (section 1.2.2), these events solely involved archaeologists and heritage practitioners. The rationale behind the participants' selection was to change the way we conduct our core practices, by engaging professionals to rethink the creation process of digital resources for various audiences and incorporate PD approaches in their own workflows. To test the coherence and efficacy of the above outlined methodology and resources, I ran a one-day pilot workshop in February 2019 at the University of York. In particular, I sought to detect potential issues with the PD workshop's structure, design methods and tools. For this pilot session I recruited eight participants from lecturers, PhD and Master students from the Universities of York and Glasgow (Table 4.3). I purposefully selected contributors already familiar with UXD and co-design practices to ensure the promptly identification of problems with the methodology and resources selected. Participants were assigned by me to two working groups based on their expertise, gender and skillset in order to create balanced teams. For the design of the UX both groups were tasked with the same project - one which I provided (see Chapter 7, section 7.1.1).

The evaluation strategy entailed the assessment of both design outputs and process. As for the evaluation of design process outputs, both groups presented and then evaluated each other's prototypes by answering four open-ended questions aimed at gathering

participants' feedback on the UX prototype format, their expectations and what was their main takeaway from the UX.

Once participants completed the questionnaires, I conducted a focus group (40 minutes) in order to evaluate the design process itself and participants' gains from their participation in the co-design activities (see Chapter 7, section 7.1.3; see also Appendix E for the complete list of questions and full transcriptions). I prompted the discussion among participants by asking their opinions on the following topics:

1. their general impressions of the PD process;
2. their opinion on the PD methodology: what they liked/disliked, usefulness, effectiveness;
3. their professional and personal gains from participation.

Table 4.3: Pilot workshop participants

Name	Profile
Sara	Senior lecturer in Cultural Heritage Management (until October 2019)
Rachel	Senior Lecturer in Spatial Archaeometry
Claire	PhD, community-based participatory practices and place-based digital storytelling
Harald	PhD, co-design in heritage
Ashley	PhD, accessibility in museums and heritage settings
Patrick	PhD, interface design for interactive digital media
Kristen	Master student, Digital Heritage
Cloe	Master student, Digital Heritage

Two month after the pilot session, I hosted the two-day co-design workshop, where eighteen participants from across Europe were recruited amongst practitioners who are working on projects focused on the creation of digital resources related to archaeological collections and heritage sites; or have research interests in UXD, UX evaluation and PD fields (Table 4.4). Participants were selected through an open call advertised on the ARKWORK website (Arkwork 2020) and Dr. Sara Perry's blog (Perry 2018b).

Table 4.4: ARKWORK workshop participants

Name	Profile
Juan	Facilitator, games design for education and digital heritage
Judith	Participant, journal editor
Ian	Participant, information studies
Delia	Participant, digital maritime archaeology
Ingrida	Participant, Digital Heritage in social media
Gavin	Facilitator, landscape archaeology and heritage management
Jennifer	Participant, community engagement manager
Costis	Participant, digital communication and curation
Andriana	Participant, digital media and libraries
Meliha	Participant, management and information systems
Catriona	Participant, Digital Humanities and immersive technologies
Claire	Facilitator, community-based PD and place-based digital storytelling
Elena	Participant, Computational Archaeology
Rebeka	Participant, Design and Architectural Heritage
Giacomo	Participant, Chemistry and Conservation of Cultural Heritage
Irina	Participant, Spectral Imaging Technologies for Cultural Heritage
Eleonora	Facilitator, UCD for Heritage Massive Open Online Courses
Maria	Participant, ArcGIS data processing
Anna	Participant, UX evaluation
Ya'ara	Participant, Game Design for Cultural Heritage
Marina	Participant, Byzantine manuscripts digitisation
Lampros	Participant, Digital Content Management

They were assigned by me to four groups based on their expertise, gender and skillset in order to create balanced teams. Contrary to the pilot workshop, each group was assigned a different project for the UXD. Since not all participants were already familiar or had previous experience with co-design practices, I decided to assign to each group a facilitator. The facilitators' role was to provide a project to use as case study, along with a brief, and support the group in creating a digitally mediated experience that matches that brief (see Chapter 7, section 7.2.1). The four facilitators were recruited amongst researchers and practitioners with expertise in designing digital interactive experiences for various audiences, as well as co-design and PD practices.

Based on data gathered through the pilot workshop, I revised the evaluation strategy for this main event. The questionnaire for the prototypes evaluation was restructured and a fifth question about the target audience for the experience was added in order to collect participants' opinion on whether or not the UX prototype addressed the needs of the intended audience (see Chapter 7, section 7.2.4; for the complete list of questions see also Appendix F). Similarly, for the evaluation of the PD process I inserted a focus group (50 minutes) at the end of the first day as a mid-point evaluation to discuss participants' progress, by asking them questions related to their first impressions, their preliminary gains from the collaborative approach and their thoughts on their group's dynamics. As for the second focus group (40 minutes), I added a fourth discussion topic on mutual learning (Bossen at al. 2010; 2016; Garde and van der Voort 2014) in order to investigate if and what participants learned from working together throughout the design process (see Chapter 7, section 7.2.4; see also Appendix F for the complete list of questions).

Moreover, I decided to audio record all groups' activities throughout the event in order to collect further qualitative data, that I could later triangulate with my observations and focus group discussions, and gain insights on group dynamics and how the collaborative process unfolded in each group. In this case, I carried out a more selective transcription of the recordings as I only transcribed extracts deemed relevant for the purpose of this research. For example, segments where either discussions were inaudible due to very loud background noise or conversation overlaps, or where group members were working on individual tasks without talking, I only provided a general description or summary of the recording (see Chapter 8, section 8.3; see also Appendix F for the full transcriptions).

Finally, a few months after the workshop I conducted a series of follow-up interviews in order to investigate what impact, if any, the collaborative design process had on each participant in the long term. The aim was to carry out a longitudinal evaluation of how and in what ways mutual learning actually took place and to what extent participants felt they benefited from their involvement in relation to their own work and personal life. For this reason, follow-up interview questions purposely covered the same topics asked during the second focus group discussion. Between June and September 2019, I interviewed select workshop participants among the members and facilitators of the two groups who I considered representative of different collaborative processes and co-

design approaches adopted during the event (see Chapter 8, section 8.2.2). Altogether, I carried out seven interviews (average length 30 minutes); (see Appendix G for the full transcriptions). Interviewees were contacted via email and once they confirmed their availability, interviewed either in person or via Skype.

4.4 Data Analysis

Qualitative research is an umbrella term that covers various approaches with different theoretical assumptions according to what is being studied and the methodology used (Braun and Clarke, 2013; Mann 2016). Thematic analysis has been defined by Braun and Clark (2006, 79) as "a method for identifying, analysing and reporting patterns (themes) within data. It minimally organizes and describes your data set in rich detail. However, frequently it goes further than this, and interprets various aspects of the research topic". At the heart of the method is qualitative coding of the data: "codes serve as shorthand devices to label, separate, compile and organise data" (Charmaz, 1983, 186). According to Braun and Clark (2006), while thematic analysis does not always seem to be acknowledged as a method on its own, a lot of qualitative analysis is actually thematic. The benefit of this method is its flexibility and the ability to provide a detailed and complex account of data. Themes, in fact, can identify something meaningful in relation to the research question and patterned response or meaning within the data set.

Themes can be identified in two ways in thematic analysis: firstly, using a bottom-up or inductive approach where themes are data-driven and strongly linked to the data themselves, without trying to fit the researcher's analytic preconceptions. However, as Braun and Clark (2006, 85) point out "researchers cannot free themselves of their theoretical and epistemological commitments, and data are not coded in an epistemological vacuum". Secondly, one can adopt a top-down or deductive approach where themes are analyst-driven and tend to be guided by the researcher's theoretical or analytic interests in the area. In practice, aspects of each of these may be combined and thematic analysis can often move iteratively between data and previous literature or theory. In the first place data are coded and collated, then are analysed to see how they may combine to create overarching themes and finally themes are revised and refined and all the relevant coded data extracts within them are collated.

The analysis of all qualitative data gathered during this research project has been conducted using the qualitative text analysis software Nvivo and following the

Thematic Analysis approach. Nvivo (QSR International 2020), is a computer software analysis package developed by Qualitative Solutions and Research Pty Ltd, designed to handle qualitative data for research, and process, code and analyse data. Qualitative data include participants' responses via interviews, focus groups and open-ended survey questions. These data have been collated, compared and then grouped into themes selected using either a deductive approach, based on the topics investigated through interview questions, or an inductive approach as recurring patterns across the dataset (for a detailed description of each theme see Appendices B-G). For each theme, extracts from participants' responses have been coded based on the number of the theme, a sequential coding reference number and the participant's name or pseudonym, for example: 2. Reference 3 - Greta.

As for qualitative data gathered through open-ended survey questions, during the first iteration, extracts from users' answers have been coded based on the number of the theme, the name of the user group (experts, non-experts and students) and a sequential coding reference number for example: 3. Experts - Reference 9. The same coding has also been adopted for participants' responses to UX questionnaires collected during the co-design workshops; 4. Group 1 - Reference 2 (see Chapters 5, 6, 7 and 8 for a detailed discussion of themes and results).

Quantitative data collected through closed-ended survey questions have been analysed using the Qualtrics Analytical Tool to study their distribution among the different user groups. Participants' responses have been classified into five themes based on the topics investigated through the survey questions and presented using colour-coded ring charts (see Chapter 5 for a detailed discussion of topics and results).

4.5 Ethics and Access

Regarding the first iteration, the yearly official license and permission to develop the research project at Erimi-*Laonin tou Porakou* has been granted by the Director of the Department of Antiquities of Cyprus. Permission to use the Erimi unpublished dataset has been granted by the Director of the Italian Archaeological Mission at Erimi, Dr. Luca Bombardieri. The collection of feedback via interviews, focus groups and questionnaires has been approved by the Arts and Humanities Ethics Committee (University of York). All data have been used with the consent of the participants. Quotes and responses obtained from participants have been either anonymised or attributed to participants if they consented for their names to be used in any publication

resulting from the study. When anonymised, interviewees have been assigned with pseudonyms.

As for the second iteration, the collection of feedback via interviews, focus groups and questionnaires has been approved by the Arts and Humanities Ethics Committee (University of York) after resubmission to make it compliant with General Data Protection Regulation introduced in 2018. For this iteration, participants were provided the option of being identified by name and job title, only by job title or to remain completely anonymous. When the option of anonymity was selected, I randomly assigned pseudonyms to identify participants and anonymised their quotes and responses. The collection of photographs during the event has been authorised by participants via the University of York image release form. Nothing has been used without the consent of participants.

4.6 Summary

As previously mentioned, while interactive digital media in general and 3D models in particular are widely adopted for the representation of archaeological sites, relatively little is still known about how interacting with such media affect people's perceptions and engagements with the past. The work assembled and discussed in this thesis firstly suggests a new approach to thinking about how 3D models in archaeology are not only used but perceived by a diverse range of audiences: to what extent interactive 3D models produce excitement and emotional response, fostering desire for knowledge about or interaction with past cultures and how users' feedback can be implemented to improve the interactive 3D model. Secondly, it examines the decision-making and design process behind the creation of the Erimi interactive 3D model and, more broadly, digitally mediated experiences in archaeology and heritage, exploring how more collaborative design practices focused not on the final digital output but on the overall experience can be practically implemented in archaeological practice. Relevant findings and analysis from the entire series of interviews, questionnaires and focus groups undertaken for the two iterations of my research project will be presented and discussed in subsequent Chapters 5, 6, 7 and 8.

5 Evaluation of the Erimi-Laonin tou Porakou Interactive 3D model: Analysis and Results

As previously mentioned in Chapters 1 (see Fig. 1.4) and 4 (see Fig. 4.1), once completed the Erimi 3D model UI in September 2016, I conducted a mixed-method evaluation study - from October 2016 to January 2018 - using a diverse array of users. Considering that the 3D model was originally intended as a research tool (see Chapter 4, section 4.2.4), I decided to first gather qualitative data from my colleagues to test the usefulness of the 3D visualisation for research purposes and also exploit their knowledge of the specific research context to detect potential issues with both the model and the UI. Moreover, I wanted to observe how they used and perceived the 3D model and compare their responses to those of other users who were unfamiliar with the case study's particular context. The specific topics and issues identified through this qualitative analysis have been subsequently investigated via a quantitative survey analysis, using a broader and more variegated sample of users, including students and non-experts (Fig. 5.1).

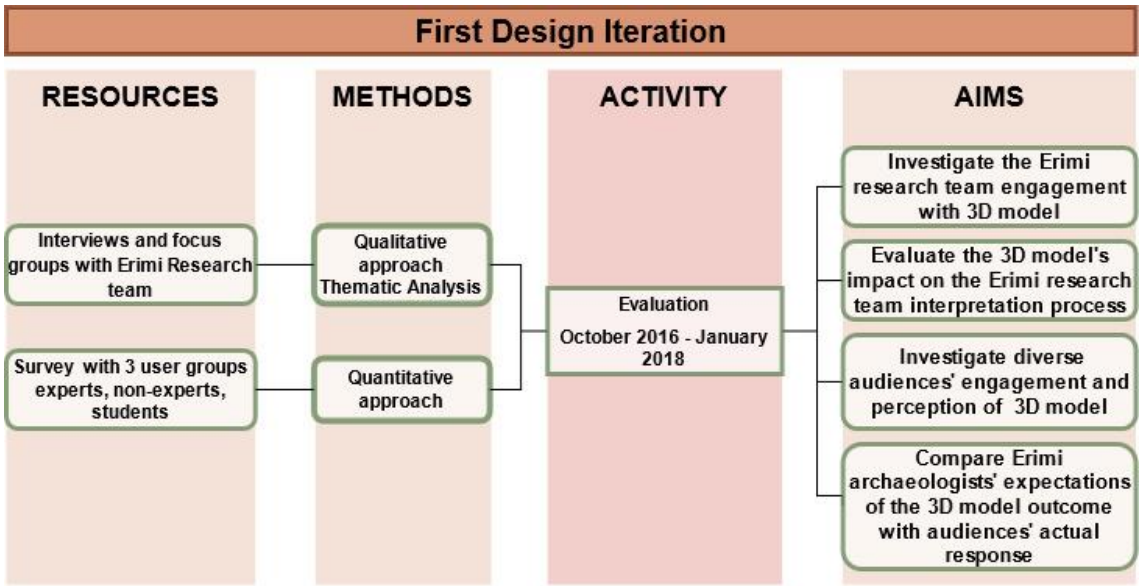


Figure 5.1: Evaluation diagram. From the left each column illustrates: resources (techniques, software, design tools) used, methods adopted, the timeline and the specific aims of the activity (credit: Francesca Dolcetti).

This chapter presents the results of such evaluation, demonstrating that digitally mediated experiences of archaeological sites are indeed used and perceived in different ways by different audiences and that some notions about audiences' needs and expectations are often unfounded, especially those regarding the non-specialist audience. The results of this study suggest that end users should play a more active role

in the creation process, from the design of the experience to its evaluation and refinement. In the remainder of this chapter, I firstly present the results of interviews and two focus groups conducted with my colleagues at Erimi-*Laonin tou Porakou* (sections 5.1 and 5.2); then introduce the results obtained through a survey distributed to 54 individuals (section 5.3).

5.1 Interviews and First Focus Group

In October 2016 I conducted seven interviews and one focus group with seven members of the Erimi research team. Interviewees' responses have been coded into five themes, as detailed in the following paragraphs (for details on data collection and analysis see Chapter 4, sections 4.2.4 and 4.4; for detailed descriptions of themes see also Appendix B):

1. efficacy of the 3D model for archaeological research
2. avatars: efficacy and unrealism
3. emotional attachment
4. different audiences needs and expectations

Through these interviews I collected a variety of meaningful feedback covering a diverse range of topics. As previously mentioned, the original aim of the 3D model was to benefit the interpretation process, so I was expecting from my colleagues to confirm the efficacy of the 3D model's application for research purposes. What I really hoped to achieve through these interviews was a better understanding of how the interaction with the model improved comprehension of the site through the identification of specific interpretive issues. Even in terms of emotional engagement, I was expecting a strong response, considering the intense bond my colleagues have with the site. Nonetheless, I wanted to observe how each of them interacted and perceived the model. Moreover, through these interviews I wanted to gain a deeper insight into topics that were never discussed within the research team, such as the potential application of the model in communicating archaeological information to both professional and lay users and, consequently, its usability for a variety of audiences.

5.1.1 Efficacy of the 3D model for Archaeological Research

None of the participants had any relevant experience with 3D modelling techniques and applications in archaeology, but they considered them a valuable tool for research, as emerged from their answers to Q1 (Do you have any previous knowledge and/or experience with the application of 3D modelling in archaeology?) and Q2 (Do you consider 3D modelling useful for the archaeological interpretation process? If yes,

explain how). Marta for example, stated that “the possibility to observe a reconstructed space may provide a different perception of the built space. The archaeological space may potentially become more easily readable. For example, it is much easier to analyse dynamics concerning the use of the space and interaction between agents within a certain space, viewing a reconstructed model instead of a two-dimensional plan” (1. Reference 29 - Marta).

In relation to Q3 (Do you think 3D modelling helps broaden the understanding of the site? If yes, explain how), and Q4 (Do you consider this model helpful in deepening the understanding of the function of structures and objects? If yes, explain how), all participants reported that the 3D model significantly improved their comprehension of spaces and volumes, as well as their understanding of how spaces within the workshop complex were organised and for what purpose they were used. According to Chiara, “to be able to visualize archaeological features and buildings in 3D can help to acquire a deeper awareness of spaces and distances and to stimulate interpretive hypotheses about their function” (1. Reference 10 - Chiara). Lorenzo pointed out that “the reconstruction of architectonic space is really helpful for the interpretation of the archaeological space and so even for the interpretation of the role and meaning that architectures have within the community” (1. Reference 22 - Lorenzo). Similarly, Aida highlighted the 3D model’s efficacy for the analysis of social dynamics within the complex: “it is really helpful for a better understanding of the relationship between people who inhabited the settlement and the surrounding environment” (1. Reference 7 - Aida). Marta also said: “it is easier to think about social dynamics, from construction to use of the structures, with a reconstructed model. It is easier to imagine social agents acting within the built space and the surrounding environment” (1. Reference 30 - Marta). Interestingly, most participants identified the possibility to visualise both phases of occupation as the most useful feature of the model, as stated by Chiara: “above all, the feature that allows to change between the two phases makes it much clearer” (1. Reference 11 - Chiara).

These results confirm that 3D models are seen by the project team as a valuable tool for the interpretation process of archaeological data, as they provide visual feedback for interpretative ideas that can be used to validate previous hypotheses or generate new questions and interpretive issues (see also Hermon 2008; Murgatroyd 2008; Earl et al. 2011; Opitz and Johnson 2016). However, such results are not surprising considering that all my colleagues already wanted to integrate the 3D model in our research

workflow, as they appreciated it as a significant tool for the interpretation process. The interaction with the model, as emerges from their answers, seems to have simply confirmed their previous opinions.

5.1.2 Avatars: Efficacy and Unrealism

After discussing the potential benefits of using the 3D model for archaeological research, participants were asked to give their opinion about avatars and their role in improving the understanding of the 3D modelled environment and enhancing the model's appreciation as a whole.

Answers to Q5 (Do you consider avatars (human figures) necessary for a better understanding of the spaces and volumes in 3D models? Do you consider them necessary for a better understanding of the model overall? If so, explain how. If not, why not?) revealed that the use of avatars in 3D models is a controversial topic. All participants appreciated the opportunity to navigate the model through a first-person perspective, finding it helpful to have a broader perception of the space, as pointed out by Marta: "for example their use would help to estimate how many people were able to work together in the same space, without limiting the accessibility to workstations and working structures within a certain building" (2. Reference 22 - Marta).

The majority also considered avatars necessary, since they provide scale for spaces and a sense of inhabited place, as stated by Greta: "the human figure is the parameter that we use to measure things. I think that especially for heights it is almost essential to have a human figure as a reference" (2. Reference 2 - Greta). However, some participants, while appreciating the first-person view of avatars, perceived them as distracting or even disturbing. Monica, for example, had a strong reaction against the presence of avatars within the model: "I perceive them as an anomaly, they are disturbing my concentration while I'm observing the model" (2. Reference 25 - Monica). In a similar vein, Aida said: "silhouettes are completely impersonal, they almost seem presences, ghosts. They don't fit in with the model" (2. Reference 7 - Aida).

The issue of the unrealism of avatars also emerged during the focus group: some participants in fact complained about the fact that they do not resemble human beings and look more like aliens. This topic is related to Ruth Tringham's (1991, 94) discussion regarding how she formerly envisaged people in the past not as individuals going about their daily lives, but as "faceless blobs". She argues that archaeologists cannot envisage nor engender prehistory until they give faces to their imagined societies. Interestingly,

the “faceless blobs” topic also emerged a few years after my data collection, during a conversation amongst some of my colleagues regarding the reticence of a field-school student to be assigned to the funerary area as they felt uncomfortable excavating human remains. While my colleagues’ comments were expressed during an informal discussion and not gathered in the formal setting of a data collection, I think it is interesting to mention that most of them could not fully understand the student’s hesitation because when they look at human remains, they only see “things” as they cannot envisage them as people. When asked how they imagined Erimi’s inhabitants might have looked like, most of them said that they could not put a face on them.

In the case of my model, the presence of human figures in the form of silhouettes in some participants’ opinions failed in part to provide a sense of inhabited space. However, other participants raised the issue of the scarcity of evidence (due to the lack of preservation of skeletal remains) necessary to characterise avatars, in relation to both physical characteristics and clothing, as inhabitants of a Cypriot Bronze Age settlement. Consequently, the topic was dismissed because the idea of humanising the environment, while considered important for enhancing the emotional impact of the overall experience, would have required to go beyond the limits of a scientific representation. Participants’ responses were probably influenced by their processual concept of archaeology: while appreciating the importance of human experience and perspective related to the inhabitants’ daily life, they consider 3D models mainly as scientific reconstructions that need to remain objective. It is probably for this reason that the focus of the discussion then shifted from more theoretical issues to practical ones, such as the use of avatars to answer specific research questions related to the use of spaces. All participants, in fact, agreed on the fact that it would be interesting to have the possibility to visualise avatars walking along predefined paths or add animations that simulate the different activities supposedly performed at the workshop, as suggested by Lorenzo: “one can choose an option, for example, ‘populate SA I’ and visualise a reconstruction of the activities carried out in that space” (2. Reference 11 - Lorenzo). They all considered this option very useful in order “to understand how much space they could have occupied while conducting activities” (2. Reference 12 - Monica).

The idea of populating 3D models of archaeological sites to study the possible uses of spaces and the interaction between human inhabitants and the environment has already been explored by different researchers (e.g., Shao and Terzopoulos 2006). Moreover, it

is not a new argument that populating virtual environments with human agents is a key issue in archaeological visualisations because it enhances the sense of presence and provides users with a more meaningful and engaging experience. In fact, several scholars have argued that 3D models should not be just empty and ghostly architectural reconstructions, but rather they should include people and objects to provide an impression of a lived space (Vosinakis and Avranidis 2016; Pujol 2017). As with Tringham's "faceless blobs", it is impossible to envisage an empty and lifeless visualisation of an archaeological site as a place that people in the past actually inhabited, as in failing to show life it prevents us from grasping the concept of inhabitants' daily lives. However, populating a 3D model with animated avatars is demanding in terms of time and effort, and this is probably the reason for the ghostly aspect of many current archaeological visualisations. The cost of motion capture equipment and personnel to digitally record human movements can be prohibitive and the process entails many hours of post-processing and data cleaning.

5.1.3 Emotional Attachment

As previously mentioned, one of the aims of these interviews was to investigate how my colleagues perceived the model in terms of emotional engagement. Overall, despite the mixed reaction to avatars, all participants showed a strong emotional engagement with the model as emerged from their answers to Q6 (How engaged do you feel with the model (if it all). Describe that engagement). Monica, for example, affirmed that "it is really shocking to see it reconstructed" (3. Reference 12 - Monica). Similarly, Greta said: "it represents not only the object of our study, but a place where people actually lived, people like us and this makes me feel closer, more involved" (3. Reference 4 - Greta). They also believed that their responses were partly due to their emotional and work-related involvement with the site, as stated by Marica: "working on this site and having such a clear image of it, it is absolutely exciting" (3. Reference 9 - Marica). These results are not surprising considering that, as previously mentioned, all participants have a strong connection with the site.

5.1.4 Different Audiences Needs and Expectations

In relation to the potential application of the model in communicating archaeological information to both specialists and non-specialists, answers to Q7 (Do you consider the 3D model to be (level of interaction + information provided) suitable for both expert and non-expert users?) revealed that all participants agreed on the fact that the model is suitable for different audiences, in terms of user interaction and clarity of information

provided, as stated by Monica: “it is clear, simple and accurate at the same time” (4. Reference 6 - Monica). Similarly, Marta said: “the 3D model is easily accessible by everyone” (4. Reference 28 - Marta). In general, most interviewees could not identify potential issues in terms of different audiences’ needs. These results were not entirely confirmed in the quantitative survey that I subsequently administered (see below), suggesting that a divide actually occurs between the idea that archaeologists working at Erimi have about how their research is going to be perceived and the audience’s actual response. The fact that none of the interviewees has experience in communicating archaeology outside academia might be the reason why they take for granted that the way they usually convey archaeological information is also valid for other kinds of audiences.

Interestingly, while discussing this topic, Lorenzo affirmed that especially for a non-expert audience “the emotional engagement is mostly due to the fact that whoever sees the model can understand from where we started and what we have achieved” (4. Reference 12 - Lorenzo). Thus, in his opinion the interaction with the model elicits in non-specialist users a sense of wonder for the level of interpretation required to create a hypothetical reconstruction based on the archaeological evidence available. This statement is particularly relevant in terms of audiences expectations, because it seems to confirm the fact that we, as practitioners, when presenting our research to the public often assume that everybody will be as interested and passionate as we are about our work. However, some participants suggested the simplification of some descriptions to make information panels more easily accessible to non-expert users: “I think that for the model to suit the exigencies of non-professionals it would be useful to add more details, for example about the surrounding environment, and simplify descriptions” (4. Reference 13 - Chiara). Greta, instead, raised some concerns about the use of an overly technical vocabulary: “I think it is comprehensible. However, there are some words, for example phase A and phase B, that are part of our lexicon and I don’t know to what extent they can be understood” (4. Reference 14 - Greta).

Regarding the intended audience for the 3D model, responses to Q9 (Do you think it is possible to identify a target audience for the site of Erimi-*Laonin tou Porakou*?) were various: some participants could not identify a specific audience, while others suggested as target audiences both archaeologists with specific interests in Cypriot archaeology, and the local community as stated by Greta: “probably it would be helpful to involve

more the local community and this kind of project could be the right incentive to establish a contact" (4. Reference 23 - Greta). Of particular interest is this comment from Chiara: "I do not think there is a specific audience for the 3D model of Erimi-*Laonin tou Porakou* though I am convinced that the people who would greater benefit from it are non-professionals, i.e. people not familiar with prehistoric features and archaeology in general" (4. Reference 22 - Chiara). The 3D model, though, was never meant nor designed specifically for this type of audience, so this comment seems to confirm the fact that there still is a misconception, or at least no clear idea, about what kinds of interests and needs different audiences might have.

The discussion prompted by Q9 (Do you think that the interaction with the model could benefit from a storytelling-based digital guide?) generally revealed a negative response to the use of storytelling. Greta, for example, was hesitant about it, especially for a specialist audience, as "usually our (referring to archaeologists and specialists) mindset does not allow to see our research as a narrated story, because it seems dangerous for a scientist to do something like that" (4. Reference 36 - Greta). Her opinion reflects a seemingly persistent notion (amongst experts) that storytelling is unscientific and can somehow compromise the reputation of the project and the validity of the research outcomes. Conversely, the majority of interviewees thought of storytelling as a useful resource for non-expert users: "I think a narrative path through the 3D model can be very enjoyable, especially for non-professionals. Besides, people tend to be lazy and a narrative path can help increase curiosity" (4. Reference 35- Chiara). However, some participants completely rejected the idea as constraining and distracting. Monica, for example, affirmed that she perceives "it as an imposition and it makes you lose your concentration" (54. Reference 40 - Monica).

These results raise an interesting issue considering that there is a consistent body of literature about storytelling that contradicts these findings. Several studies, in fact, confirm the utility of storytelling not only for communication, but also for learning and research purposes. They also prove that an array of audiences could benefit from the use of storytelling (see Gonzalez-Tennant 2010; Opitz and Johnson 2016; Pujol et al. 2013; Roussou et al. 2015; Perry 2019 to only cite a few). For example, research conducted at Çatalhöyük as part of the CHESS project (see Chapter 3, section 3.3), showed that working on storytelling authoring processes fostered an unexpected methodological

discussion amongst the site' specialists and made them reflect on their interpretation of material evidence.

There is also a vast number of studies proving the benefits of storytelling for a non-specialist audience: evaluations of audience response to immersive and interactive installations in museum settings have demonstrated that a compelling narrative is fundamental to creating an engaging visitor experience (see also Chapter 6, section 6.5). Studies conducted on interactive VR installations at the National Etruscan Museum of Villa Giulia and the Roman National Museum, Diocletian's Baths in Rome, for example, show that storytelling has been one of the most appreciated aspects of the museum experience by the public, receiving positive responses especially from adults (20-40 and 40-60 years old). The results of these studies prove the important role of storytelling in stimulating interest and curiosity, observed in the positive level of visitors' engagement with the contents provided (Pietroni et al. 2015; 2016).

Another example is provided by the EMOTIVE project (see Chapter 3, section 3.3), whose underlying concept is that emotive storytelling can meaningfully contribute to creating human connections between people and cultural sites. Through a series of case studies involving museums, archaeological and heritage sites the EMOTIVE project developed and tested different kinds of digitally mediated experiences (3D prints, multi-user interaction VR experiences, chatbot and mobile apps) aimed at engendering emotional engagement with the past. While evaluation and data analysis is still ongoing, preliminary results from the project show promising and positive responses to emotive stories for cultural heritage (Perry et al. 2017; Perry 2019; Roussou et al. 2019). As already observed above, interviewees' responses in relation to the topic of storytelling might have been affected by the fact that these specialists are very rarely involved in interpretative work for audiences outside the domain of Cypriot archaeology.

5.2 Second Focus Group

In August 2017, I conducted a second follow-up focus group with six of the archaeologists and specialists working at Erimi who I had interviewed the previous year. As described in Chapter 4 my intent here was to investigate the long-term impact of the interaction with the model, in terms of perception of the site and interpretation process. Participants' responses have been coded into three themes as detailed in the following paragraphs (for details on data collection and analysis see Chapter 4, sections 4.2.4.3 and 4.4; for detailed descriptions of themes see also Appendix B):

1. access and circulation within buildings
2. use of spaces
3. embodiment

5.2.1 Access and Circulation within Buildings

The results of the focus group discussion show that all participants agreed on the fact that their interaction with the model improved their perception of spaces, now seen as more tangible, as reported by Lorenzo: “the visual impact of the elevation, which is something that only the 3D model can provide, certainly affects your perception of spaces as physical, spaces that people passed through” (1. Reference 2 - Lorenzo).

According to some participants, the interaction with the model also promoted new questions and interpretive issues regarding how people moved within spaces. Greta, for example, said: “I have to say that during the course of my research this year, I have been asking myself more questions than I used to about circulation between spaces, and this is something that the interaction with the model led me to do” (1. Reference 1 - Greta). Interestingly. Marta reported that “just a few days ago we were looking at the model while discussing the road (a passageway located on the south side of the workshop) and we noticed that having a 3D visualisation of the front of the buildings helped us to imagine where the external passage could have been located. The model enhances your comprehension and makes you perceive the space as something more concrete. In this way the use of spaces is much clearer” (1. Reference 3 - Marta). The efficacy of the 3D model in better understanding how the various spaces within the workshop complex were utilized also emerged in the theme discussed below.

5.2.2 Use of Spaces

Some participants also affirmed that the interaction with the model deepened their comprehension of the different uses of spaces and the difference between activities carried out in open spaces and those conducted in closed spaces, as highlighted by Marta: “another thing that the model helped me with is a deeper conception of open spaces as community spaces and closed spaces as areas where selected activities were carried out by a selected group of people” (2. Reference 5 - Marta). The same notion is also stressed by Greta: “it helped to reflect on the dichotomy open/close … and think about open and closed spaces, because in fact they imply not only a difference between certain activities, but also a differentiation of roles within the community” (2. Reference 2 - Greta).

Another topic emerged related to the use of space: the lighting in closed spaces. Marta, in fact, affirmed that "the possibility to visualise the sources of light really helps you to identify which spaces were the most and the least illuminated and so understand the diversification between the activities conducted in those spaces" (2. Reference 1 - Marta). These results, along with those discussed in the previous paragraph, show that the interaction with the model helped the experts working at Erimi to better identify specific interpretive issues, such as those related to the accessibility of and the different use of spaces (e.g., why certain activities were conducted in a specific area or room of the workshop complex), confirming what emerged from the interviews and previous focus group about the 3D model's value as a research tool (see above). Some interviewees also affirmed that, for this reason, during the past year they have been frequently using snapshots of the model as visual support in conference presentations and publications.

5.2.3 Embodiment

Lastly, it is worth mentioning that one participant reported that the interaction with the model also affected his perception of the space on a more personal and emotional level. According to Lorenzo, in fact, it has somehow changed his personal relationship with the site: "now I am even more respectful towards the ancient space. So, for example, now when I enter one of the rooms of the workshop I walk through the threshold instead of the base of the wall, as I used to do, and my perception is changed only because I saw the 3D model" (3. Reference 1 - Lorenzo). In this statement he affirms that seeing the hypothetical reconstruction of the built environment conditioned his movements within the site, making it no longer suitable to step over wall basements, even though the walls are no longer in place. Interestingly, he also affirmed that "another thing that the model changed is the perception of light. It has been really exciting for me, because inside the roofed spaces I have found myself several times in a corner thinking 'it was pitch-dark in here' and I have never thought about it before" (3. Reference 3 -Lorenzo).

These statements are particularly relevant because they relate to the notion of embodiment, the process in which the body, and its spatial and material relation with the environment, influences mind, thinking and cognitive processes (Lakoff and Johnson 1999; Clark 2003; Malafouris 2004). Embodied cognition and the idea that the mind is not only connected to the body but that the body influences the mind has a relatively short history as it has only been studied empirically in the last few decades. According to Lakoff and Johnson (1999), the mind is inherently embodied, thought is mostly

unconscious, and abstract concepts are largely metaphorical. What is left is the idea that reason is not based on abstract laws because cognition is grounded in bodily experience. Within the field of digital heritage, Kenderdine (2015, 29), defines embodiment as "multisensory and results from effects of visual, auditory, tactile, olfactory, and gustatory cues. Embodiment is entanglement through, and with, context and environment". She posits that cognition itself can be embodied "when it is dependent upon features of the physical body – that is, when aspects of the person's body beyond the brain play a significant causal or physically constitutive role in processing" (Kenderdine 2015, 36).

In this case it is interesting how the interaction with the virtual space and in particular the hypothetical visualisation of the past built environment has enhanced Lorenzo's embodiment and perception of the real space and the site as it is now, influencing his cognitive processes while engaging with the material world. Unfortunately, the other participants, while agreeing with Lorenzo (they were all nodding while he was talking), did not express their opinion in relation to his statements.

5.3 Questionnaires

Following the interviews and focus group, I conducted a multi-stage survey with both expert and non-expert users in order to address topics and issues previously detected. Through focused questions, I used the survey to gather quantitative data about different audiences' perceptions of the 3D model. Between February 2017 and January 2018, I collected 53 questionnaires with 25 closed and open-ended questions from three user groups: experts, non-experts and students. For the purpose of my research, experts are defined as researchers or practitioners with expertise or knowledge in relation to the use of 3D modelling and visualisations in the archaeological and heritage sector (see also Chapter 4, section 4.2.4.3). The results of the survey show interesting responses, here classified into five themes as detailed in the following paragraphs (for details on data collection and analysis see Chapter 4, sections 4.2.4 and 4.4; for detailed descriptions of themes see also Appendix C):

1. efficacy
2. immersivity
3. comprehensibility
4. usability
5. engagement

5.3.1 Efficacy

In terms of efficacy, all groups show a general, clear agreement on the utility of the proposed model for a better overall understanding of the site: in particular non-expert users and students, whose majority either strongly agree or agree. Expert users' response is also positive but more dispersed. All groups also agree on the helpfulness of the text descriptions, as showed by the answers of more than half of the experts and the majority of both non-experts and students (Tables 5.1, 5.2).

Table 5.1: Users' responses to Question 6 - The model improved my understanding of the site overall.

Experts		Non-experts		Students	
Strongly agree	4	Strongly agree	9	Strongly agree	4
Agree	9	Agree	2	Agree	10
Somewhat agree	6	Somewhat agree	1	Somewhat agree	2
Neither agree nor disagree	3	Neither agree nor disagree	0	Neither agree nor disagree	0
Somewhat disagree	1	Somewhat disagree	0	Somewhat disagree	0
Disagree	1	Disagree	1	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Table 5.2: Users' responses to Question 7 - The text descriptions improved my understanding of the site overall.

Experts		Non-experts		Students	
Strongly agree	2	Strongly agree	7	Strongly agree	5
Agree	13	Agree	5	Agree	10
Somewhat agree	4	Somewhat agree	1	Somewhat agree	1
Neither agree nor disagree	3	Neither agree nor disagree	0	Neither agree nor disagree	0
Somewhat disagree	1	Somewhat disagree	0	Somewhat disagree	0
Disagree	1	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Less positive are users' responses to the usefulness of the proposed model for a better understanding of the use of spaces, although more than a half of non-experts and

students show a degree of agreement. For a better understanding of the site, users considered the text descriptions more helpful, with more than a half of experts and the majority of non-experts and students agreeing (Tables 5.3, 5.4).

Table 5.3: Users' responses to Question 8 - The model improved my understanding of activities carried out within the Workshop Complex.

Experts		Non-experts		Students	
Strongly agree	1	Strongly agree	5	Strongly agree	3
Agree	8	Agree	4	Agree	8
Somewhat agree	9	Somewhat agree	4	Somewhat agree	4
Neither agree nor disagree	4	Neither agree nor disagree	0	Neither agree nor disagree	1
Somewhat disagree	2	Somewhat disagree	0	Somewhat disagree	0
Disagree	0	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Table 5.4: Users' responses to Question 9 - The text descriptions improved my understanding of activities carried out within the Workshop Complex.

Experts		Non-experts		Students	
Strongly agree	0	Strongly agree	5	Strongly agree	5
Agree	11	Agree	6	Agree	8
Somewhat agree	12	Somewhat agree	2	Somewhat agree	3
Neither agree nor disagree	1	Neither agree nor disagree	0	Neither agree nor disagree	0
Somewhat disagree	0	Somewhat disagree	0	Somewhat disagree	0
Disagree	0	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Both non-experts and students appreciated the possibility to visualise both phases of occupation of the areas. Experts' responses are still positive, but more dispersed. All groups also showed a clear agreement on the help of the text descriptions for a better understanding of the chronological evolution of the settlement, in particular non-experts and students (Tables 5.5, 5.6).

Table 5.5: Users' responses to Question 10 - The possibility to visualise both phases of occupation improved my understanding of the chronological evolution of the Workshop Complex.

Experts		Non-experts		Students	
Strongly agree	4	Strongly agree	3	Strongly agree	6
Agree	8	Agree	9	Agree	8
Somewhat agree	7	Somewhat agree	1	Somewhat agree	2
Neither agree nor disagree	4	Neither agree nor disagree	0	Neither agree nor disagree	0
Somewhat disagree	0	Somewhat disagree	0	Somewhat disagree	0
Disagree	1	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Table 5.6: Users' responses to Question 11 – The text descriptions improved my understanding of the chronological evolution of the Workshop Complex.

Experts		Non-experts		Students	
Strongly agree	1	Strongly agree	5	Strongly agree	4
Agree	12	Agree	5	Agree	8
Somewhat agree	10	Somewhat agree	3	Somewhat agree	3
Neither agree nor disagree	1	Neither agree nor disagree	0	Neither agree nor disagree	0
Somewhat disagree	0	Somewhat disagree	0	Somewhat disagree	1
Disagree	0	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

These results seem to indicate that for all users the model must be associated with written information to effectively convey archaeological information, especially in relation to specific topics such as the use of spaces.

5.3.2 Immersivity

Regarding immersivity, only non-expert users show an agreement on the usefulness of avatars for a better understanding of the overall model. Both experts' and students' responses are less positive and more dispersed (Table 5.7). These results seem to be confirmed by the fact that, in relation to avatars, none of the non-expert users left negative feedback in response to the open-ended questions 22 to 25, aimed at collecting users' feedback on what they remembered, liked or disliked about the experience.

Conversely, criticisms in relation to avatars emerged in response to the same question among few members of both experts and students' user groups.

Table 5.7: Users' responses to Question 12 - The ability to see avatars improved my understanding of the model overall.

Experts		Non-experts		Students	
Strongly agree	2	Strongly agree	6	Strongly agree	4
Agree	4	Agree	3	Agree	4
Somewhat agree	6	Somewhat agree	2	Somewhat agree	1
Neither agree nor disagree	7	Neither agree nor disagree	1	Neither agree nor disagree	3
Somewhat disagree	2	Somewhat disagree	0	Somewhat disagree	3
Disagree	3	Disagree	1	Disagree	1
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Less positive and more dispersed are also users' responses to avatars' efficacy in improving the understanding of the use of spaces, i.e., providing a scale for structures and the overall built environment and a sense of how many people could have occupied or worked within each space. The same trend can be observed in relation to the avatars' ability to provide a sense of lived place (Tables 5.8, 5.9).

Table 5.8: Users' responses to Question 13 - The ability to see avatars improved my understanding of the use of spaces.

Experts		Non-experts		Students	
Strongly agree	2	Strongly agree	4	Strongly agree	5
Agree	5	Agree	4	Agree	2
Somewhat agree	4	Somewhat agree	4	Somewhat agree	2
Neither agree nor disagree	7	Neither agree nor disagree	0	Neither agree nor disagree	4
Somewhat disagree	2	Somewhat disagree	0	Somewhat disagree	3
Disagree	4	Disagree	1	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Table 5.9: Users' responses to Question 14 - Avatars provided a sense of people living in the space.

Experts		Non-experts		Students	
Strongly agree	1	Strongly agree	5	Strongly agree	4
Agree	4	Agree	2	Agree	4
Somewhat agree	5	Somewhat agree	2	Somewhat agree	2
Neither agree nor disagree	4	Neither agree nor disagree	3	Neither agree nor disagree	3
Somewhat disagree	5	Somewhat disagree	1	Somewhat disagree	2
Disagree	5	Disagree	0	Disagree	1
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Unfortunately, it is difficult to better contextualise these results since users did not provide specific feedback in relation to these topics. Only one expert user reported that one thing they did not like about the experience was "the lack of people" (2. Experts-Reference 3) suggesting that the avatars currently used failed to provide a sense of inhabited place.

Conversely, all groups appreciated the opportunity to navigate the model through a first-person perspective, especially non-experts and students with the majority of users showing agreement (Table 5.10). Furthermore, the majority of non-experts and students considered the first-person navigation useful for a better understanding of spaces. Expert users' responses are also positive, but more dispersed (Table 5.11).

Table 5.10: Users' responses to Question 15 – I appreciated the possibility to navigate the model through a first-person perspective.

Experts		Non-experts		Students	
Strongly agree	7	Strongly agree	8	Strongly agree	8
Agree	10	Agree	3	Agree	4
Somewhat agree	4	Somewhat agree	2	Somewhat agree	3
Neither agree nor disagree	2	Neither agree nor disagree	0	Neither agree nor disagree	0
Somewhat disagree	0	Somewhat disagree	0	Somewhat disagree	1
Disagree	1	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Table 5.11: Users' responses to Question 16 - The possibility to navigate the model through a first-person perspective improved my understanding of spaces.

Experts		Non-experts		Students	
Strongly agree	6	Strongly agree	10	Strongly agree	7
Agree	6	Agree	1	Agree	7
Somewhat agree	5	Somewhat agree	1	Somewhat agree	1
Neither agree nor disagree	4	Neither agree nor disagree	1	Neither agree nor disagree	0
Somewhat disagree	2	Somewhat disagree	0	Somewhat disagree	1
Disagree	1	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

Users' appreciation of the possibility to visualise the model through a first-person point of view is also reflected in several comments in response to Q22-25. In terms of positive reactions to avatars, one expert user, for example, listed it among the things they remembered about the experience: "interesting first-person perspective of the site" (2. Experts – Reference 4). One student also remembered in particular "the possibility to see from avatar point of view" (1. Students - Reference 1). Other users cited this feature among those that they liked most of the experience, as stated by this expert user: "I really loved being able to stand in the room and get a better sense of scale and lived space" (2. Experts - Reference 4). Similarly, one non-expert user appreciated "the chance to use the avatar function" (2. Non-experts - Reference 3).

However, in terms of negative reactions to avatars, users expressed the need to be able to move around the model while maintaining this kind of perspective. In other words, users wanted the option to walk through the site with a first-person view, while the UI presented only the avatars' point of view in static positions. One expert user, for example, provided the following comment on what they did not like about the experience: "lacking a sense of 'first-person-experience'" (2. Experts-Reference 7). Similarly, another expert user wrote: "I didn't feel a strong avatar experience. I would have liked to move around using my mouse" (2. Experts - Reference 6).

5.3.3 Comprehensibility

All groups showed a general agreement on the comprehensibility of the text descriptions: more than a half of users in the case of experts; the majority of users in case for both non-experts and students groups (Table 5.12).

Table 5.12: Users' responses to Question 17 - The text descriptions were clear and comprehensive.

Experts		Non-experts		Students	
Strongly agree	1	Strongly agree	4	Strongly agree	7
Agree	12	Agree	7	Agree	4
Somewhat agree	6	Somewhat agree	1	Somewhat agree	5
Neither agree nor disagree	2	Neither agree nor disagree	1	Neither agree nor disagree	0
Somewhat disagree	2	Somewhat disagree	0	Somewhat disagree	0
Disagree	1	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	0
Total	24	Total	13	Total	16

However, as emerges from the responses to Q18 (aimed to collect users' comments on the reason why they did not find the text descriptions clear), several users considered the vocabulary used for text descriptions too technical and probably not suitable for a non-expert audience. As stated by one expert user: "the language is too heavily academic for a lay audience. Even if the intended audience is professional archaeologists, it's still quite thick academic language" (3. Experts-Reference 4).

The same issue recurred in users' responses to Q24 (What didn't you like about this experience?): one student, for example, complained about the fact that "more user-friendly summaries could have been included" (3. Students - Reference 1); while one expert user affirmed that "the language in the text is unnecessarily dense and academic. I didn't like that I couldn't identify the intended audience - the text as written seems almost exclusively useful for an academic audience, due to the cumbersome and profession-specific language" (3. Experts - Reference 44). Similarly, one non-expert user did not like "the lack of explanation of the key words for those who are not archaeologists" (3. Non-experts - Reference 12).

5.3.4 Usability

Concerning the UI, the majority of non-experts and students show a general, positive agreement on its usability. Experts' responses, instead, are less positive (Table 5.13). According to their feedback, in fact, the most common issue with the UI is the navigation: "the camera navigation was difficult (even for experienced gamers!) - very few non-tech-literate people would find this intuitive" (4. Experts - Reference 15). Similarly, one expert user wrote: "the navigation was very difficult and cumbersome" (4. Experts - Reference 12); while another expert user stated that "it was difficult to control the model which made exploration of it frustrating" (4. Experts - Reference 47). Conversely, none of the non-experts and students reported having problems with the navigation, which interestingly hints to persisting preconceptions among practitioners around non specialists audiences and their supposed reaction to and perception of UIs.

Table 5.13: Users' responses to Question 19 - It was easy to interact with the model

Experts		Non-experts		Students	
Strongly agree	3	Strongly agree	3	Strongly agree	5
Agree	9	Agree	8	Agree	8
Somewhat agree	5	Somewhat agree	1	Somewhat agree	2
Neither agree nor disagree	1	Neither agree nor disagree	1	Neither agree nor disagree	0
Somewhat disagree	4	Somewhat disagree	0	Somewhat disagree	0
Disagree	2	Disagree	0	Disagree	0
Strongly disagree	0	Strongly disagree	0	Strongly disagree	1
Total	24	Total	13	Total	16

Regarding the model and the UI, the following sub-themes, identified as recurring patterns across users' responses to Q20, Q22-25, emerged as negatively affecting the experience:

Navigation control

One expert user complained about the fact that "the right click with inverted camera was a little cumbersome" (4. Experts - Reference 3); while another expert user wrote: "I'm bad with mouse controls and felt like using the arrow keys was inelegant for movement. It left me slightly disoriented and worried that I was missing content" (4. Experts - Reference 4).

Sense of disorientation

One expert user reported that he felt disoriented interacting with the model: “it is very difficult to understand where you are, when you move between the rooms/spaces. I would suggest to create a 2D map that allows to select the rooms/spaces favouring the ‘teleportation’ from one room/space to the others” (4. Experts - Reference 17). Another expert user also wrote: “I didn't know exactly what would be best to click on next - and the lack of direction was a bit more confusing rather than liberating. I think I would have appreciated the option of a "story" I could navigate as well as the option of free exploration. By "story" I mean a recommended path of exploration, perhaps offered by the tutorial” (4. Experts - Reference 6).

Text descriptions disconnected from the model

Several expert users advocated the need for more organic and seamless ways to incorporate the text descriptions in the user interface using different approaches: “also codifying some of the text to be visual or presented as part of the model rather than disjointed I think would be a little more cohesive” (4. Experts - Reference 18). Similarly, another expert user complained about the fact that “there was a lot to read that was separate from the model itself which meant I was having to move out of the model to then look at the text and then try to relate that to what I was seeing in the model. IE: the text itself was clear, but a little removed from the model” (4. Experts - Reference 1).

Lack of landscape

Some users criticised the absence of the landscape surrounding the site, as emerged from this non-expert user comment on what they did not like about the experience: “not being able to see the view over the countryside to set the site in the landscape” (4. Non-experts - Reference 2); or this student’s comment: “I maybe wanted to see some vegetation like plants etc.” (4. Students - Reference 1). Similarly, one expert user wrote: “maybe an improvement could be to see the landscape around the site” (4. Experts - Reference 11).

5.3.5 Engagement

Generally, experts’ responses to the overall experience were not particularly positive (only 9 of the participants considered it very engaging and 6 of the participants thought it was very stimulating). Nonetheless, the majority of experts did not consider it a waste of time or feel particularly bored (Table 5.14). However, some experts left positive feedback on the UX. One expert user, for example, wrote “I think at the core this is a brilliant idea - I am super in love with being able to shift between different perspectives and times of day - it adds a level of time and interaction which is rarely seen in these

architectural reconstruction models" (5.Experts - Reference 8); while another expert user expressed their appreciation for the experience: "I really enjoyed the model, I can see that a lot of work has gone into making it and interpreting the excavation results. I think it helps to visualise the site well. I know very little about Cypriot archaeology, and this has made me curious. Thanks!" (5. Experts - Reference 10).

Interestingly, these comments differ significantly from what emerged from interviews with members of the Erimi research team, whose response to the experience was more positive, even considering their professional and emotional bias. Moreover, my colleagues affirmed that in their opinion other specialists, even without a specific interest in Cypriot archaeology, would have surely appreciated interacting with the model. On the contrary, experts who took part in my survey were the most critical of the experience among all user groups. These results seem to provide a further evidence of the difference between what archaeologists working at Erimi think might be the outcome of their research's presentation and the actual response of other specialists.

Table 5.14: Experts' responses to Question 21 - How would you evaluate this experience?

Statement	Not at all	A little	Mildly	Moderately	Somewhat	Very	Extremely	Total
It was engaging	1	1	1	6	4	9	2	24
I felt bored	10	7	2	2	2	1	0	24
It was stimulating	2	1	2	4	8	6	1	24
It was a waste of time	17	3	1	1	2	0	0	24
It was useful for learning	1	3	2	3	6	8	1	24
It evoked a sense of another culture	2	5	4	3	6	4	0	24
It fostered curiosity in learning more about the site and its history	0	5	2	4	6	6	1	24
It fostered curiosity in learning about Cypriot history and culture	1	5	2	4	7	4	1	24

The majority of non-experts and students, instead, showed a general positive response to the overall experience, which was perceived as engaging and stimulating (Tables 5.15, 5.16). This positive feeling is also reflected in some of the users' comments. One student, for example, stated that it "was a very interactive learning experience, was much easier to visualise the site by seeing the reconstruction and moving around it than by reading descriptions alone" (5. Students - Reference 2); while another student wrote: "a fantastic model, thank you for letting others experience this, inspiring for somebody who wishes to one day do this themselves" (5. Students - Reference 4). Non-experts also enjoyed the experience, as emerged from this feedback: "I really enjoyed it, as it helped me to develop a broader perception of the space" (5. Non-experts - Reference 5).

Table 5.15: Non-experts' responses to Question 21 - How would you evaluate this experience?

Statement	Not at all	A little	Mildly	Moderately	Somewhat	Very	Extremely	Total
It was engaging	0	0	0	1	3	7	2	13
I felt bored	11	1	0	0	1	0	0	13
It was stimulating	0	0	0	3	2	6	2	13
It was a waste of time	12	1	0	0	0	0	0	13
It was useful for learning	0	0	2	1	0	6	4	13
It evoked a sense of another culture	0	0	1	1	4	4	3	13
It fostered curiosity in learning more about the site and its history	0	1	1	1	2	5	3	13
It fostered curiosity in learning about Cypriot history and culture	0	0	2	2	2	5	2	13

Table 5.16: Students' responses to Question 21 - How would you evaluate this experience?

Statement	Not at all	A little	Mildly	Moderately	Somewhat	Very	Extremely	Total
It was engaging	0	0	0	2	2	9	3	16
I felt bored	12	2	0	2	0	0	0	16
It was stimulating	0	2	1	0	1	9	3	16
It was a waste of time	16	0	0	0	0	0	0	16
It was useful for learning	0	0	1	1	1	7	6	16
It evoked a sense of another culture	1	1	1	0	6	5	2	16
It fostered curiosity in learning more about the site and its history	0	0	2	2	3	5	4	16
It fostered curiosity in learning about Cypriot history and culture	0	1	0	1	5	5	4	16

Interestingly, while the majority of both non-experts and students rated the experience useful for learning, very few of them answered question Q22 (What do you remember about this experience? Please list at least 3 things) mentioning specifics around the information learnt through this experience. Some students, though, in their comments on questions 22 to 25 highlighted its educational potential. One student, for example, affirmed that the model "used in early years education would give younger children a chance to see that history can be 'experienced' in a sense" (5. Students - Reference 1). Similarly, another student wrote "the use of modelling like this alongside the interpretive data could be used to great effect in early education to give children a more 'hands-on' approach to history without having to resort to logistically difficult (albeit fun) groundwork. Adapting this for VR could benefit those in later stages of education, remotely accessing sites or taking part in historical events. Those with dyslexia could benefit because of the more visual aspect" (5. Students - Reference 3).

In relation to engagement, it is also worth mentioning that some users reported the feeling of being present. One non-expert user, for example, left the following comment on what they remembered about the experience: “The sense of navigation of the spaces. The feeling of getting into the site, the imagination of being there during the bronze age” (5. Non-experts - Reference 2). The same feeling was reported by one of the expert users: “the sense of being in the rooms. The placement of objects in relation to me” (5. Experts - Reference 2). Conversely, one expert user reported the opposite feeling in relation to what they did not like about the experience: “I did not have a sense of presence” (5. Experts - Reference 1).

In general, the overall perception of the UX was positive across all user groups. Experts’ feedback, while less positive, was generally the most structured and constructive: commentary from expert users was, in fact, more focused on identifying potential issues, such as the comprehensibility of text descriptions and the usability of the UI and suggesting possible solutions. On the other hand, non-experts’ feedback was more positive but less specific, focused mainly on the appreciation of the immersive component of the experience. Students’ feedback, instead, while generally positive, was more critical than those provided by non-expert users, particularly in relation to avatars and text descriptions. Moreover, students were the only user group to discuss the potential application of the model for educational purposes, even though their comments seem to be informed by assumptions regarding interactive digital media and education. While, in fact, several studies have been conducted exploring the relation between interactive digital media and learning in children (see for example Roussou 2004; Roussou and Slater 2017), in the case of my model, text description embedded in the UI were not written with a vocabulary easily understandable by a very young audience.

5.4 Summary

In general, the results of the quantitative analysis show that interactions with the model were considered useful in terms of gaining a better understanding of the site overall even amongst people unfamiliar with the specific case-study’s context, as emerges from users’ response to Q6-11 (Figs. 5.1-5.6). However, users’ responses to Q8 indicate that the model was considered less effective at conveying specific archaeological information, such as the function and use of spaces (Fig. 5.3).

Among all the topics covered by users’ feedback, the most controversial seems to be the use of avatars. During interviews, in fact, the presence of avatars emerged as necessary

to provide a sense of inhabited place and a scale for spaces; however, some interviewees had negative reactions perceiving them as unnatural and disturbing. Moreover, questions regarding the role of avatars for a better understanding of the model (Q12, Q13, Q14) were among the few to not show a clear, general agreement in all groups (Figs 5.7-5.9). All groups also showed a disagreement on the avatars' ability to provide a sense of lived space (Fig 5.9).

Some insights for this lack of consensus about avatars can be found in the following feedback provided by an expert user: "I didn't like the avatars. It took me a while to work out what they were and I don't feel they added to the experience" (2. Experts - Reference 8). Similarly, a student wrote "I didn't find the avatars to be of great use, it was relatively easy to just position the camera at head height in one of the rooms without using the avatar cameras. They felt slightly unnecessary but did not hinder the model in any way" (2. Students - Reference 4). These results seem to confirm what emerged from interviews with archaeologists and specialists working at Erimi in relation to the type of avatars selected for the UI (see paragraph 5.1.2): the choice to use human figures in the form of silhouettes was not appreciated as they were considered unnecessary and failed to give the feeling of an inhabited space.

Another interesting topic, related to the use of avatars, concerns immersivity. As already highlighted during interviews, users appreciated the possibility of visualising the model through a first-person point of view; in fact, survey questions Q15 and Q16, which directly address this topic, show a higher degree of agreement, especially among non-experts and students (Figs 5.10, 5.11). This aspect was then reflected in several comments in response to Q22: one non-expert user particularly remembered "the first-person navigation" (2. Non-experts - Reference 4). Similarly, one student listed among the things that they recalled "the possibility to see from an avatar point of view" (2. Students - Reference 1). Further in Q23, users cited this feature among those that they liked most of the experience: one non-expert user affirmed that they appreciated "the chance to use the avatar function" (2. Non-experts - Reference 3); while one expert user wrote: "I really loved being able to stand in the room and get a better sense of scale and lived space" (2. Experts - Reference 4). As the current implementation of the model only allows users to look through a first-person view from pre-defined, static positions, users expressed the need to be able to move around the model while maintaining this kind of perspective, as they were actually walking through the site. One expert user, for

example, wrote: “I didn't feel a strong avatar experience. I would have liked to move around using my mouse” (3. Experts - Reference 1); while another expert user stated that the experience was “lacking a sense of ‘first-person-experience’” (2. Experts - Reference 7). These results seem to confirm the fact that users demand a higher level of immersivity and possibly the presence of moving avatars, as opposed to what my model provided.

Regarding the UI, the possibility to visualise the site in two different chronological phases and its evolution over time were particularly appreciated as they are often listed by users among their favourite UI features. One expert user, for example, wrote: “I really liked that you could view both phases of the site history, and that it felt seamless to move between them” (4. Experts - Reference 19); while one student affirmed that “the view of both phases improves my understanding” (4. Students - Reference 10). One non-expert user cited this feature among the things they remembered about the experience: “the organization of the rooms in the workshop, their use and the difference between the two phases” (4. Non-experts - Reference 4). Several users also appreciated the sunlight control feature, which was frequently mentioned among the things they remembered/liked the most, as emerges from this expert user comment: “how the workshop's rooms/spaces were affected by the light exposure during the day” (4. Experts - Reference 10). Similarly, one non-expert user affirmed that they liked “being able to change the light (time of day)” (4. Non-experts - Reference 1).

On the other hand, other features of the UI were criticised by several users and perceived as cumbersome, disruptive and counterintuitive. One of the recurrent criticisms was, for example, directed at the avatars’ perspective. One expert user indicated that “probably the position of the avatar (when you use the avatar camera) it's not clear. Maybe have a location map would be useful” (4. Experts - Reference 26). In a similar vein, one non-expert user wrote: “I wasn't entirely sure which avatar's perspective I was viewing from. Is there a way to add, perhaps, a small inset map with an indication of which avatar's "eyes" are being used and which direction it is facing?” (4. Non-experts - Reference 7).

Another UI issue often brought up was the need to seamlessly incorporate the text descriptions in the UI, as emerges from this expert user comment: “incorporating the wordy-stuff into codified visuals would really help with the design and the ability to

understand and interrogate it from all perspectives without the break in having to move out of the model to read" (4. Experts - Reference 33). Similarly, another expert user wrote: "I personally found that there was a lot to read that was separated from the model itself which meant I was having to move out of the model to then look at the text and then try to relate that to what I was seeing in the model" (4. Experts - Reference 1). In the matter of the last category, it is worth noting that one expert user mentioned the dissociation between the text and the model as disruptive to their feeling of embodiment: "I was interested about the relationships between things and the feeling of lived space but having to jolt out to read text, and move between fixed avatar points meant breaking that connection and that feeling of embeddedness in the space frequently" (5. Experts - Reference 7).

This feedback on the UI relates to the vast body of literature demonstrating that the design of the interface plays a significant role in shaping the UX (Sengers et al. 2006; Opitz and Johnson 2016; Pietroni et al. 2015; 2016). For this reason, it is extremely important to take users' comments into account in order to create a more enjoyable UI that makes them feel comfortable and engaged.

Contrary to what emerged from interviews, several expert users' feedback in relation to the UI identify it as more suitable for an academic audience. One expert user affirmed that "from a public-engagement perspective, the lack of use-examples and additional graphical detail would mean many people would struggle to engage" (4. Experts - Reference 1); while another expert user wrote: "I also remember thinking that the model is far too cumbersome for a lay audience, that I hope the intended audience of this model is purely for professional archaeologists and students of archaeology" (4. Experts - Reference 21). Similarly, another expert user stated that "the model/interface here is very much geared to the academic researcher - there is very little to engage the non-archaeologically-literate" (4. Experts - Reference 40). Interestingly, though, the analysis of non-experts' and students' feedback does not reflect any of the abovementioned experts' concerns, and their responses to the questions addressing this specific topic (Q17, Q18, Q19, Q20) show a general degree of agreement (Figs 5.12, 5.13). These results not only highlight how the assumptions that members of the Erimi research team have about the outcome of their research's presentation does not find confirmation in the audience's actual response, but also seem to confirm that among the practitioners

who participated in my survey there is still no clear idea about what kind of interests and needs different audiences might have.

Overall, the results of the survey show interesting responses in terms of engagement from both professional and lay users. They highlight several key topics, such as the role of immersion and interactivity in enhancing the UX and the perception and acceptance of avatars, as well as what needs and expectations different users have when approaching this specific form of representation of the past. The results are a promising step towards a better understanding of how interactive 3D models in archaeology are not only used but perceived by a diverse range of audiences and to what extent they produce excitement and emotional response, fostering desire for knowledge about or interaction with past cultures. Moreover, these results stress the importance of conducting evaluations on the UX we as practitioners design to identify and address any potential assumptions we might have on what our intended audiences think, feel and want. The high rate of response to the open-ended questions (46 records for Q22-23, 40 records for Q24 and 21 records for Q25) and the constructiveness of feedback given by different users, suggest that they not only have clear and specific expectations when they interact with this kind of technology, especially in terms of content and UI, but also are more than willing to give their opinion about how interactive visualisation of archaeological sites should be.

Understanding the impact of interactive digital technologies and adopting PD practices to design with stakeholders experiences that are more meaningful to them, are amongst the most important challenges for the heritage sector and are also the topic of discussion of the following chapter (Chapter 6). Here, I will present the results of my interviews with museum curators and digital heritage practitioners aiming to discuss their experiences within audience research studies as well as their research results on the impact that digital interactive media have upon visitors' experience. From the analysis of the interview data, in fact, emerges the value of PD and how important it is to enable users to be part of the creative design process, in order to create experiences that are bespoke to their needs and expectations.

6 Interviews with Digital Heritage Practitioners and Museum Curators: Analysis and Results

As mentioned in previous chapters, relatively little is known about how people engage and interact with 3D interactive media (Roussou 2008; Economou and Pujol 2011; Yannoutosu and Avouris 2012; DiGiuseppantonio DiFranco et al. 2015; Economou 2015; Johnson et al. 2015; Damala et al. 2016; Economou 2016). For this reason, I concluded the first iteration of my research by interviewing museum curators and experts in the application of digital interactive media to discuss and better understand their research results on the impact that these new technologies have upon users' experiences. Interviewees work in a variety of contexts at different stages in their careers: some of them are lecturers or professors at well renowned universities around the world, while others work for research institutes and university museums. I carried out a total of eight interviews between November 2017 and January 2018, while I was still circulating the online survey, as a way to gauge my own work in terms of both UI design process and evaluation framework and learn how to improve my research methods.

Their experiences are especially important because they provide unique insights into how different audiences engage with these technologies. Most of the interviewees, in fact, work at or in collaboration with museums and have the opportunity to conduct studies on a large and variegated audience. Moreover, especially in the case of commissioned evaluations, the results of these studies are sometimes unpublished and accessible only to the commissioning institutions; therefore, interviewing these experts has proven important in terms of understanding aspects of the research field that are not always discussed in publications.

Throughout these interviews, I have aimed to gather key information regarding experts' experiences both in creating interactive digital media, for museum displays or research purposes, and in evaluating audiences' responses to such media, as well as their evaluation strategies and any problems and challenges they have encountered in both the creation and evaluation processes. Data collected through these interviews were used to develop a better comprehension of the effect that the dissemination of these forms of (re)presentation of the past have upon people's perceptions. Moreover, such data helped me to better contextualize the results of my research within the wider field of audience research studies (see Chapter 5) (Fig. 6.1).

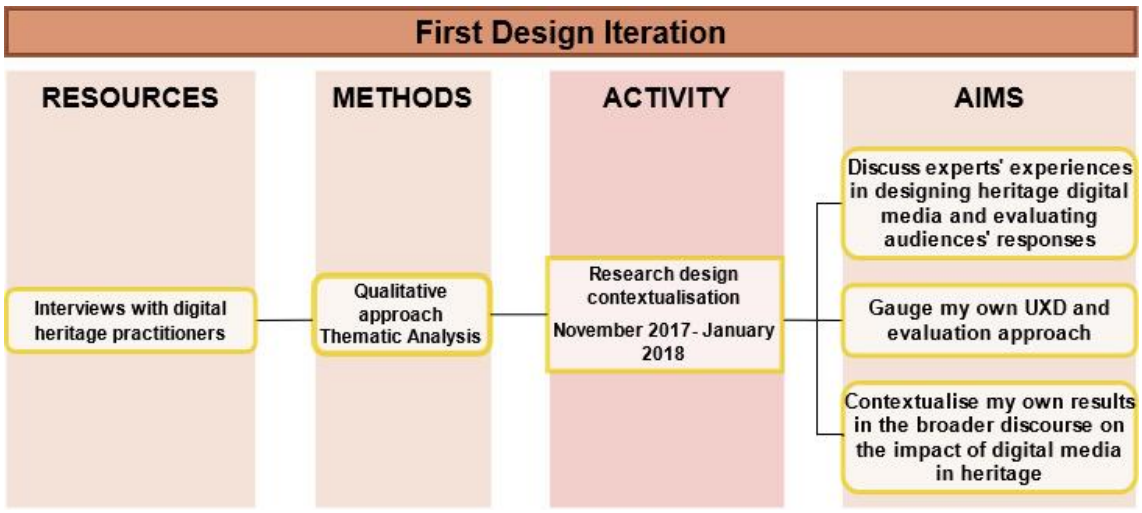


Figure 6.1: Research design contextualisation diagram: From the left each column illustrates: resources (techniques, software, design tools) used, methods adopted, the timeline and the specific aims of the activity (credit: Francesca Dolcetti).

Interview data were coded into five themes as detailed in the following paragraphs (for details on data collection and analysis see Chapter 4, sections 4.2.4 and 4.4; for detailed descriptions of themes see also Appendix D):

1. interactive digital media: why, what and for whom;
2. audience expectations;
3. evaluation: aims, approaches and efficacy;
4. audience response;
5. best practices, participatory process and storytelling.

6.1 Interactive Digital Media: Why, What and for Whom

The interviewees are researchers and professors working at universities and public research institutions, heritage practitioners and museum curators. They all are experts in interactive digital media and their application for various purposes, which can be classified into three main categories: research, dissemination and education.

Laia Pujol is a senior researcher at the Pompeu Fabra University in Barcelona, where she also leads the EU-funded Coordination and Support Action (CSA) Virtual Multimodal Museum (ViMM). A few years ago Laia worked on a project related to virtual reality and virtual reconstructions, whose aim was to evaluate the concept of cultural presence in archaeology. In this case the virtual environment was built to investigate specific research questions related to presence. Eva Pietroni and Alfonsina Pagano, instead, have been working on projects related to virtual archaeology as researchers at the Virtual Heritage Lab of CNR ITABC in Rome, focused on the

communication of archaeological sites and objects in museums and cultural heritage settings, such as the Vatican Museums or the Baths of Diocletian (National Roman Museum). Alfonsina is responsible for UX evaluation, while Eva is an art historian and heritage practitioner. In terms of education, Maria Roussou, Professor in Interactive Systems (i.e., Human-Computer Interaction, Virtual Reality, Computer Games) at the Department of Informatics & Telecommunications, National and Kapodistrian University of Athens, has worked on interactive virtual learning environments for children, specifically designed for educational purposes.

In general, the majority of interviewees have been involved in the evaluation of interactive digital media in museums and exhibitions, in most cases designed for a specific audience. For example, Sophie (who decided to remain anonymous) is responsible for the public-facing programs at an archaeology and anthropology university museum in the UK and a few years ago worked on a project aimed at creating digital resources for teachers at primary and secondary levels across the region. She has also been evaluating an app made for a specific display at an earth sciences museum, an old cabinet containing early collections that could not be opened for conservation reasons. The app was designed to give visitors a view into the cabinet without compromising the preservation of the objects.

Areti Galani, senior lecturer in Digital Cultural Heritage (design and study of digital media in museums and galleries) at the University of Newcastle, instead, has been applying a different approach: in 2011, for example, she worked on the design of web apps about rock art in a rural site (Rock Art on Mobile Phones (RAMP) project) without an intended audience in mind: “we started assembling the audience through the research project: we observed the site, we figured out more or less what kind of people were visiting and we went from there recruiting groups to help us with the design” (1. Reference 4 - Areti). In general, all these projects, while carried out for different purposes, have a common aim: investigating how digital technologies shape and enhance users' experiences with museums and heritage sites.

6.2 Audience Expectations

The theme related to audiences’ expectations emerged across interviewees’ answers and refers to the notion of what kind of experience visitors expect to have when approaching and interacting with interactive digital media.

According to Laia nothing much has changed between 2017, when I interviewed her, and her evaluation of the exhibition Virtual Rome in 2005 in terms of people's expectations and perceptions of information and communication technologies (ICT): "audiences still want to be transformed, to be amazed. People really want to be moved, they want to travel to the past, to see people like them so they can relate to them, they want to say "Wow, tell me a story". They are interested in things like "why the statue's nose is broken", while the archaeologists are interested in telling them about the chronology and things that don't really make sense to people" (2. Reference 6 - Laia). Related to storytelling and its importance is also this statement from Eva: "two are the components that generate interest: interaction and storytelling. Visitors in museums want to interact and feel immersed in a story: "I really felt like I was part of the story", "I felt like I was there", "it was interactive" are, in fact, the most common feedback we received on our installations, so it's clear that interaction and storytelling have an immediate impact on visitors' experience" (2. Reference 5 - Eva).

Interestingly, while discussing the unexpected results of her study about the interactive installation "Sit with me" at the Discovery Museum in Newcastle, aimed at encouraging visitors to reflect on migration in the North East of England, Areti said that "people expected it to be all singing all dancing, that it would be something spectacular and because the installation was trying to think about reflection it was a very quiet installation and people didn't expect that in a gallery where all the other installations were touch screens with sounds and things like that" (2. Reference 2 - Areti). In relation to Areti's comment, some of my interviewees broached the issue of assumptions among experts about audiences' expectations and needs. Laia, for example, within a general discussion about her experiences in audience research studies said: "I have to say there is an expectation, or I would say that [among] experts in cultural heritage what they think audiences expect is not really what audiences expect. They are concerned about different things. People really, audiences I would say they still want to be transformed, to be amazed, you know. So, let me put it in a different way: to me, archaeologists and people from cultural heritage they do think in terms of information, while other people and audiences want experiences" (2. Reference 6 - Laia). In other words, in Laia's opinion heritage practitioners still perceive interactive digital media mainly as means to deliver factual information rather than something people might enjoy experiencing beyond a passive consumption of information. She then went on to say, "I think it is because cultural heritage people take for granted that everybody is interested and the

way to communicate is universal and valid for anybody and it is not. For example, studies have proved that photorealism can be counterproductive, but we still think that it is all about visualisation and it is not" (2. Reference 7 - Laia). In a similar vein Alfonsina, after years spent on evaluating audience's responses to immersive virtual reality installations in museums, realised that some notions about audience's expectations were unfounded: "visitors do not care if the rendering is perfect, the only important thing is that it is something familiar and believable. We have been working for years on rendering, photorealism and characterization and in the end, we realised that that led us nowhere and that simpler things were enough" (2. Reference 1 - Alfonsina). What emerges from these responses, especially as related to audience's interests and needs, is particularly relevant to my own research and the results from the first iteration of my research (see Chapter 5). It is, in fact, a further demonstration of the kind of assumptions, we as practitioners make about what our audiences really want from heritage experiences.

6.3 Evaluation: Aims, Approaches and Efficacy

I also aimed to investigate my interviewees' typical evaluation methodologies and identify their opinions on the best, most effective evaluation strategies to assess audiences' experiences and perceptions of 3D interactive media. My interest in terms of my own research initiative was to gain insight from interviewees' experiences and better understand how to approach this complex and multifaceted subject.

According to their answers, and perhaps unsurprisingly, the aims of evaluation processes are various, relating primarily to the interviewees' research projects and interests or, in the case of commissioned evaluations, to the brief of the commissioning museum or heritage institution. Luigina Ciolfi, a Professor in Human-Centered Computing (HCI), Computer-Supported Cooperative Work (CSCW) and cultural heritage technologies at Sheffield Hallam University, runs mainly qualitative projects looking at the impact of digital technologies (in particular smart replicas) in museum visiting experiences. Erik Champion, Professor of Cultural Visualisation in the School of Media Culture and Creative Arts at Curtin University, Australia, and UNESCO chair of cultural heritage and visualisation, used to ask participants "to rate the environments (in-games environments based on Maya archaeological sites) with a scale from 1 to 7 in terms of local culture authenticity, interactivity and engagement. I asked them questions to see if they have observed things in the environment and which environment took less

time to finish. Now we evaluate more experience rather than tasks completion" (3. Reference 9 - Erik). Alfonsina, instead, usually conducts evaluations taking into consideration "four macro-categories: usability, so everything related to the practical component of interaction, contents meaning storytelling, audience reception of multimedia contents and cognitive learning" (3. Reference 4 - Alfonsina).

All participants have been using mixed methods, including both quantitative and qualitative approaches: Alfonsina, for example, as part of her standard evaluation protocol, applies "a mix of questionnaires, guided scenarios and observations" (3. Reference 2 - Alfonsina). Sophie also uses observations and guided interviews: "with the teachers, we set up a few websites that we wanted them to look at and gave them a specific task asking them to find something to fit with their current teaching plan, so we ask them to find information, and we recorded and observed what they were doing and did interviews at the end" (3. Reference 24 - Sophie). Luigina, too, applies mixed methods: "I have used loads of 'evaluation approaches' throughout the years, depending on the project, so I have used plenty of observations shadowing people around in installations and exhibitions and documenting what they do both with video and notes, photographs. We have done interviews with people before and after the visit and asked feedback, questionnaires, surveys. We have done observations without people, so with fixed cameras and looking at more quantitative indicators". Moreover, she has also done "post-exhibition workshops to evaluate with museums where you can actually go and find visitors again, ask them back, do workshops where you get together and present them examples of interactions and they comment on their memories, what they liked and what they didn't like, what they remember and so on" (3. Reference 17 - Luigina). Laia during the course of her studies, moved from "more traditional visitors' studies from a museum point of view to a more human-computer interaction approaches or methods of investigation and now, more recently, I've gone into multiple 'correspondence' analysis, which is something that is done in the field of human-computer interaction and more or less it is the same, just more structured and, again, if you want to analyse very much in depth observations" (3. Reference 14 - Laia). In other words, Laia's evaluation techniques moved from museums standard evaluation techniques, towards a more holistic approach that enables nuanced understanding of data sets. Multiple correspondence analysis (MCA) is, in fact, a statistical method used to analyse the pattern of relationships of several categorical dependent variables. This

method processes “qualitative” or “categorised” variables, meaning it is of particular interest in the social sciences (Le Roux and Rouanet 2004).

In general, all the approaches adopted by interviewees are common in the field of audience research studies and have been extensively applied in museum evaluations (see also Chapter 3). They are also well established in the field of digital cultural heritage as evaluation methods to investigate the role and impact of interactive digital media on visitors’ experiences, on site and virtual, in museum and heritage sites (Sylaiou et al. 2013; Graf et al. 2015; Damala et al. 2016).

In terms of efficacy, though, some of the interviewed experts prefer qualitative methods, such as Maria, who has been using mainly qualitative approaches, specifically observations and semi-structured interviews: “I still do think that qualitative methodology is the most appropriate methodology to use” (3. Reference 20 - Maria). In Maria’s opinion, quantitative approaches are less useful than qualitative ones in gaining a better understanding of how people engage with interactive digital media. Similarly, Luigina said: “I find surveys of limited use, they are very useful when you are getting a lot of visitors and you want to get something up from all of them, so they can tell you something that you can't possibly get with interviews, but I find that on their own they can be a little bit shallow” (3. Reference 18 - Luigina). Areti also applies primarily qualitative approaches, but she also tries to add something different: “within my research projects sometimes I have the flexibility to practice some that I wouldn't necessarily use in a commissioned process, so I have used diaries to understand how people live with their apps for a long period of time. One of my students is using a go-pro to have a first-hand recording of a visit with a mobile app; we did a project where we used recording glasses, so basically, we sent visitors into the galley using these glasses and after we showed them the video, they made to discuss their experience” (3. Reference 7 - Areti). According to her, it also important to allow people to express their opinion in a more familiar way outside the interview situation: “when we evaluated the web apps (i.e. the rock arts project) we did the shadowing in the field and the post-visit interviews, but also we did mind maps based on prompts from the interpretation and in fact that aspect of the evaluation gave us a lot of insights on something that interviews couldn't give us because we were looking on how people experience sense of place” (3. Reference 8 - Areti).

Generally, many interviewees consider observations to be an essential tool for a proper evaluation, such as Eva: “observations are the most important component of the evaluation” (3. Reference 12 - Eva); or Sophie: “observation I think was the most useful method of really seeing what people do in their own natural environment” (3. Reference 25 - Sophie). However, observations present some disadvantages, as highlighted by Laia: “observations, for example, when you don't have the possibility of video recording was a challenge because you have to record everything on the spot, you can’t have multiple researchers going through everything, so research suffers from that because it's less orthodox, it's less objective and someone would say it's not valid for research” (3. Reference 15 - Laia).

In terms of understanding the real impact of interactive digital technologies upon visitors, Maria raised a concern regarding the efficacy of evaluation approaches applied right after the experience: “the fact that they have to re muster the event after the experience to answer the questionnaire or to respond to an interview can also give you different data than what in fact they did experience, because they have forgotten and they are out of context when you ask the questions” (3. Reference 20 - Maria). According to her, the same issues also occurs in the long term: “the evaluations have not been very useful in showing us how these kinds of experiences impacted visitors in the long term and that means that you need to set up a kind of long-term evaluation, which is difficult to do when you have a virtual reality experience open to the broad public: they will come and have this experience for ten, maybe twenty minutes and then they will leave. It is very hard to set up a longer impact study based on ten-twenty minutes experience, you know. Results are not very conclusive I would say. I can say that everyone is always impressed of what they see, but I really don't know whether that impression has a lasting impact” (3. Reference 22 - Maria). The long-term impact of museum visits in terms of sense-making and learning is one key topic in the wider field of audience research studies (Hooper-Greenhill 2004), as well as in the digital cultural heritage sector (Damala et al. 2016). For example, the results of the second focus group I conducted with my colleagues, one year after their first interaction with the model, show that in the long term their experience with the 3D model has deeply affected their perception and relationship with the site (see Chapter 5, section 5.2). For this reason, when possible, long-term evaluations should be embedded in research projects related to interactive digital media and supported by cultural heritage institutions that are using these technologies (Davies and Heath 2013).

All the evaluation approaches discussed above are representative of the vast and variegated array of techniques from visitor studies and HCI fields. While interviewees pointed out their effectiveness, they also highlighted limitations in terms of fully grasping how interactive digital media shape people's encounters with the past. Such limitations have been the subject of debate within the heritage sector, as they are challenging and not easy to overcome. The reasons are various: for example, evaluation practices usually do not take into account the impact of emotions on the experience (Perry et al. 2017; Katifori et al. 2020); or they do not fully allow for reflexivity in users and need to be more context-specific and experience driven (Galani and Kidd 2019). As such, evaluation methodologies should allow participants to have more agency and use the evaluation to continue to make meaning of the experience. This process, though, requires an iterative approach to evaluation and longitudinal studies, in order to achieve a more meaningful analysis of digital heritage experiences.

6.4 Audience Response

Concerning the results of their studies, many interviewees agree on the fact that people still feel wonderous about these technologies, in the sense of being in awe of what they can do in terms of graphics, interactive interfaces and immersivity. Laia, for example, said: "you always keep having this wow effect, people are still amazed, you know, of the technology and what the technology allows" (4. Reference 11 - Laia). Maria also agreed on this notion: "this kind of technology, especially immersive virtual reality has always been very impressive and so, there is this novelty effect that really impacts the experience" (4. Reference 15 - Maria).

However, as pointed out by Eva, the novelty effect is not enough and it is important to provide a compelling narrative. In fact, when discussing the positive feedback the Virtual Heritage Lab of CNR ITABC received for their immersive installations, such as Etruscanning and the Virtual Museum of the Tiber Valley, she said: "surely the technology is cause for attraction, but that runs out very fast and at that moment comes into play the ability to hold the visitor, because if visitors find interesting contents, then they will stay. We have been working on this and we are noticing that it is worth it, because people spend 20-30 minutes interacting with our installations, which is a lot of time" (4. Reference 10 - Eva). Similarly, Sophie noticed that digital technologies often draw visitors' attention, but are not always able to keep it: "I was just doing some analysis of some data that I have got from another gallery and I just discovered that a

jigsaw that they have in the gallery people stopped at for an average of four minutes and a piece of digital technology they stopped at for an average of two minutes, and I found really fascinating that the piece of digital technology was drawing people in but it wasn't necessarily keeping them there in a way that the jigsaw really did" (4. Reference 17 - Sophie).

According to Areti, an important lesson she learned from her project within the Discovery Museum in Newcastle is that "when you put these installations, especially in a specific context, you almost need to curate the overall context to allow different engagements to happen so basically, the story, the narrative around the installation needs to cohere with the context" (4. Reference 4 - Areti). Interestingly, Areti's statement is related to one made by Sophie while discussing her negative experience with commissioned evaluations, where museum curators were not sure about what they wanted to do with the digital installation and the expected outcomes were not defined: "I think that sometimes people use digital media as a brain dump and then expect other people to be able to find what they want" (3. Reference 25 - Sophie). Both statements are emblematic of the tendency to consider digital installations as standalone features that do not need to be curated. On the contrary, interactive digital media must be seamlessly integrated within the exhibition in order to be effective.

In terms of audiences' reactions and engagements with interactive digital media, some of my interviewees highlighted how important is the design of the UI, as stressed by Erik: "they also want simple, clear things for navigation, because they get very confused by complex navigations" (4. Reference 6 - Erik). According to him, the way contents are presented also affects the experience and while discussing the results of his study on in-game Maya archaeological environments, he said: "another interesting thing is that if you tell people something is a game and not an archaeological simulation, then they will engage; if you tell them it is an archaeological simulation they value and respect the artefacts but then they don't engage, they get lost" (4. Reference 7 - Erik). In Erik's opinion, introducing a game environment with the more authoritative definition of archaeological simulation triggered a sense of deference akin to what people might experience in archaeological and heritage sites, thus discouraging users to interact with digital replicas as they were the original artefacts. Alfonsina also pointed out that: "the usability is fundamental to engage visitors: it doesn't have to be simple, but it has to be intuitive (4. Reference 1 - Alfonsina); "it is also important, especially with natural based

interaction, that the user's motricity is synchronized with the interface and there is no delay" (4. Reference 2 - Alfonsina). In her experience, in fact, whenever a gesture-based UI was not promptly responding to the visitor's movement it was cause for confusion and frustration, ultimately leading visitors to abandon the experience.

The important role assumed by technology is pointed out by Areti: "technologies bring with them assumptions of use, so for example with the website if you put out an experimental website - we are trying to work around some experimental interfaces for collections - one of the key facts is that people have very long standing and solely understanding of what a certain database is likely to look like, so they don't know what to do with them; so in a way the website is a technological tool that brings many socio-cultural assumptions which basically shape the experience and the expectations of the users" (4. Reference 5 - Areti). Similarly, according to Laia, visitors' responses rest on their understanding of the role of technology: "I guess that depends on people understanding that they are experiencing a digital heritage medium, that the experience is being mediated and so they will accept it and understand that it is not perfect, it is not a direct experience and they are going to accept to suspend this belief and just enjoy the experience and see what it can provide" (4. Reference 11 - Laia).

In discussing with my interviewees the unexpected results of their studies, several interesting topics emerged about the relationship between visitors and technology. For instance, Luigina highlighted how visitors value the narrative over the technological medium: "I find that a very effective question in interviews is: "If you were to tell your friends about the exhibition you saw today, what would you tell them?", and it is really interesting how people tell the story, because they mention the technology because they have used it, but it is never the main thing they mention. It is always part of the overall experience, which to me is a good sign in the sense that the technology is not the end, it is the story you tell around it" (4. Reference 13 - Luigina). Through her studies, Sophie noticed that "some of our audiences have more confidence than others and so some people are just happy to come and play around on a piece of technology without necessarily knowing where they are going, while some people are put off by the technology" (4. Reference 17 - Sophie). Similarly, Eva reported: "we noticed that, especially with natural gesture-based user interfaces, there is a correspondence between the response of adolescents and visitors over-60, and this might sound strange, but they are less inhibited with gestural UIs, while 20-40 years old visitors are more reluctant

and self-conscious" (4. Reference 9 - Eva). Interestingly, Alfonsina discussing the unexpected results of her research studies on immersive installations reported that "another thing I did not expect, but that now is emerging, is that being completely immersed in the technology doesn't help to focus on the content" (4. Reference 3 - Alfonsina) (i.e. the immersive components of the experience actually distracted visitors from the narrative).

According to some interviewees, differences in audiences' responses also depend on geographical provenance, as stated by Laia: "it also depends on the country. I have done evaluation both in the UK and in Catalonia, actually one of my studies was a comparison between the two countries, and audiences do have different expectations and different ideas of what a museum is. The visit modality also is different: in the UK, for example, people want to do things together and if they learn something is fine, it is another outcome, but it is really about being together and being amazed and doing things. While here (Spain) visits are more formal and even if people come as a family they will split. So here museums, as in Greece, are more associated with formal learning environments, while in the UK it is completely different and it is why also perceptions of the technology are different" (4. Reference 12 - Laia). The fact that such divergent approaches to museum visits by people from different geographic areas might in some cases lead to a sort of reluctance in using and interacting with new technologies, affecting de facto their experiences, is reflected in Alfonsina's research: "what emerged, for example, from one of our studies is the sense of embarrassment especially with immersive and quadrangular applications where visitors can sit like in a movie theatre (i.e. immersive installations where one person stands in the interactive area in front of the screens and the other visitors sit behind it): visitors who come with family and friends don't want to use the interaction in front of them and being the center of attention. This happens in the Mediterranean area, while in north Europe is completely different and visitors shamelessly throw themselves at it!" (4. Reference 1 - Alfonsina). In other words, according to Alfonsina's experience some visitors, particularly from Mediterranean countries, do not feel comfortable using immersive installations in front of others, maybe because they feel it is not proper to have a more playful attitude towards museum experiences.

What emerges from these interviews is particularly relevant to the results of my own study (see Chapter 5) and relates to the existing literature, confirming that the

technology has an important role in digitally mediated experiences and it needs to be clear and intuitive to positively affect users' responses, otherwise it may be counterproductive and discourage them (Sengers et al. 2006; Quanjer 2013; Opitz and Johnson 2016). Interviewees' studies also demonstrate that when investigating users' responses to interactive digital media, various factors need to be taken into account, as the way in which people approach these media is influenced by their personality and cultural background, which I unfortunately did not take into account when developing my UI.

6.5 Best Practices, Participatory Process and Storytelling

Lastly, I discussed with interviewees what they learned during their studies, such as best practices and practical guidelines for devising and carrying out audience research studies. What occurred more frequently in terms of best practices is obviously the importance of the evaluation process. Laia, for example, whilst listing the most valuable thing she learned through her work, said: "second thing, and this also comes from the human-computer interaction field, is to evaluate always, because up to now there is a really small percentage of projects that do it" (5. Reference 15 - Laia). Similarly, Sophie suggested to "do user testing as much as possible, I think that definitely is something that we need to look at as much as possible, having really clear objectives and do observations before you even design your own thing" (5. Reference 23 - Sophie). These statements underline a persistent issue within the digital heritage sector: the fact that a wide percentage of projects and applications are not subject to a proper evaluation or do not go through a further design iteration informed by the evaluation's results. The reasons for such neglect of, in particular, changes or improvements are various: sometimes after the evaluation there is no more funding available to cover the cost for another design iteration or the developers are not willing to revise their products. In some cases, these applications are monitored and tested only in controlled environments, e.g. digital labs, without having been evaluated with end users in other settings. Even when conducted in situ, taking into account for example the natural environment of exhibitions, evaluation studies can fail if clear objectives for the experience, and consequently the parameters against which to evaluate it, have not been set (Graf et al. 2013). Evaluating the use and perception of interactive digital media is a complex task that needs to be conducted in a range of settings and focused on users' needs and interests in order to be successful.

Some interviewees also emphasized the value of a participatory process, as stressed by Laia “it is also very important to create a participatory process, take end users into account and have them design things with you, evaluate, then refine” (5. Reference 15 - Laia). According to her, in fact, “technologies could bring this, being less formal and more experiential, they could really bring this more multi-sensory and participative dimension, where people can contribute and bring their opinions, experiences and perceptions” (5. Reference 14 - Laia). Alfonsina also highlighted the importance of a participatory process: “it is important to include in the design process people in charge of the evaluation and run pilot tests before the product release” (5. Reference 1 - Alfonsina). Luigina as well, talking about the methodological approach she applies to her projects said: “the way I work has always to do with understanding end users, institutions’ stakeholders, so it is always designed with a very long process behind. At the beginning, we never start knowing what technology is going to be. There is always a process of design and that process most of the time is participatory, so it is the museums, the heritage professionals, the visitors who have a role in shaping that and we show them options: they have an idea about what the interaction should be like and we show them what they can use to achieve that" (5. Reference 16 - Luigina).

Several interviewees also stressed the need to move past the notion of interactive digital media as means to deliver mere information, as it can be overwhelming for visitors: “what I think...is really important and valuable is that people should be able to respond, to speak back, because you give them so much content and you have these additional things that give you even more content and I just find that they are overwhelmed with it” (5. Reference 16 - Luigina). My interviewees advocated, instead, moving towards even more engaging experiences, as stated by Laia: “I really hope that we will be able to develop more multi-sensory group-shared experiences” (5. Reference 15 - Laia). Similarly, Maria while discussing her recent work within the EMOTIVE project, said: “what we feel missing is this deeper connection to the visualised content, to the visualised cultural content, which is this emotive engagement, so what I previously coined as a "longer lasting impact" or "deeper meaning", that is what we are trying to add into our work, so trying to add a type of storytelling that really engages the visitor” (5. Reference 21 - Maria).

Regarding storytelling, Eva raised some concerns about how it is currently conceived and applied: “everybody is talking about storytelling and its importance, but if we

investigate who is actually exploring its potentialities, we realise that very few changes and improvements have been made. I am convinced that there is much more development in the research related to visualisation than in the research focus on narratives" (5. Reference 10 - Eva). Instead, what she learned from her studies is that: "storytelling in museums is essential and its creation represents a real challenge, trying to put together rules coming from virtual reality, but also from cinema and theatre" (5. Reference 13 - Eva). Creating a compelling narrative is, in fact, a complex and multifaceted process that requires interdisciplinarity and a participatory approach, involving authors with different background and skills (Danks et al. 2007; Johnsson 2006; Lombardo and Damiano 2012; Vayanou et al. 2014).

As for my own study, results from the first iteration indicate how the experience I developed could have benefited from a narrative to engage users, as some participants in my survey complained about the lack of a story to accompany the exploration and being overwhelmed by jargon-ridden text descriptions.

6.6 Summary

Data gathered through these interviews cover an interesting range of topics. The data analysis has been particularly relevant for my research project, since some of the themes are closely related to the results of the first iteration of my study with different audiences, such as persistent misconceptions amongst some practitioners regarding audience's needs and expectations (see Chapter 5).

The first and probably the most anticipated topic is the need for an evaluation framework that also includes user testing and the subsequent refinement of the experience. The paramount importance of evaluation has been stressed by several interviewees whose research studies prove that some elements considered essential for providing visitors with engaging digitally mediated experiences were in fact unnecessary or counterproductive, such as photorealism or perfect rendering. Even in regard to immersivity, some of the interviewees' evaluations have demonstrated that being completely immersed in the technology actually distracts visitors from the narrative and content provided.

The role of technology and its impact upon visitors' experiences recurred frequently in my discussions with these experts. Several interviewees, in fact, highlighted the

important position assumed by technology. According to Alfonsina, for example, “it helps people to bridge the gap between imagination and comprehension” (5. Reference 3 - Alfonsina). However, my interviewees also stressed that the awe produced by the technology is no longer enough to retain visitors’ interest and attention and, consequently, we as practitioners need to think more in terms of experience and create compelling narratives that can deeply engage visitors. The majority of interviewees emphasized the value of storytelling and curated contents: according to them, the technology, while playing an important role in shaping the overall experience, it is not the end of it and what really matters, what visitors would engage with and remember, is the story around it.

Worthy of notice in terms of audience response, is the notion that arose from some interviewees that visitors’ experiences and interactions with interactive digital media are to some extent affected by their geographical origin. According to a study conducted by Laia, in fact, museum visits in the Mediterranean area are more conventional as museums are considered more formal learning environments and that has an impact on visitors’ perceptions of and attitudes toward technologies. Particularly interesting it is also what emerged from both Eva’s and Alfonsina’s research regarding the unique relationship that occurs between each visitor and the medium they interact with, especially with respect to natural user interfaces. These interfaces can be deeply influenced not only by users’ personalities and attitudes, but also by their body and spatial awareness, as the same gesture can be made in different ways by different people. Eva, in fact, said: “with the interaction based on the body there are thousands of implications, because it’s a 360 degrees experience that includes different factors, from the familiarity with the technology to the perception of one’s own body” (4. Reference 9 - Eva).

Finally, regarding best practice it is important to mention that several interviewees pointed out the significance of the PD of interactive digital media, where users are integrated in the creation process as peer co-creators. They highlighted, in fact, how important it is to take visitors’ opinions into account and enable them to have an active role in creating experiences that are tailored to their needs and expectations. In relation to my own research, the results presented in Chapter 5, in fact, indicate users’ clear expectations on how interactive visualisation of archaeological sites should be.

Conducting these interviews with more experienced practitioners was very useful as it engendered an even more critical reflection on my own work and the common challenges we face when it comes to grasping the complexities of the role of digital technology in heritage experiences. Moreover, it allowed me to have a personal dialogue to discuss in-depth topics covered in their research outputs and publications. Rather than just focusing on the implementation of my interactive 3D models then, I decided it was even more worthwhile investigating how digitally mediated experiences in our discipline are actually developed and how to improve their design from the outset by adopting collaborative practices. As such, I decided to conduct the second iteration of my research process according to the principles and methods of PD and co-design practices (Muller and Druin 2002; Sanders and Stappers 2008; Simonsen and Robertson 2012; Bratteteig and Wagner 2014; Malinverni et al. 2016).

In the following chapter (Chapter 7), I will present the results of the second iteration of my research project, carried out in the form of two workshops on the co-design of digital experiences in archaeology and heritage sectors. These workshops aimed to test the benefits of design strategies and tools coming from the PD field for archaeology and devise a digital resource work pipeline that involves end users and stakeholders from the outset. By work pipeline, I mean the overall process from ideation to UXD, prototyping and evaluation of archaeological digital outputs.

7 Participatory Design Workshops: Evaluation of Co-design Processes and Resources

In Chapter 5, I have presented the results of the first iteration of my research, focused on evaluating the impact that interactive 3D models of archaeological sites have upon archaeological research, and academic and public dissemination. The results show that users have clear and specific expectations when they interact with this kind of technology and are willing to give their opinion about how interactive visualisation of archaeological sites should operate. Such results are closely related to the themes that emerged from my interviews with digital heritage practitioners and museum curators, discussed in Chapter 6, highlighting how important it is to take visitors' opinions into account and to enable them to take an active role in creating experiences that are tailored to their needs and expectations.

Insights gained from my first evaluation led to the adoption of a co-design approach for the second iteration of my research, by means of practical hands-on workshops, a one-day pilot session and a two-days event hosted at the University of York Archaeology Department in February and April 2019, respectively. Through these events I gathered qualitative data (observations, opened ended questionnaires and focus groups) on the use of PD practices for UXD in archaeology and heritage.. The scope of these workshops was to provide practical experiences on how to integrate archaeological data, storytelling and digital platforms to encourage professional and wider public engagement with the past. Moreover, they were meant to foster reflections on the importance of users' experience assessments and iterative design, as well as the fundamental role played by the multisensory, interactive and emotional components of the experience in encouraging cultural engagement with the past (sections 7.1 and 7.2).

In this chapter I present a detailed description of both events, and discuss results and lessons learned (for details on the theoretical framework, the rationale behind these workshops, how they were structured and the evaluation strategy I adopted see Chapter 4, section 4.3). Data collected have been used to promote my own critical reflection on how the UXD process is adopted and incorporated into the archaeological practice. Moreover, by discussing lessons learned through a series of hands-on group activities, the experience of these events allows me to articulate practical guidelines for devising a

co-design methodology for the interdisciplinary creation of digital experiences for the cultural heritage sector, that will be presented in Chapter 8 (Fig. 7.1).

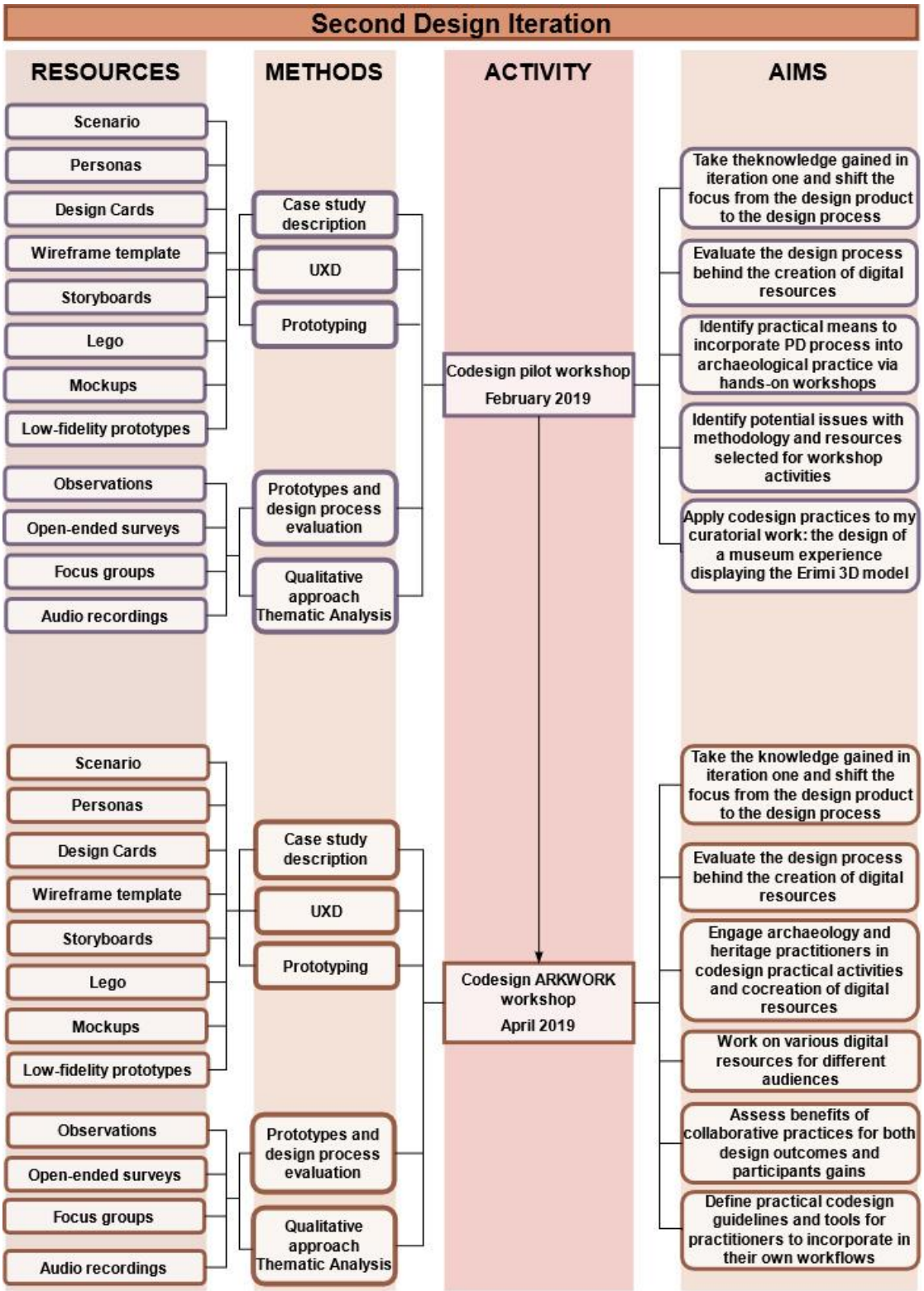


Figure 7.1: Co-design workshops diagram. From the left each column illustrates: resources (techniques, software, design tools) used, methods adopted, the timeline and the specific aims of each activity (credit: Francesca Dolcetti).

7.1 Pilot Workshop

This workshop was run to test the methodology and resources I designed for the main event scheduled for April. Eight participants attended this workshop: one senior lecturer, four PhD students, two Master students from the University of York (Archaeology department) and one lecturer from University of Glasgow (Archaeology department). I aimed to select contributors experts in UXD and PD practices in order to ensure that any potential issue with structure, design methods and tools was detected. This pilot workshop was run as a one-day event with two groups working on the same case study according to the following timetable (Table 7.1):

Table 7.1: Pilot workshop activities structure

case study description	60 minutes
UX Design	60 minutes
prototyping	135 minutes
evaluation	105 minutes

I chose this structure because it seemed to allocate enough time for each activity, based also on the examples provided by the meSch project Co-design Booklet, a resource for cultural heritage professionals to co-create their own interactive exhibits using co-design methods and technique (McDermott et al. 2014).

At the beginning of the workshop, I offered an introduction to my larger research aims: the data gathering techniques, i.e. observations, questionnaires for the evaluation of prototypes and audio recordings of the focus group discussion on participants' perception of the event; the future use of such data which would come to inform my PhD. Ethic forms were signed by all attendees (see Appendix E). Then I explained the goals of the event, described the methodology and presented the case study, outlined below. All information and available materials on the case study (including pictures, plans and weblinks), along with design resources, were pre-circulated to participants a week before the workshop, to give them enough time to familiarise themselves with the project. Once the UXD activity began, I was free to move around, observing and taking notes about the development of the session. I made myself available to facilitate the activities, but both groups carried out their tasks without requiring any assistance, so I

mainly intervened in the process by providing additional information on the case study where it seemed appropriate and by controlling time.

7.1.1 Case Study Description

For the pilot workshop, I used as a case study a project I have been working on alongside my PhD research: the exhibition "Cipro. Crocevia delle Civiltà" that will be held at the Royal Museums in Turin from January 2021. As described in Chapter 1 (section 1.2.2), my role in this exhibition has been as content curator and project manager. The exhibition's aim is to present the history and art of Cyprus across millennia and its paradigmatic role within cultural exchanges in the Mediterranean. Historically, the city of Turin has actively contributed to acknowledge the important role of Cyprus, as witnessed by the archaeological interest of the city, as well as by its many collections of Cypriote antiquities from the late 19th century until now. From this perspective, Cyprus plays a fundamental role in the history of reception, mediation and diffusion of many important aspects of Mediterranean culture, as an ideal and geographical trait d'union bridging the gap between East and West. When launched, the Turin exhibition will present the history of Cyprus through its culture and art, by focusing on its capacity to turn from a geographical port into a cultural bridge in the Mediterranean. Specifically, my project is focused on one of the thematic sections of the exhibition: "TH 7.7 - Turin in Cyprus. From fieldwork to virtual reconstruction: 3D models and immersive experiences". This section is meant to provide visitors with an immersive visit to the Bronze Age site of Erimi, according to the following objectives defined in the brief supplied to me by the museum curators and the director of the Erimi Archaeological Project (Cyprus):

- increase museum access and enhance perception of and engagement with ancient material culture;
- democratise museum curatorial practices and facilitate audience participation in museums;
- investigate how experiencing ancient artefacts through such media affects visitors' perception and interpretation of past material culture.

In order to achieve these objectives, and since both the museum curators and the director of the Erimi Archaeological Project wanted to include in the gallery space 3D prints of Cypriote artefacts and the interactive 3D model of Erimi I built for the first iteration of my research project, I suggested to use a variety of both traditional and

digital display/interpretation techniques to engage and challenge the visitor. These will include:

- a display case with a selection of three prestige/symbolic artefacts from Erimi to provide visitors with traditional visual observation of original objects;
- 3D printed replicas of the same artefacts to provide visitors with a tactile, embodied experience with the objects;
- touchscreen with the Erimi 3D model to provide visitors with a multi-sensorial and engaging experience of the site. This will include information about the site, the life of the community and the objects on display within the gallery space;
- interactive tablets to allow visitors to contextualise and engage with the objects, replicas and interpretation present in the gallery space.

The three artefacts selected from the Erimi assemblage have been interpreted as particularly relevant to and embedded with symbolic value for the Erimi community. They are related to textile activities which were pivotal to the local economy and performed by a large number of the community members. The artefacts include:

1. A goat-shaped askos: special containers shaped as animals or birds are typical of the pottery production on the south coast of Cyprus, in the Bronze Age. Unlike this one, they are usually found in burials and possibly had a ritual function. Erimi was an agro-pastoral community which strongly relied on goats and sheep for dairy products and wool. For this reason, the shape of this vessel seems to have a symbolic meaning (Fig 7.2).
2. A decorated spindle-whorl: spindle whorls, as one of the key elements for textile production, have both functional and symbolic value. Moreover, this particular whorl is biconical with incised decoration, a type that at Erimi is usually found in funerary contexts. In fact, used spindle whorls with the most complex decorations were often buried in tombs as grave goods, probably because of their symbolic value as tools used in the production of the community's main resource. Spindle whorls were often deposited near the individual, perhaps to identify the person as someone who was socially recognised as a spinner or belonging to a specific family group (Fig. 7.3).
3. A comb-shaped pendant: this object is a personal ornament made in Picrolite, a soft variety of serpentine used as decorative stone. Comb motifs and comb-shaped representations are typical of Bronze Age Cypriot art. Different interpretations have been made about this type of pendant: the most convincing

are the ones that identify these objects as models of combs for carding wool or of beaters used in tapestry weaving. Considering the importance of textile manufacture at Erimi, a pendant representing a miniature of a comb for carding wool was probably worn as a symbol of community identity (Fig. 7.4).

Figure 7.2: Objects from Erimi-*Laonin tou Porakou* selected for the exhibition. Goat-shaped askos (credit: Francesca Dolcetti).

Figure 7.3: Objects from Erimi-*Laonin tou Porakou* selected for the exhibition. Decorated spindle whorl (credit: Francesca Dolcetti).

Figure 7.4: Objects from Erimi-*Laonin tou Porakou* selected for the exhibition. Comb-shaped Picrolite pendant (credit: Francesca Dolcetti).

According to one of the interpretations made regarding the abandonment of the settlement, these artefacts, along with other common use objects and working tools found in the workshop complex, were left behind on purpose as part of a ritual practice involving the burning of significant structures. Archaeological evidence seems to suggest that before leaving the settlement, the Erimi community performed commemorative and ritual practices: they selected objects with symbolic value to leave behind in the workshop; then, they set some buildings of the workshop on fire to physically and symbolically 'seal off' a place that was an integral part of the community identity. Such an interpretation is supported by field analysis and spectroscopic analysis conducted on mudbricks, wall plasters and roofing materials. All these materials show the impacts of fire including discoloration and vitrification. Moreover, experimental analysis and forensic fire investigations demonstrated that mud-brick structures are difficult to ignite without accelerants and additional fuel (Amadio 2017). In addition, stratigraphic analysis revealed the presence of a rich assemblage of both symbolic and common-use objects and working tools on the latest occupation floor of many buildings of the workshop complex (Bombardieri 2017; Amadio and Bombardieri 2019).

As for the intended audience, the brief given to me only identified museum visitors, in general, and groups of primary and secondary school students with scheduled visits focused on activities to be conducted in section TH7. Unfortunately, when I asked for more information the museum curators could not provide details on their average audiences as they do not often conduct visitors studies. The vagueness and lack of clarity about the intended audience of this museum experience, was one of the main issues of the brief, alongside the fact that my interactive 3D model was included as an exhibit even though it had not been designed for that purpose. Regrettably, I was not able to fully address these issues as many decisions regarding the exhibition had already been made before I was consulted and assigned the job (see also Chapter 8, section 8.2.1 and Chapter 9, section 9.2). As a result, the brief for the exhibition had not been informed beforehand by a more participative, and in my opinion more useful, decision making process. For this reason, I decided to use the brief as it was given to me for the pilot workshop, in the hope that the design of the museum experience could then benefit from ideas and suggestions generated by collaborative design practices.

7.1.2 UX Design/Prototyping

I decided to provide participants in my pilot test only with a loose indication of design possibilities, allowing them creative freedom as long as the designed experience matched the brief. The only constraints I gave to them were to consider the physical space where the digitally mediated experience takes place and take into account visitors' fatigue, as section TH7 is the last room of the exhibition path (Fig. 7.5).

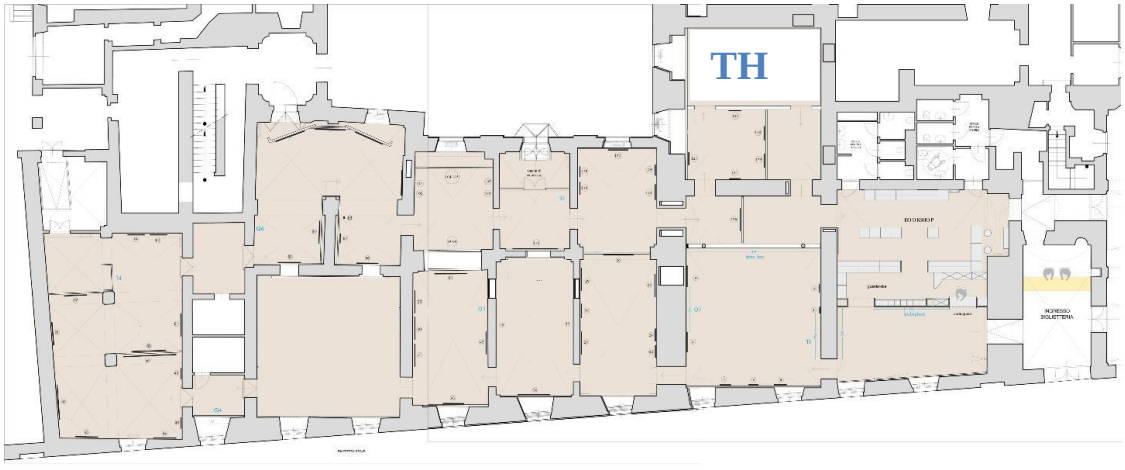


Figure 7.5: Royal Museums floor plan (image credit: Musei Reali di Torino).

Along with design cards, storyboards, wireframe templates and building blocks, participants were provided with A1 white papers, sticky notes, markers, pens and

pencils, rubbers, scissors, glue and tape. After being given these tools, both groups first started defining the experience. In terms of design, while conceptualising different visitors' experiences, both groups as per my instructions embedded their digital designs into a broader UXD framework that also considered physical components, such as lights, pathways and division of spaces. Group 1 decided to focus on a design whose main aim was to encourage visitors to reflect on the stories and lives of the objects they might have seen in previous sections of the exhibition, by offering them a journey into the site guided by three interactive characters, or influencers, representative of the Erimi community: a comber, a spinner and a dyer. Group 1 aimed to deliver their design starting with the touchscreen with the Erimi interactive 3D model, then by tablet: specifically, three tablets, each providing a textile-related task (combing, spinning and dying) that visitors would be asked to complete to be able to access a secret room where they would be revealed the secrets of the dying process as it was supposedly carried out at Erimi. In contrast, Group 2 opted for a design fostering visitors' reflections on how someone from the future would know their lives from what they leave behind, by presenting how archaeologists at Erimi have interpreted evidence and objects, thus shaping stories about the Erimi community. They decided to deliver their design starting with tablets and 3D replicas of the Erimi artefacts to introduce information on the objects in their own time, moving to the touchscreen to present the objects within the excavation and ending with another set of the same replicas for visitors to take a photograph, and leave behind their comments and reflections of the meaning of certain objects in their own life to be displayed on a screen.

Then, both groups went on to prototyping their UX for which they adopted a different approach. Group 1 decided to use Lego-like building blocks to visualise room layout and visitors' pathways, including sofas for visitors to rest and a mural with a bird-eye view of the site. Group 2 provided sketches of the visitors' pathway, guided by different lighting and instructions for media interaction such as 'turn me', and a digital mock-up of the tablet UI (Figs 7.6; 7.7).

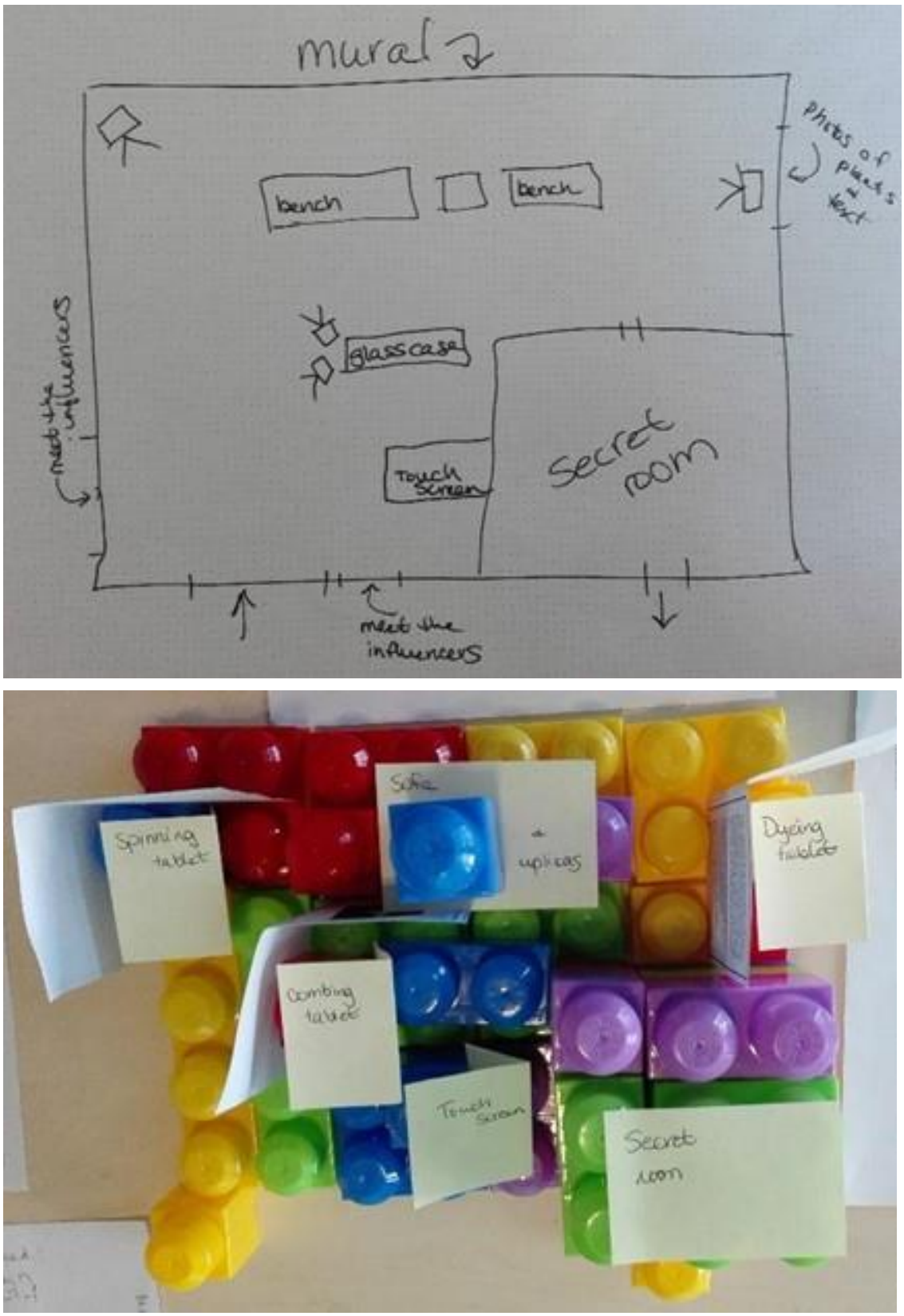


Figure 7.6: Images from pilot workshop. Group 1 design (top) and building blocks prototype (bottom) (credit: Francesca Dolcetti).

Figure 7.7: Images from pilot workshop. Group 2 design (top) and prototype (bottom) (credit: Francesca Dolcetti).

In terms of project objectives, both designs matched the brief by providing interactive experiences that aimed to engage visitors in reflecting on the objects' stories, their significance and value for the Erimi community, while also incorporating all the digital components into a defined pathway.

7.1.3 Evaluation

As outlined in Chapter 4, the evaluation strategy for this workshop consisted of my observations and notes taken during the event, open-ended questionnaires and a focus group to evaluate both the design outputs (UX prototypes) and the PD process itself (for details on data collection and analysis see Chapter 4, sections 4.3.2 and 4.4; for detailed descriptions of themes see also Appendix E). Below I present my personal observations taken during the pilot workshop, then the discussion of results from questionnaires and the focus group.

7.1.3.1 Observations

Participants committed to the event with enthusiasm and engaged in all activities without difficulties or disruptions. This is not surprising, considering that they were precisely asked to join the pilot as a result of their interest and previous experience in UXD and PD approaches. Both groups struggled with the time allocated to each activity: for example, they needed more time for the UXD phase, which took 90 minutes instead of 60 to be completed. As a result, to have enough time for the prototyping phase, participants decided to work through most of their lunch break. This decision inevitably caused an increase in participants' fatigue towards the end of the day, however it ensured that no time had to be eliminated from the evaluation phase.

The intra-group dynamics were really positive in both groups: all participants actively contributed according to their skills and personality in a democratic way. Each participant seemingly had equal opportunity to voice their opinions, and the decision-making process was, from my observations, always collaborative. In the case of Group 1, participants worked together throughout all phases, while Group 2 conducted the prototyping activity separately, with team members working simultaneously on different tasks. In general, all participants seemed to enjoy working together and the event overall. Both groups explored and commented on the prototypes with evident interest and enjoyment during the evaluation section of the workshop.

7.2.3.2 UX Prototypes

For the evaluation of UX prototypes, I allocated ten minutes for each group to present the experience they designed. After that, each group had 15 minutes to explore the other group's prototype and fill in a questionnaire, answering four open-ended questions. Questionnaire responses were then discussed in detail during the second part of the focus group, as participants pointed out the benefit of collectively reviewing and offering feedback on prototypes. Questionnaires and focus group data were coded into the following themes:

1. Design
2. Audience
3. Role of expertise

In general, participants liked both experiences. With regards to Group 1, some elements of their design were particularly appreciated by the Group 2 evaluators, like the integration of sofas and the mural with a bird-eye view of the site: "I liked that the experience starts outside of space with texts on walls; the goat footprint for navigation; people guides in interactive (avatars); the room as an excavation site; the sofa!" (1. Group 1 - Reference 5). Such sentiments were confirmed in the focus group discussion: per Claire, "I really liked that idea of the mural wall and the sofas, because I am such a lazy person in museums. I thought even if did nothing else but coming in and sit in the space and spend some time there you had an interaction" (1. Reference 1 - Claire). In Group 2's design, Group 1 evaluators liked the idea of giving visitors the possibility to leave their immediate feedback: "I liked the object focus and the opportunity to leave things behind" (1. Group 2 - Reference 3). Moreover, the visitors' pathways were particularly appreciated: "I really liked the lighting and the idea of the path, having the pathways change between rooms and I also liked that each room had a guiding question or a theme like 'turn me, pose me' and all that and I think that is one of the ways that you mitigate against things like 'how are they going to know that they need to turn out the light?' Well if you get in and the only thing you see is a sign that says, 'turn me', presumably they are going to say 'ok, I will do it. There must be something else in this dark room'. So, I thought that was quite nice and simple too" (1. Reference 7 - Sara). Both formats were also considered compelling: "the use of digital things really enhanced the exhibit and was quite integral to the experience" (2. Group 2 - Reference 3). Another said, "I loved the excavation room. There is more opportunity here for archaeology-themed interactions. The games which center on the artefacts are a unique way to teach about how they're used" (2. Group 1 - Reference 3).

In terms of audience, and specifically the experiences' main takeaways, most of participants' answers focused on objects' stories and lives, matching at least in part the intended visitors' takeaways as defined by both groups: per Group 1, "visitors will learn about the context of the artefacts within the social context of the time and interact with each other while doing so" (2. Group 1 - Reference 4); or per Group 2, "objects have lives and they do different things at different points-perhaps not functionally but certainly thematically" (2. Group 2 - Reference 2). Moreover, participants' answers suggest that both prototypes matched their expectations for the experiences: as described about Group 2's experience, "I expected quite a lot of interactivity and yes, the prototype matched this expectation (2. Group 2 - Reference 4); and for Group 1, "Yes. The prototype gave an impressive broad overview of the experience" (2. Group 1 - Reference 8).

As for the intended audience, Group 1's experience was considered more geared to a young audience: "I think that works well for multiple audiences, because I felt that a lot of the more interactive stuff in your pitch was more geared towards kids, so in my head the parents would all go to sit on the sofas and the kids would be going around playing with the interactive things and it would be just a space for everyone" (2. Reference 1 - Rachel). However, some participants considered the overall experience not informative enough: "I felt whereas ours was reasonably structured, I felt yours was a lot more free flowing, a bit more open. I had the impression that there wasn't an expectation that you needed to see everything in there and that was a really good thing. But there is also a flip side to that that a lot of the information you came across in the room is kind of predicated on some understating of what has gone previously, so it is sort of ensuring that people have taken enough knowledge to move into the other space" (2. Reference 1 - Patrick). Contrarily, Group 2's experience was considered potentially overwhelming for the amount of information provided: " I probably would have been put off by the amount of text there was on the tablet and maybe it is because I don't like museums that have a lot of text, especially specialist-oriented text, and as I was going through it, I was wondering what it is the main takeaway that yours was meant to have and I know that in your description it was kind of stated, but even afterwards I was like, 'is it so I come out of things feeling like I have seen an object from multiple dimensions?'" (2. Reference 9 - Sara).

These comments led to an interesting discussion and collective reflection on different audiences' needs and the role of experts in the design process, started by Harald: "I think for me the fact that this is the last room of the exhibition weighed quite heavily on the back of my mind on what I thought the spaces should be like and I guess for me thinking about the space at the end was like: "we need a couch! And we need something that is kind of lighter in a way", so for me I went there quite quickly and maybe comparing with yours [referring to Group 2 prototype] I feel like archaeologists will like it better and feel like their work is properly represented and taken seriously and communicated, whereas they might not like ours. If you think about the audience ours is, in a way, designed for and the audience yours is designed for, is probably different" (2. Reference 3 - Harald). Similarly, Cloe said: "We didn't want people to leave the museum like "Oh, that was just more cases of artefacts" (2. Reference 6 - Cloe). Sara shared a similar opinion: "in some ways ours maybe doesn't actually match the brief of what you wanted for that room, in another way we were thinking 'would you really want to hear a massive story about a site after you had to go through six rooms with a bunch of traditional artefact displays'. So, I think we were more driven by a more playful aim" (2. Reference 5 - Sara).

To that matter, Rachel replied that, as an archaeologist, during the design process she "felt an obligation of communicating a certain amount of information about the site, like what are the main points in the story, what this tells us about competition and the emergence of social complexity and here is the big picture plus some bits of material culture". So, for her, the visitors' experience "wouldn't have succeeded if someone had left without some information about the site itself and I don't know if you conceived yours as needing to do that or if you didn't think that was part of the purpose of what you were designing" (3. Reference 2 - Rachel). According to Sara, the reason behind Group 1's design choices was that they "were thinking what would make people want to go into this room after having gone through all the other rooms and that is where we were like 'ok, here we are going to add some flesh on to'. So, I don't know if we told an honest story about the site itself, in which case I think the archaeologists would be very disappointed in us!" (3. Reference 3 - Sara). According to Rachel, their design stemmed from self-reflection on how the archaeological interpretation process works and was meant to encourage visitors to make their own narratives: "I think we wanted you to understand a little bit about the objects and the site and the importance of archaeology on those stories. It was conceived in a way like all objects tell a story, but archaeology

and archaeologists help shape those stories" (3. Reference 5 - Rachel). Similarly, Patrick said: "It was really kind of a reflective end. I think one of the interesting things is also that you are given a lot of information by archaeologists, but our reinforcement would be this is our interpretation. In the excavation room we are saying this is the evidence we have based it off, but this is merely our opinion. But I think that one of the interesting things for visitors in museums is that they can have an opinion too and saying that "This is merely what we think based on the evidence, but here is the evidence, what do you think about it?" (3. Reference 6 - Patrick).

7.1.3.3 PD Process

To collect participants' feedback on the PD process, I decided to structure the focus group discussion around their general impressions and opinion of the co-creation approach and methods adopted for the pilot workshop, as well as what they gained both professionally and personally from their participation in the co-design activities. When requested, participants were anonymised and assigned pseudonyms. Their comments on the PD process were coded into the following themes:

1. Strengths
2. Issues
3. Perceived benefits

Generally, participants expressed their positive reception of the experience. In fact, they considered the PD approach to be useful and worthwhile: "I think it is important to come from the experience point of view, which means everything in the user experiences not just the technology, because sometimes you find that that takes the focus immediately. So, for me this process is about taking that holistic experience" (1. Reference 2 - Claire). According to Patrick, it gave him a new outlook on UXD: "I have to say I found it really useful. We had conversations together (referring to our previous meeting regarding the exhibition) where we tried to process all this information and pull out a few strands and when it's just two people you end up going around the same things, but having other people involved in those conversations...I mean, the lighting thing that came over (referring to the prototype developed by Group 2) was brilliant. I would have never thought of that" (1. Reference 1 - Patrick). Some participants also appreciated that even though this was "specifically meant to be an event about digital design, or design with digital media, but then you build in a very strong mandate to also think about the non-digital parts of the user experience and so this made think on how do you embed your digital design in a broader experience design that has digital and

non-digital components" (1. Reference 6 - Rachel). Similarly, Sara said: "I like the fact that it is not just a digital experience and that you are forced to think about everything else. Because coming into this morning I thought we were just going to build a mobile app, but it was much more in the way we did this, and I found it much more meaningful" (1. Reference 7 - Sara).

According to some participants, the museum plan and building blocks were crucial in promoting reflection on the physicality of the experience, as stated by Rachel: "I think that what pushed us in that direction is that you gave us the plane of the space and that we all had to think to the physicality of the space in which the digital media were going to be used and where they were going be and that I think really helped us to bridge that gap" (1. Reference 8 - Rachel); and Kristen: "That's a great point because I don't think we necessarily would have thought it in that way if we didn't have the site plan" (1. Reference 9 - Kristen). Likewise, Harald said: "I think the blocks did it for us as well. We talked a little about this and when we were sketching stuff out on paper we thought 'oh we have all the space', but then we tried to translate that into blocks, we thought 'Oh, it's going to be really crowded in here!'. So that changed our we approach, our core design, automatically and even towards the end thinking about how is this space compared to the room and thinking about our bodies in the space, that felt useful as well, where having dimensions that could actually be mapped out in the space you were in so you have the sense of how big it is compared to elements" (1. Reference 10 - Harald).

As for issues, Sara pointed out the need for allocated time within the workshop's structure to collectively discuss feedback on prototypes: "I would have liked to have an actual debrief after the experiences after filling out the questionnaire. I feel unsatisfied because I want to do more. I think there needs to be a question about the audience because, you guys maybe don't know what audience we were pitching at and we don't know yours either" (2. Reference 2 - Sara). The same feeling was expressed by Harald: "I think it would have been nice to hear the kind of feedback you guys were writing down and conversely, I don't know if you are curious of what we thought about yours. We presented this thing that we partially love and partially think it is ridiculous, but I am genuinely curious" (2. Reference 3 - Harald). As mentioned above, since all participants agreed with them, the second part of the focus group was then dedicated to the collective discussion of the prototypes.

Finally, as regards perceived benefits, participants appreciated potential applications and transferability of the adopted approach to other projects, as stated by Sara: “it’s these little things where you are like: ‘Ok I can use that in a different scenario’, which I probably wouldn't have thought about in any other case” (3. Reference 2 - Sara); or Kristen: “that has definitely changed how I think about museum displays and also, I think I can incorporate this kind of thinking into the design of my own work” (3. Reference 3 - Kristen). Interestingly, Rachel also mentioned the usefulness of the process “in terms of building your own professional network doing a design focused workshop like this is really a great way to see who your natural collaborator might be” (3. Reference 4 - Rachel). Similarly, Sara said: “it’s about recognising the things that work and don't work with other people and also being able to recognise people's skill set. I think that there is something nice that comes out of that, where they are creative thinkers, or they are good at writing texts or they have wild wacky ideas. I think there is a lot of benefit to that and appreciation of other people's skills” (3. Reference 5 - Sara)

In general, the focus group discussion was meaningful in terms of reflecting on the role of archaeologists and cultural heritage practitioners in the design process and how to address audience needs. Also, discussing feedback gave participants the possibility to gain insights on the actual audience response to their designs: “I think it's very helpful to have gone through that and it is interesting to get your thoughts on what we did and also your thoughts on what you thought we said but we didn't say. That is very worthwhile” (1. Reference 12 - Sara).

Regarding the PD methodology, my observations combined with the focus group discussion highlighted various issues that needed to be addressed to improve the workshop structure. In particular, the following aspects needed to be revised for the April event:

- project brief, by adding a more detailed information on target audience, aims and main takeaway;
- time allocated to each activity, by adding more time for the prototyping phase;
- evaluation strategy, by adding a question regarding the audience of the experience in the questionnaire (who the audience is, and did the experience properly address that audience's needs); a mid-point evaluation after the first day; a group discussion of the comments on prototypes provided on the questionnaire.

In terms of my personal reflections on the event, being able to observe the creative process unfolding around me was fascinating and enlightening. In particular, seeing how people unfamiliar with the case study site constructed very powerful and evocative narratives about it gave me insights on the meaning-making process of specialists outside the Erimi research team. It made me reflect on how other practitioners make sense of evidence we collected and our interpretations to construct their own narratives (see also Chapter, section 8.2.1).

7.2. ARKWORK Workshop

Following the pilot session, I conducted the main workshop. This co-design event, sponsored by ARKWORK, brought together an international and multidisciplinary group of practitioners from around Europe, all working in the archaeological or museums sectors designing digital resources (e.g., databases, online publications, digital archives, video games, interactive experiences, mobile apps, etc.) for different types of specialist and public audience. In total, twenty-three participants from six countries took part in the event, including four facilitators who provided the case studies. The workshop was organised with participants working in four groups. Activities for each group were moderated by the facilitator and structured as outlined in Table 7.2.

Table 7.2: ARKWORK workshop activities structure

DAY ONE	
introduction and overview of case studies	60 minutes
case study description	60 minutes
UX Design	150 minutes
first focus group	60 minutes
DAY TWO	
prototyping	180 minutes
prototypes evaluation	120 minutes
second focus group	60 minutes

After welcome remarks, Dr. Sara Perry and I explained the research aims which informed the data gathering techniques, observations and audio recording practices that we were adhering to, and the future use of such data in relation to my PhD (and subsequent outputs). Ethics forms and a picture release form were signed by all

attendees (see Appendix F). Then I offered an introduction to the goals of the event, the methodology adopted and introduced the facilitators (see Chapter 4, section 4.3.2.5 for more information on the facilitators). Each of them had five minutes to provide a brief overview of their case studies. Design resources, the list of each member of the working groups, and information on case studies were pre-circulated to participants ten days before the workshop. Facilitators were asked to provide in advance: a one-page description of their case study, a one-page brief of the project (aims, intended audience and technologies available), and any other relevant resources (pictures, video, maps, etc.).

Since none of the rooms available in the department were able to accommodate the space needs of four working groups, it was decided to split the groups with two per room. For this reason, all activities were conducted separately, including the prototype evaluation, with participants only reconvening at the end of each day for the focus group discussion. Once the case study description activity started, Dr Sara Perry and I alternated between the two rooms to take notes, record the activities, offer logistical support and ensure that each activity was carried out on schedule. Below I provide a summary of the case studies brought to the workshop by facilitators.

7.2.1 Case study description

Group 1, facilitated by Dr. Juan Hiriart, senior lecturer in Interactive Media Art and Design, University of Salford, worked on a project titled 'Designing digital archaeogames'. The main aim of this project was to design a digital archaeogame based on the early Anglo-Saxon period and the village of West Stow, to be used as an educational resource to teach students from primary schools about the Anglo-Saxon period. This archaeogame was meant to give pupils from eight to eleven years old access to a historically accurate representation of the Anglo-Saxon world, while encouraging them to analyse everyday life from multiple perspectives and provide them with insights into the historical significance of Anglo-Saxon times. The game's purpose was also to communicate narratives conveying factual and evidence-based historical information while also allowing players to participate in the construction of a non-linear storyline.

Group 2's project, 'Prehistory Performing' was conceived and facilitated by Gavin MacGregor, director of Northlight Heritage. This project aimed at co-designing a web-based interface which blends provocative digital content to attract wider audiences to

support and attend prehistoric themed events and experiences. The focus is the prehistoric resources and associated stories relating to the Neolithic and Bronze Age of Scotland (c 4100 – 800 BC), as in the absence of first-person accounts from prehistory, the remains require activation by archaeologists to facilitate archaeological encounters for wider audiences. The aim is to further develop the BuildNBurn approach as an example of new forms of event-based experiences. BuildNBurn has been delivered on four occasions in Scotland and provides an experiential learning context through experimental archaeology and performance participation (Brophy et al. 2017)

Group 3, facilitated by Claire Boardman, PhD candidate in Archaeology at the University of York and Digital Creativity Labs, worked on a project titled 'Micro-Engagements at Castlegate'. It is based on the Castle Getaway project, where a participatory urban design is being attempted by inviting the residents of York to take an active role in York City Council's urban development decision making about the Castlegate area. During 2018, a series of themed events were run by an independent team to allow open discussion and ideas sharing across all stakeholders: residents including students, elected councillors, city planners, developers and heritage organisations such as English Heritage and the Castle Museum. The aim of Claire's case study was to co-design a heritage experience based on the history and historic environment of the Eye of York, a small area located within the city walls and in the south-east quarter of York which has been referred to as the symbolic centre of York and Yorkshire. The target audience for this experience was meant to be York residents (city and surrounding areas) who work/study in the city and who frequently - up to two times per day - pass through or by the Eye of York area either on foot or on wheels (including bikes, buses and mobility support devices, e.g. wheelchairs).

Lastly, Group 4's project 'Designing online interfaces' was presented and facilitated by Eleonora Gandolfi, PhD candidate in Archaeology at King's College London and Digital Scholarship Manager at the University of Southampton. Her project was based on the Southampton Library Special Collections and Archives and its plan to relaunch their digitised collections, as part of the Centenary celebration of the University of Southampton's Highfield Campus. The Collections are currently spread across different websites, mediums and formats, making engagement with non-specialists difficult. This would represent a good opportunity to group all digital resources and to consider how they could be used to engage with local communities. Accordingly, the aim of

Eleanora's case study was to design an online interface/platform based on the library special collections and archival material to increase engagement with local museums, historical groups and communities in Hampshire. The platform was meant to communicate how documents can be enriched by archivists and conservators, encouraging users to create and share newly found links between collections (based on facts and evidence-based data) and to enrich the existing digital collections with information from private archives or other museums.

7.2.2 UX Design

After having discussed in detail the case study with the facilitators, each group started designing their UX. As for design resources, each group was provided with the same materials used during the pilot session (for examples see Fig 7.8; see also Appendix E).

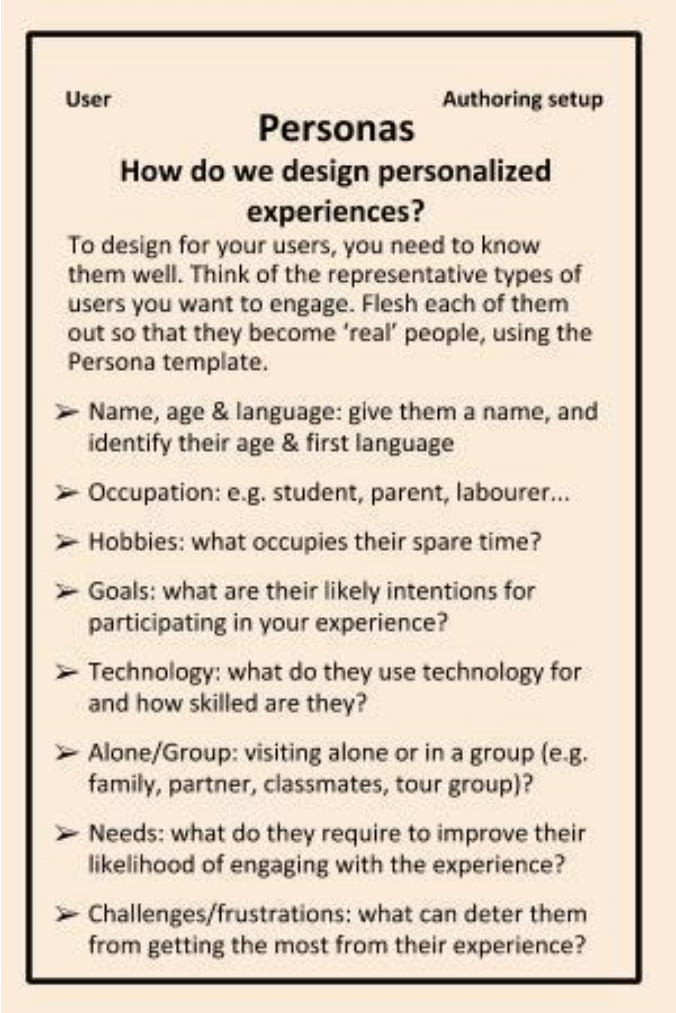


Figure 7.8: Example of design resources. UXD personas card (EMOTIVE nd).

During this activity, all groups used white sheets and sticky notes as resources, while only Group 2 went through all the Emotive cards (see Chapter 4, section 4.3.2.2). Both Groups 2 and 3 spent most of their time on brainstorming ideas for the design concept,

features and contents; they also decided to use the persona cards (see Chapter 4, section 4.3.3.2) to identify and represent potential users for their experiences.

Group 2 started the activity with a discussion of key questions around the importance of prehistory (Why is it relevant? How can it make a difference to people's lives?), as well as potential audiences, their expectations and how to attract them to the experience. Then, the group continued working by writing down key words on sticky notes and collectively discussing them to identify common themes for the experience (dynamic, engaged and intuitive). Finally, the facilitator encouraged each participant to develop one persona for their experience: interestingly, three out of five were male personas even if the group was mainly composed of female participants.

In Group 3, members first worked on a empathy map (i.e., a visual tool used to define potential users' needs and desires and define user personas), then decided to work on separate tasks: one of them created a matrix framework for design implementations in historic urban environment (Fig. 7.9), a tool adopted within UNESCO's Historic Urban Landscape approach seeking to improve the sustainability of design interventions in urban historic environments by taking into account both tangible and intangible factors: heritage, economic, environmental and sociocultural (UNESCO World Heritage Centre 2013). The purpose of this matrix was to visualise and develop the main elements of the UX and subsequently evaluate which aspects better address persona needs. Meanwhile the remaining members first created two personas, a male local commuter and a female student at the University of York; then did a role play exercise with two people impersonating the personas they had developed and the other two interviewing them. During this activity, the group discussion also revolved around the physical space of the experience and its potential for fostering social interaction, as well as the importance of adopting a historical urban landscape management approach, where heritage is just one component of the overall experience that people can have in that place.

Group 1 did not use the cards, as the facilitator had planned every step of the design in advance to structure the group's work. This approach allowed the group to start developing a paper prototype of the game right away, reviewing design goals and concept definition (linguistic aspects, characters, actions and challenges). As per the

facilitator's instructions, the group worked on defining everyday life and language components of the game in terms of conflicts, because a game works as a system of conflicts that is built around challenges and actions. Then the group quickly moved to a bodystorming session (a technique of physically testing and experiencing a design to derive new ideas) where they played with the board game to go through core mechanics of the design, types of interactions (for example single player or collaborative) and consequences for actions (Fig.7.9).

Figure 7.9: Images from ARKWORK workshop. UXD Group 1 (top) and Group 3 (bottom) (credit: Sara Perry).

Group 4 started reviewing materials in the archive and discussing requirements for different users and possible ways to engage them: e.g. with a story of the week or crowd-based participation. One group member proposed to adopt a sort of call for action for people by organising competitions or exhibitions of work inspired by the archive

collections, where users could upload their own interpretations. Then they started sketching the key elements of the web interface, such as the search buttons, themes and narratives. During this activity, the group also discussed digital born information and issues regarding digitisation and curation in the long term: who decides what is important and not, what needs to be digitised and made accessible to others. Such discussion, though, took over the majority of the activity and the facilitator had to steer the group back into the definition of the intended audience, its needs and desires.

7.2.3 Prototyping

After defining the core elements of the UX, each group moved to prototyping. Group 1 spent the time allocated for this activity improving the board game and making it more complete. The facilitator first took some time to show how games and animated characters are developed in Unity, then divided members into small groups to work on separate tasks and further develop actions and consequences for the game. The group's discussion during this activity revolved around the issue of accuracy and how to represent archaeology in games in a way that is faithful to archaeological evidence. Moreover, they examined how to make archaeogames educational experiences by creating conflicts between the children's everyday reality and past daily life, in order to foster curiosity and encourage them to learn about the past (see also section 7.4.4.2). This notion is related to the theory of the uncanny, a concept inherited from Freud (Freud 2004; Auger 2012) and conceptualised by Auger in which unfamiliarity is the starting point for the audience's experience: "any experience that challenges a preconception will at first appear odd, but here the detail and finish of the artefacts, combined with the short explanations describing their functions and modes of interaction, entices the audience into exploring the concept further" (Auger 2012, 145)

Group 2 started the activity by resuming their discussion on how to make prehistory relevant to people and how to connect to one other the various aspects of Scotland prehistoric sites, such as material culture, landscape and the cosmology. Then, they selected two of the five personas developed the previous day (one male and one female) and started working together on developing scenarios for their personas using the storyboard template, to identify what to do to attract and draw them into the experience. Once they had developed different scenarios, at the facilitator's suggestion, they decided to work separately on the various features/components of the web-based interface (content, user journey, modalities of interaction with the platform and type of

events to organise at the site) and started building the prototype using image collages, markers, white and coloured papers (Fig. 7.10).

Figure 7.10: Images from ARKWORK workshop. Prototyping Group 2 (top) and Group 4 (bottom) (credit: Sara Perry).

Similarly, Group 3 decided to begin the prototype phase by developing potential scenarios for their personas, to better identify what would attract their attention and tailor the experience to their needs and interests. However, they opted for a different distribution of tasks: four people worked on scenarios by drawing a storyboard, while one person was in charge of developing the prototype – a map of the Castlegate area of

York upon which overlapping drawings were inscribed on permatrace to show the different aspects of the experience: physical, historical, cultural and social. This group also used the mobile wireframe templates to present the design detail of the mobile application (Fig. 7.11). As per facilitator's suggestion, the group discussion during these activities focused more on the overall experience and its physical space rather than the technological aspect of the application interface.

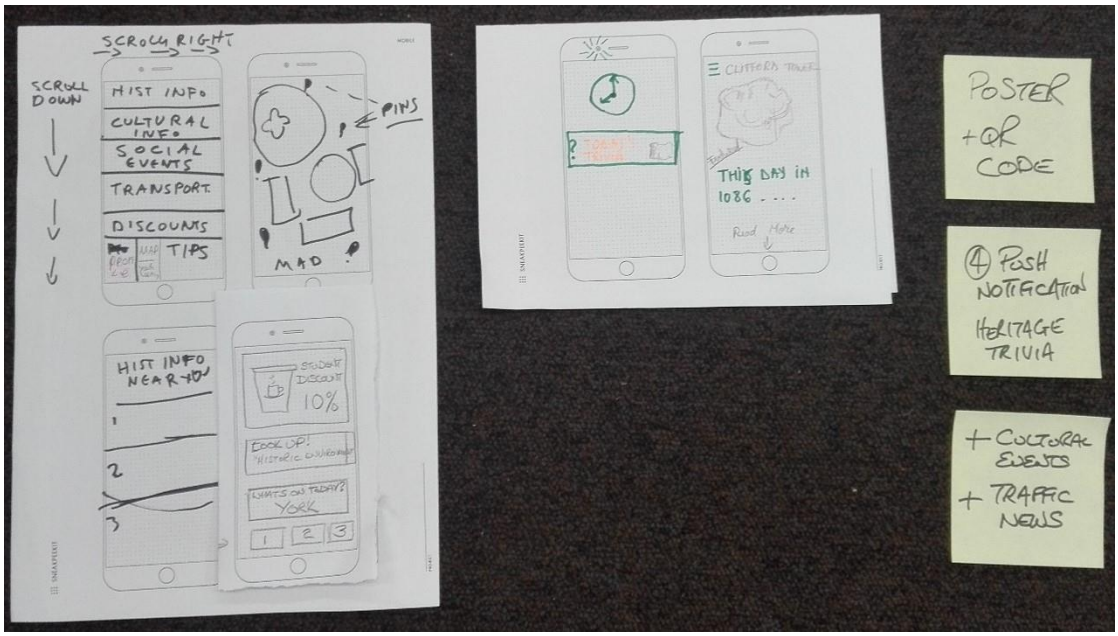


Figure 7.11: Detail of Group 3's prototype (credit: Claire Boardman).

Unfortunately, for Group 4, this activity was not particularly productive, as they struggled with some issues that had emerged the previous day, such as defining their target audience, and needed more time to work on the design of the online interface. Nonetheless, they were able to produce some basic sketches of the platform's structure and features (Fig. 7.9). As mentioned in the previous section, it was difficult for this group to stay focused, as oftentimes discussions generated within the UXD activity went off track and ultimately distracted the group from the task at hand. The vagueness of the brief in relation to the audience and objectives of the UX seemed to have also contributed to the group's struggles (see also Chapter 8, section 8.3.1).

7.2.4 Evaluation

As outlined in section 7.1.3, the evaluation strategy for this workshop was revised after the pilot session to include recordings of all activities and a focus group at the end of the first day to collectively discuss each group's progress in relation to the design of their experience and participants' general first impressions of the event. Moreover, the questionnaire to evaluate prototypes was revised and implemented with a question

regarding the intended audience of the designed experiences and whether the prototypes properly addressed their needs. Finally, for the final focus group, I added a question about mutual learning to investigate the impact of the collaborative process on participants and what they learnt from each other (for details on data collection and analysis see Chapter 4, section 4.3.2 and 4.4; for detailed descriptions of themes and both questionnaires and focus groups list of questions see also Appendix F). Below, I present my personal observations and the analysis of groups' activities, then I discuss the results of the UX prototype questionnaires and focus group discussions.

7.2.4.1 Observations

During the first day, the intra-group dynamics were generally positive depending on people's familiarity with the PD process, but also on the facilitator's approach in supporting the group. In regard to facilitators, some acted more as an additional party to the process, such as in the case of Groups 2 and 3. They mainly intervened to moderate the discussion if and when needed, as well as to bring the group back on track when it was digressing and losing focus on the task at hand. Conversely, other facilitators (e.g., Group 1) decided to adopt a more structured approach and lead the group throughout all the activities. Nevertheless, the majority of participants committed to the activities with enthusiasm and they appeared to contribute something to the process, according to their skills and personality. It is worth noting that during the first day, the discussion and decision-making process in some groups was more participative and democratic than in others. Particularly in Group 3, some people tended to take on a leadership role and dominate the discussion, while others were less vocal and seldom took part in the group's conversation. This was probably due to the personality of the participants, their level of experience with co-design practices and their confidence in speaking English in the case of non-native speakers. However, the facilitator intervened to make sure that all participants felt comfortable and had an active role in the discussion.

As for the second day, the intra-group dynamics seemed to improve and participants appeared more comfortable and relaxed. Groups 1 and 2 showed the same collaborative decision-making process observed during the previous day and continued working in a positive atmosphere, while members of Group 3 who were less vocal during the first day became more involved and actively contributed to the activities and discussion. In some cases, though, it became clear that some non-participative attitudes were due to a lack of interest in the event, Specifically for Group 4, this degenerated into a negative and disruptive attitude towards the group activities, resulting in some tension among the

group members and working at a detriment to their progress. However, the majority of workshop's participants seemed to enjoy the event and the collaborative approach adopted. In most cases the activities were carried out in a collegial and fun atmosphere, also due to the important role played by facilitators. The presence of facilitators proved, in most cases, to be fundamental in guiding the group throughout the development of prototypes, by assigning participants to specific tasks when necessary, helping the group reach consensus in the decision-making process and ensuring that every participant, in particular the ones less familiar with co-design practices, had a say in the design process.

7.2.4.2 Activities' Recordings

Activities' recordings collected throughout the workshop were analysed and coded into the following themes (for details on data collection and analysis see Chapter 4, sections 4.3.2 and 4.4; for detailed descriptions of themes also see Appendix F):

1. authenticity
2. UX social impact
3. UX social and physical components
4. accuracy
5. social presence
6. uncanny

During the UXD activity, a theme that emerged in Group 2 discussion was the concept of authenticity and how it relates to the audience engagement with the experience. The conversation raised interesting issues related to the need to move past authoritative heritage interpretations towards more emotional experience, to create a journey where the encounter with heritage is meaningful and believable for the people experiencing it. An example is provided by Jennifer's comment: "I was thinking about practical experience, what brings people to our event and it is very often things that we wouldn't approve of. There is not a delineation between active learning and the entertainment element of their life. What we are trying to do is to use it as a window in, so what it is being presented is probably not authoritative, but it brings people to you, so you have the opportunity to give them the other bit. I guess it worries me to put authenticity as an overarching theme because it is ruling out a lot of potential avenues for getting into people's lives" (1. Reference 5 - Jennifer). This conversation than led to a very interesting discussion centered around the theme of engagement and what impact the experience they wanted to develop could have on their audience. Jennifer started asking the group: "what impact would it have in their lives? what would change in their life

after this encounter? We need to start thinking about a visitor journey, so we need to increase awareness as it is where knowledge comes from, there is a participation element to be brought in but there is a signpost you need to engender that engagement. If success is that they have encountered this new world and they have become interested and they are inspired to do more, to act, then we need to have a signpost element that leads people in that journey" (2. Reference 1 - Jennifer). Similarly, Costis said: "what is meaningful engagement? I actually want to ask you if this is the case, it is the issue here that we want people more engaged for instance in participation, in the sense of co-responsibility for land management, for protection. Is this the way that we want to engage people, so they become more mindful of the needs to preserve historic and material heritage?" (2. Reference 1 - Costis). Costis also raised the issue of cultural exclusion: "what about for instance if I were an economic migrant and I didn't feel very much included in society, so the notion of Scottish Bronze Age doesn't mean much to me […] There a cultural exclusion here that we need to address somehow" (2. Reference 3 - Costis). Jennifer then suggested using art to address such issue: "what you are alluding to is that everybody's past is different and that is why I think it is dangerous to handle things like prehistory where prehistory start depends much on where you stood in the world, so it is relevant to the place rather than the person. We have to make it more about human experience, using art as our initial coat-hanger that we hang staff on, is how you make to relate and you bring in the difference in time, the academic content once you have made the connection through art" (2. Reference 4 - Jennifer).

These discussions relate to the current debate around the notion of authenticity and the critique to the AHD presented in Chapter 2 (section 2.2.1), specifically the idea of authenticity as defined by social, cultural or personal values instead of an objective quality of tangible heritage. As such, the authenticity of heritage and heritage experiences cannot be judged on the basis of fixed parameters set by specialists. In order to be authentic and meaningful, heritage experiences must be based on the active and critical participation of the public, in particular people and communities usually excluded from the traditional authoritative approach to heritage management and use (Smith 2006, 35-38; Jones 2010; DiGiuseppantonio DiFranco et al. 2018b, 4).

Within the same activity, Group 3 discussion focused on socialisation as main theme exploring the potential of the space for social interaction within the physical space where the experience was going to take place. The discussion started with Claire's

reflection on the Castlegate area and how York residents relate to it: “there is something about the experience of being a tourist in your own city and also about the physicality of the space and the fact that it’s free” (3. Reference 1 - Claire). Then Rebeka replied: “that’s why I think that the space should be an amphitheatric plaza so it can be a space for performances as well and we can use the platform to encourage people to go and spend more time there” (3. Reference 2 - Rebeka). She then continued: “we are not designing a digital experience, but a digitally-mediated experience which means that there are actual experiences in the physical space and there a digital layer. I am thinking about the prototyping phase tomorrow and how do you represent something like this. We can represent the physical space and then add layers for each category and show what each layer brings to the space. It would eb a physical expression of the digital world” (3. Reference 5 - Rebeka).

During the prototyping activity, Group 1 continued the conversation around the issue of accuracy that emerged during the previous phase, with Judith highlighting the importance of focusing more on the learning aspect of the game rather than historical accuracy: “the difficulty that I see is that there is a lot of real archaeology going into this, whereas with a lot of games you don't know whether they are truthful or not or what evidence are they based on. You don't know if they have extended too far beyond evidence and considering that this game is educational too, we have the licence to go little bit beyond of what the archaeology has got to say” (4. Reference 4 - Judith). Participants also discussed the importance of social presence (a crucial component of interactions in virtual environment defined as the feeling of being “there” with a real person (Oh et al. 2018)), as Juan was explaining that the game they were developing was much better than a previous one he created for his PhD research because of the family group characters which give the possibility to play the game as a family/clan, allowing meaningful interaction and communication among players. He stated that “there are a lot of similarities between what I did and what we did yesterday, but I found that there are also differences. Potentially a lot better differences with this one that can be incorporated. One of the things that I love about the game we are developing is cooperation that I don’t' have in the game I did. I thought I gave the sense of it because I made it multiplayer but still, I didn't get that idea of what a family is. I think this game is a lot better, because the dynamic that appears when we are cooperating, I didn’t have it in the other game. That game didn't have social presence. I also never developed a game with archaeologists before, which I think it's quite useful” (5. Reference 1 - Juan).

In terms of social interactions in archaeogames, the group also discussed the importance of unfamiliarity (see also chapter 7, section 7.2.3) as a vehicle for learning: “they [children] need to build that tension between the present and the past to start learning about the latter. By creating conflicts in the game between our understanding of the present and how things were done in the past is how you create some educational experience. Also is going to affect your emotion because at the end it makes you care” (6. Reference 7 - Juan).

7.2.4.3 UX Prototypes

The prototype evaluation phase started with each group briefly presenting the experience they designed to the other participants. Then groups were paired (Group 1 with 3, and Group 2 with 4) and were given 60 minutes to explore each other’s prototypes, fill in the questionnaire with five open-ended questions and collectively discuss their comments on the questions. Participants’ responses were classified into the following themes:

1. Design
2. Audience
3. Efficacy

As regards the Group 1 prototype, members of Group 3 liked the board game: “I liked the learning through play aspect: collaboration=survival. I liked the language (intangible) and the toolkit (tangible)” (1. Group 3 - Reference 2). The format was also considered compelling as emerged from participants’ answers: “game very effective…keep attention, social. I can imagine children not just playing this but talking about it with friends afterwards” (1. Group 3 - Reference 1). Participants were surprised by how developed the prototype was: “I had no expectations and I thought the prototype was really great…much more developed that I would normally expect from a prototype” (1. Group 3 - Reference 2). However, there was an expectation to see a digital version of the game: “I didn’t have an expectation regarding the prototype of the game. Perhaps, I thought it would already been exported into a digital prototype. Other than that, I think the task of creating a game, with rules, situations and resources was respected” (1. Group 3 - Reference 3). Interestingly, Group 3 indicated that for most of them the main takeaway was the efficacy of a physical mock-up for the design of a digital product: “Having experienced the computer game, I could very easily see how ideas can be effectively represented in a paper interface. This makes it easier to design effectively digital experiences in the future” (1. Group 3 - Reference 2).

Regarding Group 3's prototype, members of Group 1 appreciated how the app merges into the commuters' real life: "I liked the mixture with real life, where other aspects of a commute are included but are not only focused on heritage" (1. Group 1 - Reference 1). The same topic also emerged in regard to their expectations of the prototype: "I had thought that there would be more of an architectural focus, where different kinds of buildings would be suggested. I was pleasantly surprised that the suggested experience was based much more in reality for individuals – thinking about how people navigate through the city; that traffic issues are a daily reality, etc. Also, I really appreciate the collaboration concept with local businesses (e.g., coffee rewards)" (1. Group 1 - Reference 5). However, some participants expressed concerns about the chosen format: "Yet, it's another app. I find it somewhat implausible that the ecosystem that really brings together all the envisioned actors world-wide, but I might be wrong and with careful planning it could work quite well. The physical/virtual link is nice, and I liked that is based on the technologies people already have" (1. Group 1 - Reference 4). In terms of target audience, Group 3's prototype was considered effective in addressing the needs of York local commuters: "it taps into the everyday life of people and doesn't expect them to do something extra for heritage engagement" (3. Group 1 - Reference 1).

In regard to Group 2's work, members of Group 4 liked the visual impact of the prototype, but some of them were unclear about the experience aims and contents: "it's slightly unclear at a fist glance what the experience is supposed to offer" (1. Group 4 - Reference 1). Mixed reactions also emerge from participants' comments on the efficacy of the format: "not much effective. It needs more reflection on the ways the project will be communicated" (3. Group 4 - Reference 6). Yet another commentator noted that "the format is effective and although it's digital. It related to event and objects in the physical world in a seamless way" (3. Group 4 - Reference 5). The target audience for the experience was also considered quite broad: "the audience can be anybody, it can be very heterogenous. You need to guide the audience, especially firstcomers" (2. Group 4 - Reference 2). However, participants appreciated the concept behind the prototype, as reflected in some of their comments on what was their main takeaway from the experience: "It is an intriguing solution for creating a digital learning experience about prehistory – not a typical website/interface, which makes it more interesting. The offer of practical activities is interesting. Thinking outside the box, although slightly unclear about the back-end pages/learning experiences" (1. Group 4 - Reference 4).

As for Group 4's prototype, members of Group 2 liked the simplicity and intuitiveness of the interface even though it was not particularly innovative: "I liked the community archive co-curation layers with archival data. I didn't like the dated, a little overused interface" (1. Group 2 - Reference 1). However, the prototype was considered effective for the purpose of the experience: "the format was very suitable for the purpose and easily comprehensible" (3. Group 2 - Reference 4). Another noted that "everybody can participate. Wider interest not only from Southampton community. The prototype was effective" (3. Group 2 - Reference 3).

7.2.4.4 PD Process

As previously mentioned, the evaluation of the PD process was carried out iteratively throughout the workshop via a focus group at the end of each day. The first focus group session started with each facilitator presenting their group's work and updating other participants on their progress. Then I opened the discussion to all participants, prompting a collective review and reflection on the first day by asking about their first impressions, gains and their group dynamic and interaction. The second focus group was meant to be a final evaluation of the event, gathering participants' feedback on the methodology and resources adopted, whether they benefited from their involvement and what they learned from each other. Moreover, the final focus group also aimed to discuss facilitators' reflections on the work conducted on their case studies. To start the conversation, I asked participants to comment on the PD approach and the resources provided to support the collaborative process, what they thought they gained both as practitioners and on a more personal level, what they learned from each other and from working together. Participants were identified either with their name or pseudonyms if they requested to remain anonymous and their responses were coded into the following themes:

1. efficacy of PD process
2. efficacy of design resources
3. frustrations
4. gains
5. mutual learning

In general, participants expressed a positive opinions on the process: "I really appreciate the method of working because you diverge before you converge, and I feel that at the end of the first day we are still in this divergent stage, that we are ready to converge now and to become more concrete, which is actually the key to the creative process rather than decide what's the solution" (1. Reference 1 - Rebeka). Juan, for example,

highlighted its efficacy in avoiding solutionising (i.e. identifying solutions prematurely, without exploring more creative options): “I also think that of having a framework and structure to follow is to prevent what happens a lot in design that people go immediately to prevailed solutions, so you have some sort of problem, and instead of guiding you through submission of steps, you immediately jump for what you think is there. And in that way the structure needs to be constructed in a way that it helps you avoid that basically” (1. Reference 4 - Juan).

Moreover, participants were positively surprised by the amount of work they generated in a short amount of time, thanks to the multidisciplinary competencies of group members. They recognised how that increased their confidence in the PD process: “I’m absolutely flabbergasted how so much can be generated in such a short amount of time, you know, ideas, it just amazes me every time. So, I suppose it’s having confidence in the process and knowing that when you have a group of motivated people, people who want to be here, and just via the process stuff comes out, and it’s really, really productive” (1. Reference 6 - Claire). They also recognised the value of the multidisciplinary nature of the event and being able to work on broader and more variegated themes: “what indeed I was struck by today was how, in a small group of people, all of them related with archaeology one way or another, with very different approaches, very different standpoints from which each person contributed. It was very valuable because of that, because it was like everything from a more sort of theory of archaeology kind of perspective to other perspectives that were much more audience and visitor experience related” (1. Reference 2 - Costis). In other words, in Costis’ opinion having participants from different backgrounds and with different research interests, helped develop more rounded and multi-faceted heritage experiences.

In relation to group interaction, some participants felt that the participatory and positive dynamic fostered mutual learning, as stated by Meliha: “I certainly heard some different ideas from others. I had my own ideas and I was thrilled to hear that there are people with different ideas about the same thing. We started with relatively different proposals and were able to come to something that’s core and common for all, and that was really a great achievement that we could actually agree on something, making some maybe compromises but, yes” (1. Reference 3 - Meliha).

In terms of design resources, participants also appreciated the hands-on and learning-through-doing approaches that allowed them to focus on practical activities, working on concrete solutions and moving away from abstraction: “I don't know, it’s going to sound cynical but I’m really pleasantly surprised that so many of the answers are not the usual things you hear at regular heritage conferences. A lot of the ideas are so fresh and new and also seem really based in reality. I think it’s really good that there's a mix of people, that it’s not all, let’s say, about back-patting and saying, “Oh, we’re great”, but it’s collaborative. It also means that there are new ideas and all, so constructive criticism coming in” (2. Reference 2 - Delia). As stated by Costis, “this is also really good because this card playing, you can feel you're playing as a game really and say each person contributes one card, so we go around contributing cards and lay them out on the board. Then suddenly you've got your pages and your navigation structures for them. One of the things I’d like to have really had more is more collective processes. I found that when you guided us to be together and to do things together, that was better than when you tried to tell us we’re working individually as a person now, write stuff on your own or something like that” (2. Reference 3 - Costis).

Participants' feedback on the workshop also highlighted a few sources of frustration. Some of them, for example, thought it to be daunting at first: “I was intimidated to start with because it was a subject I wasn’t necessarily comfortable with, but actually I found it really, really engaging, and I think it definitely would be very possible to be engaged a lot more than I thought. I think I became more useful than I thought I was going to be. I thought I was going to sit in silence and not be able to contribute, so that was interesting from my perspective” (3. Reference 1 - Catriona). Jennifer, in particular, felt that they were quite rushed into working together without enough time to get to know each other: “from an engagement point of view, I found it a little challenging because I never thought I got to know the group very well. We split up very quickly and I guess when I’m designing engagements for community members, for members of the public, there is that always orientation element and the settling down and getting to know your space element. I guess I missed that a bit today. We jumped straight to task rather than grounding ourselves in the space and making it a comfortable place to work, so we had to do that as we went along, as well as the thinking” (3. Reference 2 - Jennifer).

Moreover, some facilitators pointed out the need to allocate more time for the presentation of case studies and discuss the design resources and toolkit ahead of time:

“I kind of would have welcomed seeing the design part as a toolkit and had a conversation beforehand, because of the limited extent we used them” (3. Reference 4 - Gavin). They also wished there had been more feedback earlier in the creation process and more social time focused on cross-contamination of ideas. Eleonora, for example, pointed out the need for more time for each group (in addition to the first day focus group) to comment on each other’s work and brainstorming ideas with other people outside the group: “it would have been really good to have maybe a feedback structure maybe after one day as well it would be nice to have more and more cross information of ideas. Because we have space to socialise, that was mainly in the team, which is fine, because we had to compress everything in two days, but it’s a shame, this is a missed opportunity having so many other people around and then you don’t. The thing is you tend to sit next to each other at dinner and then you actually don’t know much about the others” (3. Reference 3 - Eleonora).

Lack of clarity on PD process and design resources also emerged as cause for frustration: “I still don’t know what a wireframe is. I’m still not really sure what this process I’ve just been through was, if you see what I mean. This is me coming from completely not a technical background or never done anything in this setting before, but I think there was perhaps a step missed at the very beginning to make sure every participant was roughly aware of what was going to happen, not just in a structural timeframe but what this methodology was, what a design card is, what this stuff was in some way” (3. Reference 5 - Jennifer). Others instead highlighted the need for more opportunity to actually use the resources, as stated by Costis: “I was wondering whether with more time perhaps, it’s the time issue, it’s time pressure, we’d have this opportunity of just playing with the cards, shift them around and not to have to just go straight on the page, on the storyboard and say this is the layout. But try to somehow see what the different modes of interaction are that we want to encourage. We could shift them around, photograph them one way and have a more fluid mechanism. This is also really good because this card playing, you can feel you're playing as a game really and say each person contributes one card, so we go around contributing cards and lay them out on the board” (3. Reference 6 - Costis). Gavin also pointed out the need to make the toolkit (i.e. the design resources provided for the workshop) more tailorable to the needs of each project: “I would agree in the sense that it’s kind of confirmed the need to work with a toolkit approach in terms of different materials and different methods, and then be flexible depending on the group dynamics and preparing a full workshop to tailor

toolkits that were appropriate for the project" (3. Reference 4 - Gavin). Finally, it was suggested that the feeling of comfort participants felt after the first day lunch break, which allowed them to know each other and made it easier for some people working with the group afterword, could have been generated more consciously, for example by allocating more time to introduction and orientation at the beginning of the workshop.

In terms of both personal and professional gains, some participants said the work conducted during the day promoted some sort of self-reflection as it challenged their preconceptions, as stated by Claire "I think professionally I'm quite familiar with using techniques of co-design, but what really comes home for me is every project, every workshop is different. They're completely different, and that keeps it fresh but it's also surprising and it makes you think. It turns whatever preconceived ideas you came in with, it challenges them, it turns them upside down" (4. Reference 1 - Claire); or Meliha: "I thought that this will be educational sort of, and it turned out that we are going to go emotional mainly rather than educational, so that was a completely new orientation for me" (4. Reference 2 - Meliha). Similarly, Gavin said: "I realised that my technical competencies are somewhat limited. I think my group has a wide range of skills and understanding, but I think some groups had programmers in really technically people with other skill sets and I think that it'd be very interesting to see how that confidence and competence affects the design process. The second thing was that kind of challenge for me to force my assumption about why this matters. There was a lot of talk about it on a high level and I think with this room, the things that we're excited by and take for granted, a lot of this is ultimately about relevance or reach to audiences or groups that actually, this isn't all self-evident" (4. Reference 3 - Gavin).

Participants also appreciated the flexibility of the co-design process and the possible transferability of some elements into their day-to-day work. Meliha, for example, said she wanted to adopt the process for classroom teaching, adapting both the workshop's concept and resources: "I decided to introduce what we were doing into class, so I will be teaching a similar thing, of course adapting from Scottish to Bosnian but basically adapt a little bit but repeat, redo the experiment that we had here, with me as the facilitator" (4. Reference 8 - Meliha). Jennifer stated that for her "it's been an incredibly valuable experience taking part in a co-design activity in a topic that I know nothing about, because I've been thrown into the role of a very unconfident user and that's enabled me to reflect very strongly on my practice as a facilitator and about if I was

facilitating my experience over the last few days how would I have anticipated some of those challenges that I faced. I guess I would really strongly recommend trying to go to an event like this, that it's completely outside your realm of experience. I think for me that's been very valuable" (4. Reference 7 - Jennifer).

According to facilitators, taking part in the event gave them a new outlook on their own practice and they advocated for a more frequent adoption of this process. In fact, they affirmed to have collected useful ideas and concepts that can be applied to their projects, as reflected in the following comments by Juan: "as a lecturer I'm picking up a lot of stuff from this event. I quite like trying to have some goals to achieve in a short period of time. I'm a big fan of jams [meaning sessions where participants have to design something in a short timeframe] when people get them, you know, there's a complete development there but also there's this thing about achieving something really rare. In my experience at times I have a lot more going in a jam as the one we had here than in a semester working with students" (4. Reference 5 - Juan). Moreover, they considered the workshop useful to better understand the facilitator role, what it entails and where during the process it was necessary for them to intervene: "it just made me think about the entire process. That includes different types of these engagement and co-designing activities, so it's literally on a scale. You have the free design one, the matching a need to a final product that you can actually go out there or a game you can play, and the other one maybe more structured, and it would definitely have some delivery at the end. It just made me think about the facilitation requirements" (4. Reference 6 - Eleonora). Similarly, Claire said: "it's something about the level, the method, the process itself, and perhaps it's the level of structure and facilitation and the participants involved about where in the process you are employing these, so you're either very close to end delivery, so you want a very structured workshop with end users There's something about the design process but it's in a bigger process as well and knowing where you are on that process" (4. Reference 9 - Claire).

As to mutual learning, some participants felt they acquired new knowledge on diverse subjects and on how some archaeologists think. Delia, for example, said what they learned through the workshop is going to inform her PhD research: "I figured out what I can do for one of my cases, for my PhD, and I also learnt loads of things about what happened during the year in Anglo-Saxon England" (5. Reference 4 - Delia). According to Eleonora: "is actually about learning more, about how amazing things are really

happening around and just learning from projects that other people are doing. It makes me feel I'm not really the crazy person the things that I'm doing, there are other people like me in the world. So, it just made me think that yes, I'm not alone, it's nice to have a group of people that think in the same way, that understand about co-design, which is nice" (5. Reference 2 - Eleonora).

7.3 Summary

Data gathered through both workshops provide useful insights on how the collaborative process unfolds and how different dynamics of participation take place within the same design phases, in a context where all participants are encouraged to develop ideas without worrying about technological or budget constraints. Several scholars have in fact pointed out that more research is needed to better understand the different ways in which co-design processes can develop within the same participation frame (Ciolfi et al. 2016).

As for the ARKWORK workshop, in all four groups the process of sharing knowledge and skills and the forms of participants' involvement varied greatly, due also to the role that facilitators decided to take in the participatory activities. When facilitator-driven, the decision-making process led to a more developed and structured prototype making it easier for other participants to explore and evaluate it. However, in terms of participants' gains, this more structured approach might have been less effective than the more open and participatory one adopted by other facilitators.

To further investigate the impact of these dynamics, I conducted more in-depth interviews with members of Groups 1 and 2, as respectively representative of these two different design approaches. Through these interviews I aimed to collect their comments on design methods and tools adopted for the workshop in general and, specifically, for their working group to investigate whether they were effective or not. Moreover, I used these interviews to gather their opinions and reflections on whether, what, and how they actually gained in the longer-term by being involved in the co-design activities. Participant gains is, in fact, one of the core characteristics and values of PD, but so far very few studies have been conducted on participants' views of PD processes and outcomes (Bossen et al. 2010; Garde and van der Voort 2014). As discussed above (Chapter 4, section 4.3.1), instead the research has mostly focused either on the assessment of outcome or the process itself from the researchers' perspective.

Results from my follow up interviews, along with lessons learned from both workshops are presented in the following chapter (Chapter 8), where I discuss how insights gained through the iterative evaluation process adopted for my research project have been used to define strategy and tools for UXD in archaeology and how to structure co-design activities to find a balance between a more open and creative approach and a more constrained one. In addition, I present how I have drawn upon the results of my study to refine both design resources and methods to identify a more fluid method and design a tailorable toolkit. I also discuss how I have revised the evaluation strategy to identify which approaches are the most effective to not only examine how collaborative design processes unfold, but also if and in what ways these processes lead to personal and professional benefits for participants.

8 Discussion

Archaeology is a discipline rich in visual material which has long invested in the application of various forms of visualisations, from illustration to photography, from artistic impressions to interactive 3D models. However, while digital resources have become ubiquitous within archaeological practice, fundamental issues with their use remain problematic and often unresolved, and our professional understanding of their real effectiveness and impact on diverse audiences is still limited. This research has, in fact, highlighted the persistence within the archaeological and cultural heritage sectors of preconceptions and assumptions around 3D visual media and their impact on specialist and non-specialist audiences. It has also suggested more robust UX assessments, as well as iterative design workflows, involving end users and stakeholders from the outset, as fundamental to creating experiences that are truly bespoke to diverse users' needs and expectations. In order to do so, this research has suggested a more consistent integration of design theory and PD practices as ways for creating these resources in cooperation with end users.

A series of research questions were outlined from the outset of my project:

- What is the impact of interactive 3D models upon a diverse range of audiences, specifically how do different users (specialists and non-specialists alike) engage with these specific forms of (re)presentation of the past?
- How can we integrate evaluation frameworks and iterative processes to use users' feedback within the design and improvements of these digital resources?
- How can we incorporate User Experience Design (UXD) and Participatory Design (PD) processes into archaeological practice to create digital products tailored to the needs and expectations of our audiences?

Investigations of these research questions has shown that adopting design theory and PD practices and involving end users in the creation of digital resources and experiences in archaeology may result in greater engagement with the intended audiences of such resources.

This chapter aims to present a review of the findings of the two iterations of my research project (section 8.1) and discuss how lessons learned through the iterative evaluation process adopted for my research project have been used to refine methods and resources for incorporating UXD and PD practices in archaeology (sections 8.2 and

8.3). Specifically, in section 8.2.1, I detail how the results of my survey and the practical experience of the first co-design workshop have informed the refinement of my interactive 3D model and the visitors' experience design for the exhibition "Cipro. Crocevia delle Civiltà" where it will be displayed as a digital exhibit; while in section 8.2.2 I discuss the results of follow up interviews I conducted with some of the participants of the second co-design workshop and how they complemented and deepened my insights from that event. Finally, in section 8.3 I present my suggestions on how to refine and improve both design strategy and toolkit for co-design activities.

8. 1 Review of the Findings

The initial research problem underlying this study concerned the efficacy of interactive 3D models as digital resources for archaeological research as well as academic and public dissemination. It has been noted that despite the widespread application of digital technologies in archaeology and heritage, the development and dissemination of digital products has been often conducted without assessing their impact on intended audiences. Recognising that my own production of an interactive 3D model of Erimi-*Laonin tou Porakou* had the potential to fall into this same trap, I attempted to grapple with it in the first iteration of my research project by first presenting it to my colleagues at the Erimi Archaeological Project, then to different user groups (experts, non-experts and students), evaluating how they perceived and engaged with it using mixed-methods: questionnaires, interviews and focus groups. The evaluation process consisted of seven interviews and two focus groups with the Erimi research team, followed by one multi-stage survey with both professional and lay users (54 questionnaires in total).

The results suggest a persistent tendency among some practitioners to consider the way we communicate archaeology via digital products universal and valid for everybody, without considering how diverse are the needs of different audiences. They highlight how the idea that archaeologists working at Erimi have about the outcome of their research's presentation does not find confirmation in the audience's actual response. For example, they anticipated a positive response from other archaeologists and practitioners, while in fact the experts in my survey were the most critical and less enthusiastic user group. Moreover, feedback from non-experts regarding their engagement with the model does not reflect the concerns expressed by expert users, suggesting how we as practitioners are still making assumptions about our audiences. The experts user group, in fact, pointed out several issues with the UI that in their opinion were likely to have a negative effect on the experience of non-expert users,

whose response instead contradicted this prediction. Such results were further confirmed by data gathered through eight interviews that I conducted with digital heritage practitioners and museum curators working on the design and evaluation of interactive digital media for various audiences. Their responses, in fact, not only underline the lack of proper evaluation of digitally mediated experiences as a persistent issue within the heritage sector, but also point out that we still have partial knowledge of the actual impact and effect of such experiences.

Since the results of my own case study and the studies conducted by other practitioners indicate the importance of involving users in the design process, I decided to address these issues by experimentation with practice-based solutions in the second iteration of my research project. Herein I designed and conducted a series of workshops focused on the application of UXD and PD practices for the creation of digitally mediated heritage experiences. Both events proved to be useful practical experiences on how to integrate UXD in archaeology and promoted meaningful discussion among participants. As discussed in Chapter 7, workshops fostered reflections on crucial topics within the discipline that can be summarised as follows:

- the role that archaeologists and heritage practitioners play in the design process and how to move towards a more multivocal approach to heritage interpretation;
- how to design digital products tailored to the needs of the intended audience by taking into account users' expectations;
- the importance of the emotional component of UX and crafting compelling stories that engage users instead of producing merely informative experiences;
- the importance of multi-sensoriality and how to embed digital designs into physical spaces.

Moreover, these workshops provided useful insight on the dynamics of participants' involvement and the different ways in which the collaborative process unfolded in each group; as well as how participants shared their knowledge and skills to inform the decision-making process and the construction of knowledge. Finally, they gave me a better understanding of the ways in which the activities, the role played by facilitators, and the composition of the groups, shaped and influenced these processes.

8.2 Rethinking UXD in Archaeology: Lessons Learned from Co-Design Workshops.

Design is a collaborative effort that requires multidisciplinary expertise. According to Bratteteig et al. (2010, 18) to fully understand design we need to focus on it as a

collaborative process involving various stakeholders "which influences the ways designers express, represent, and communicate an evolving design concept [...] and the multiplicity of the design object itself, its changing representations in different media, and how it gets translated/ transformed in the process of design".

Bearing this in mind, we can recognise how design is an integral part of archaeological practice, in the way we, as practitioners, develop and share our work and engage with our audiences. However, we have not fully exploited the potential of a more design-led practice yet. To change archaeological practice, we need to incorporate critical reflection on design into our processes and explicitly embed design theory and PD practices into our outputs. This is particularly true in relation to digital resources, whose pervasiveness within our sector have not always been accompanied by considerations, not to mention thorough evaluation of, users' experiences.

In the following sections I discussed lessons learned from the co-design workshops I organised on how to rethink the design of heritage experiences and to effectively actualise collaborative design practices in our discipline.

8.2.1 The Erimi-*Laonin tou Porakou* Case Study

As mentioned in the previous chapter (see section 7.1.1), for the pilot workshop I decided to use as a case study a project involving the 3D model I created for my research project to be displayed as a museum exhibit. The results of my evaluation study, combined with lessons learned from the workshops, provided useful insights on how to refine and improve it for the exhibition in Turin, where it will be experienced and evaluated in a different setting and with a different modality.

For the first evaluation, the interactive 3D model was presented as a desktop-based standalone feature, and while users' feedback reflected a general positive reaction, some components of the UI were criticised in terms of usability and comprehensibility of text descriptions. Some users, in fact, reported the feeling of disorientation while interacting with the model and suggested as a solution the adoption of a story as a recommended path of exploration. Several users also advocated the use of less academic jargon to ensure readability. Moreover, users' feedback registered a negative reaction to the choice of using avatars as neutral silhouettes.

To overcome these issues and ensure the model's accessibility to the wide and variegated audience that will experience it during the exhibition, the following improvements have been undertaken. First of all, the medium: the 3D model will be displayed via a 42 inches free-standing touchscreen kiosk, offering a physically static form of digital interaction that is best suited for 'stand-alone', visually led information, also allowing both individual and group experiences. In addition, the large screen provides better opportunities to display what is primarily visually led content and offers benefits to both regular users and those with visual impairments. The second implementation made relates to the modality of exploration. The navigation of the model has been improved, maintaining the possibility to visualise the site from different perspectives, which was one of the most appreciated features, but also providing a predefined exploration path to avoid the sense of disorientation mentioned by some users in my survey (see Chapter 5, section 5.3) From an initial 'overview' screen of the 3D model, visitors will be able to touch information buttons (Fig. 8.1).

Figure 8.1: Exhibition touchscreen app. View of Erimi 3D model (credits: James Osborn and Patrick Gibbs).

These interactions trigger a movie, meaning moving the camera position to a closer angle on a specific model element, as well as a pop-up multimedia information panel with further details, video and images. Information is layered so visitors will still be able to access it without feeling overwhelmed with too much content. Thirdly, an implementation was carried out in regard to storytelling. In order to move past the informative approach previously adopted, the exploration is accompanied by a narrative text about the site and the community that inhabited it. The story of the artefacts from

Erimi selected for the exhibition, interpreted as common-use objects and ornaments embedded with symbolic value as they are related to textile activities, serves as an entry point for a narrative on how textile productions were pivotal to the local economy and performed by a large number of the community members. It also presents one of the interpretations regarding the abandonment of the settlement and how these artefacts, along with other common-use objects and working tools found in the workshop complex, were left behind on purpose as a part of a ritual practice involving the burning of significant structures. Finally, a further improvement was undertaken to the animation and soundscape. So as to convey the sense of an inhabited place, which the first version of the 3D model did not achieve according to several users who took part in my survey (section 5.3), and provide a more engaging and multi-sensorial experience, the 3D model has been populated with animated characters, performing working activities supposedly carried out at Erimi (e.g. grinding and pounding, burnishing pottery and washing textiles). Moreover, the animation is complemented and enhanced by a natural and human soundscape delivered via a sound cone or directional speaker that provides a limited-area sound experience that requires no physical interaction by the visitor (Dolcetti 2021 in press).

Lessons learned from the pilot workshop were used to identify the best way to integrate the 3D model within the visitor's pathway. During that event (see Chapter 7, section 7.1) both participating groups created engaging experiences and constructed evocative narratives pivoting around Erimi objects' stories, their significance and value for the Erimi community. Hence, I decided to incorporate some ideas and components of each group's design within the final project. Specifically, the final design is meant to offer visitors a journey into the site through the stories and lives of the objects displayed, as shaped by archaeologists' interpretation of the evidence. First presenting the objects in the present context of the excavation; then contextualising the objects in their own time: what they did in their working lives and where they ended their ancient social lives. The aim is to encourage visitors to reflect on the cultural significance of the artefacts and what they tell us about the identity of the Erimi community. To find a balance between the two designs, which were variously critiqued as either not informative enough or overwhelming in terms of information, and focus more on the engagement, the amount of textual description is minimal and all content is layered to give access to descriptive details to visitors who want to know more without being disruptive to the overall experience (Mason 2015). This choice stems from my reflection on the discussion that

emerged during the focus group carried out at the end of the pilot session about the obligation to match the brief and the need to properly communicate the work of archaeologists at Erimi, while also considering audience needs and taking into account visitors' fatigue as it is the last segment of the exhibition (see Chapter 7, section 7.2.1). Adopting this approach for the experience design will hopefully present how the archaeological interpretation process works and, at the same time, encourage visitors to make their own narrative, avoiding the risk of discouraging them with large blocks of text.

The practical experience of this pilot session proved to be extremely useful for the development of my project, as the collaborative approach adopted not only generated important ideas for the development of the model, but it also provided me with a new perspective on the construction of knowledge. Indeed, for the first time, I was able to observe in action a collective meaning-making process that was formed by individuals outside the Erimi research team around the archaeological evidence. This experience inspired me to incorporate their critical reflections within the experience design and try to explicitly convey the ambiguity and subjectivity of the interpretation process, developing a less didactic narrative.

8.2.2 The ARKWORK Workshop

While outcomes from the pilot workshop proved to be valuable for the curatorial work of the Turin exhibition, they also hinted to the benefits of collaborative design practices both for developing more compelling UXs and generating positive gains for participants, which were further confirmed by the results of the ARKWORK event.

As mentioned in the previous chapter (see section 7.3), to further investigate participants' gains from the ARKWORK workshop and refine both the structure of co-design activities and design resources, I conducted seven interviews between June and September 2019 with members of Groups 1 and 2, selected as representative of two different design approaches and facilitation methods (Fig. 8.2; Table 8.1).

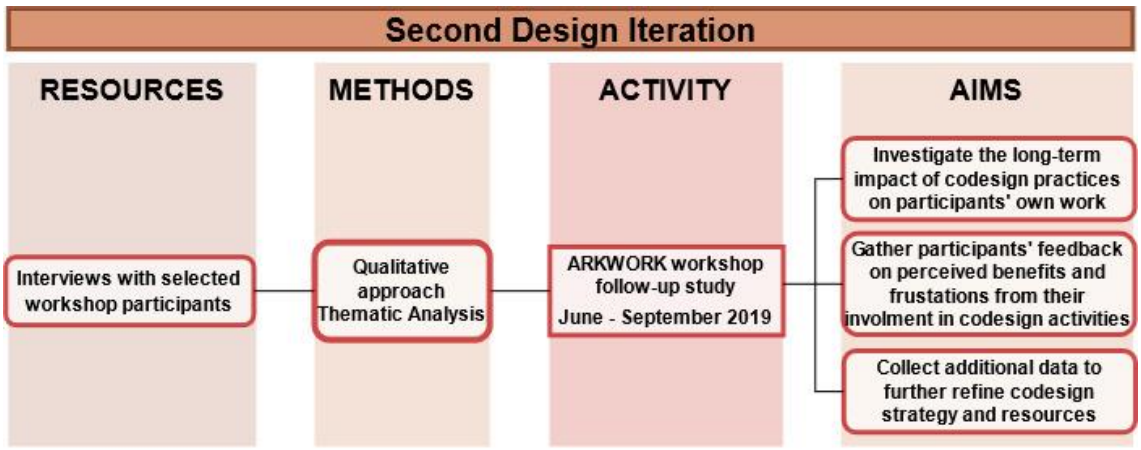


Figure 8.2: ARRKWORK workshop follow-up study diagram. From the left each column illustrates: resources (techniques, software, design tools) used, methods adopted, the timeline and the specific aims of the activity (credit: Francesca Dolcetti).

Table 8.1: Follow-up interviews. List of participants

Name	Group/Role
Juan	Group 1, facilitator
Judith	Group 1, member
Ingrida	Group 1, member
Ian	Group 1, member
Costis	Group 2, member
Andriana	Group 2, member
Meliha	Group 2, member

All participants were asked to answer three open-ended questions and give me their honest opinions on the co-design workshop, what was effective and what did not work, their perceived professional and personal gains and what, if at all, they learned from working with other participants. Participants' responses were analysed and coded into the following themes (for details on data collection and analysis see chapter 4, sections 4.3.2 and 4.4; for detailed descriptions of themes see also Appendix G):

1. Efficacy of PD process
2. Efficacy of design resources
3. Gains
4. Frustrations
5. Role of facilitator

Generally, participants enjoyed the event, confirming what emerged from the focus group discussions during the workshop (see Chapter 7, section 7.2.4). Andriana, for example, stated: "I think for two days the preparation was solid, so we could make the

most out of it. In general, the preparation you did was really important to help us adjust and feel familiar with the rest of the group, which I think is very important to produce and achieve a final outcome. The materials were very interesting and solid, as well as the instructions It was really interesting to be able to combine different methods to get new perspectives" (1. Reference 1 - Andriana). They also enjoyed working with the other group members, confirming my observations on the dynamics of participation among these groups, as shown in the following comments:

- "I think our group worked really well and were surprisingly good at working together, with complementary expertise and competences" (1. Reference 4 - Ian);
- "I really like the idea to have people with different backgrounds on each group, all of us have different perspectives and this helps to run things smoothly" (1. Reference 1 - Andriana).

Moreover, participants highlighted how the collegial atmosphere and the good balance of different expertise in their group were fundamental to the creative process behind the UXD, as pointed out by Meliha: "we were really lucky in our group, because we had different expertise, it was a good combination for the development of personas" (1. Reference 7 - Meliha); and Ingrida: "It really worked, as the skills in our group were so complementary, we were all contributing in our own way. It worked really well for our group, it was well balanced" (1. Reference 3 - Ingrida). The same opinion was expressed by Juan: "my group was fantastic, we had a very good mix of different skills. I think that our conversation was more interesting than the prototype itself. All the discussions that you have while moving along were quite interesting" (1. Reference 5 - Juan). In relation to this topic, it is worth mentioning Costis's comment (Group 2): "it always takes some time to get familiar with each other, so maybe we spent an hour getting to know each other and it was very natural and reasonable within the process and maybe this is part of the learning, for people to be creative together they need to overcome issues of social capital and recognition of professional expertise. That was very fluid for us, there were interesting ideas on the table" (1. Reference 2 - Costis).

However, participants highlighted several issues and weaknesses in the workshop's structure that can be summarised as follows:

- insufficient time for the introduction of case studies at the beginning and for participants to get familiar with each other: "maybe have more time to meet each

other before to get more familiar with the other participants" (3. Reference 1 - Andriana);

- insufficient time for the prototypes presentation at the end: "I think we missed the opportunity to engage with other groups and to have meaningful discussions with them. In the last bit there was a 'show and tell', but that instance was really short, and I wanted the opportunity to talk more with other participants about their projects" (3. Reference 6 - Juan). This point was reinforced by Judith who said, "I think the main thing that could have been better was actually to have been given more structured time, so that each group could have presented properly as opposed to people just wandering around the table and having a look, but you don't know what you are looking at if you're seeing scribble and some notes and something made of paper. So, it would have been nice to have an actual pitch by the group, I know we had that, but it felt it wasn't wrapping up some of the ideas, or maybe have a discussion about why we did something the way we did and how we reached some decisions" (3. Reference 8 - Judith).
- need for all groups to spend more time together and discuss their creative processes as they progressed: "It might have been more useful to have more time to discuss each project/output at the end and even at the start it would have been nice to understand a little bit more of what the other groups were doing, because I was aware they were being directed in a very different way from our group. I wanted to know more about what they were doing and some of the questions they were trying to answer (3. Reference 8 - Judith).

In terms of design resources, participants appreciated the paper interfaces and in general the low-fidelity method of prototyping, as stated in the following comment by Costis: "we liked the paper prototype approach, I think it works very well because it doesn't presume any kind of technical competence" (2. Reference 2 - Costis). Similarly, Judith said: "I think overall at the end we were happy to use papers, pens and scissors and we were quite creative in what we were doing" (2. Reference 5 - Judith). However, according to Juan the design toolkit was not flexible enough to meet the needs of each project: "the set of materials you developed was quite standard, in the sense that it's difficult to have something that works for every different project" (2. Reference 4 - Juan).

In relation to design cards, while generally considered a useful tool for the UXD, some participants found them limiting for the creating process: “I would have liked more freedom, less constraints in the cards” (3. Reference 9 - Meliha). In a similar vein, Costis said: “I think we used the cards to some extent in the beginning, but it was almost heuristic in a sense; we didn't really use them very much, but it doesn’t mean that they weren't useful. It might be overloading the role of these cards because they are trying to play many different goals at the same time, so my feeling is that the real value comes from using these cards at a heuristic level, maybe a more open-ended approach as that might yield different results from different groups of people” (2. Reference 2 - Costis).

In terms of frustrations about the design approach, some participants felt that the imperative of producing a prototype might have been to some extent detrimental to the creative process, limiting participants’ ability to explore different ideas, as stated by Costis: “my take on this is that we did perform well, the workshop worked well for us, I think it was driven very much by the performative task of producing the prototype. If there was more time, different conversations might have materialised and taken place, on the other hand we were very much driven by the imperative of making it good and maybe better than the others” (3. Reference 2 - Costis). Similarly, Ian said: “to a certain extent I was disappointed with some of the ideas, both from our group and the others, they weren't as wild as they could have been, not that much out of the box. In our group there were moments when we were wilder and moments when we were focused on delivering something and making things work and you need this kind of escalation between being realistic and being visionary, but I guess somebody (facilitators and organisers) should have encouraged us to be more creative” (3. Reference 5 - Ian). These statements find confirmation in Juan’s comment on a common and persistent issue in co-design events that facilitators and coordinators need to address: “during these workshops there is a tendency to find solutions immediately, so we should try to lead people to think more abstractly” (3. Reference 7 - Juan).

It is interesting to note that participants had different opinions regarding the role of facilitators and the approach they adopted. In relation to Group 2, Meliha, for example, stated that: “it is absolutely necessary to have a facilitator for this kind of activity, otherwise you can lose yourself, as the facilitators reinforce the process and converge after diverging” (5. Reference 7 - Meliha). Similarly, Andriana appreciated that the

facilitators gave them “the same amount of opportunities to express our ideas individually and combine all of these ideas” (5. Reference 1 - Andriana). Costis, on the other hand, considered the process “a little hierarchical” (5. Reference 2 - Costis), but in his opinion this was due more to the pressure of completing the task than the facilitator’s choice to lead the decision-making process. Regarding Group 1, the highly structured and facilitator-driven approach adopted by Juan, is reflected in the following comments: Judith felt that in their case “a lot of conversation had gone on before we started, whereas it was clear that some of the other groups were starting from scratch, whereas we were more focused” (5. Reference 6 - Judith). She also thought that the facilitator “guided us more than we initially thought he was going to” (5. Reference 6 - Judith). A similar concern was raised by Ian: “I suspected [the facilitator] was facilitating us quite a lot, in a sense that the process wasn't quite open as it might have been. It might have been just my problem as I didn't get at the beginning a clear enough picture of what he wanted us to do, but I was under the impression that it was going to be a more open-ended thing” (5. Reference 5 - Ian). Conversely, Ingrida had a different opinion on the matter: “I enjoyed the process very much, because the facilitator was really nice, knowledgeable and open minded. He was brainstorming the ideas and we were really happy to provide those ideas” (5. Reference 3 - Ingrida).

These comments are not surprising and confirm the observations I made during the workshop about the different approaches adopted: more facilitator-driven in the case of Group 1, more open and participative for Group 2. In Group 1, the facilitator’s decision to lead all the stages of the decision-making process allowed the group to achieve a functioning board game and it was considered by some the only choice for that purpose: “I think the facilitator was really great at what he had done and having in mind the time pressure we would have never been able to create a digital game from scratch, but he knew that, and I think we did the best we could and he also benefited from our brainstorming session” (5. Reference 4 - Ingrida). However, this approach seems to have caused frustrations in some participants and eventually resulted in impediments to their professional and personal gains: “we didn't kind of follow the approach we were supposed to be following, so I'm not quite sure, we didn't really work with the approach and tools you provided us as it was described. I didn’t much learn about the participatory approach” (3. Reference 4 - Ian). Similarly, Judith made the following comment in relation to the design cards: “we ended up not using the cards, even though they looked like they would have been more useful for me, personally, because

especially given the context within which I work, I think having those as a sort of prompt on how to design things it would have proven being more useful for me" (3. Reference 8 - Judith).

Interestingly, for these participants it was difficult to specify what they gained from the workshop or how to incorporate the knowledge acquired into their own work. According to Judith, in fact "it's quite difficult to see how I could implement it in the journal [Judith is the editor of the Internet Archaeology journal], but I could definitely see that if I were to implement a project I would actually try and get more people at the early stage to collaborate and design" (4. Reference 10 - Judith). Likewise, Ian initially stated: "I was thinking quite a lot about that after the workshop, because I had the feeling that I learned quite a lot, but I can't point directly at what that could be. What I might have learned, even though it wasn't entirely new to me, it was not to expect much about the participants' expertise and keep it really open" (3. Reference 6 - Ian). However, he then continued saying "I have been thinking about design-based approaches and how to relate it to the research I'm doing, so in that sense I think I got something, it helped thinking forward on how to integrate design-based approaches in my own work" (3. Reference 7 - Ian). Even Ingrida, while appreciating being more knowledgeable in games development, was unsure about the applicability of what she learned in her own job: "I really don't know if and how I will apply that to my work" (3. Reference 5 - Ingrida).

Conversely, participants in Group 2 were able to identify benefits, new knowledge and outlook on their own practice deriving from their participation. For Costis, the workshop was an opportunity "to think again on how to integrate some ideas about users' interests, using the personas methodology, within scenarios for user interaction. We used these notions in our group, I was reflecting we can better develop a proper interaction model with different personas and I think to our extent our paper prototype storyboarding helped a little and I would like to do more of that in the media course if I will teach it next year" (3. Reference 2 - Costis). Meliha appreciated the opportunity to learn more about prototyping techniques: "I liked the storyboarding part, I knew about it, but I have never used it, so I learned something new. It is a nice way of thinking when you want to tell a story, it is a good tool and it was new for me to use it" (3. Reference 12 - Meliha).

Worthy of mention is the case of Andriana, as participation in the workshop not only allowed her to apply in practice the knowledge acquired during her Master's in Interactive Design, but also had a positive impact on her job as curator of digital libraries: "after I came back, I developed a low fidelity prototype and tested it with some of my colleagues and I also created personas about potential users of the virtual library and applied some evaluations methods like focus groups and interviews. Now, I am learning how to use software for creating high-fidelity prototypes and I have got inspired by the workshop to look into prototyping techniques and I did some research by myself, so now I am building a prototype for this new digital library we have been working on and I am so happy that we are slowly integrating these approaches in my work because now people can see how important it is to avoid future mistakes" (3. Reference 1 - Andriana). Moreover, by applying UXD and PD methods she was able to make her colleagues aware of the validity of these approaches: "it was very interesting because I work with a lot of academics and mentioned to them that we needed to do some prototyping and user testing, but they thought we didn't have time nor resources, and that it wasn't so useful, but in the past our digital libraries had problems and users were facing technical issues. So, after I came back, I told my colleagues that it was important that we adopted UX methods and they couldn't really understand the point until we tried, and they find it really useful and interesting to participate" (3. Reference 1 - Andriana).

While these differences in terms of professional gains are to some extent related to participants' subjective experiences and the expectations they had about the event, they can also be attributed to the design strategy adopted by facilitators and the nature of the case studies they decided to use. In Group 1, participants who expected to be guided and to some extent trained in design processes appreciated Juan's decision to adopt a highly structured approach, where each step was planned in advance. Other participants, instead, found it disappointing as they felt they did not have much of a say in the decision-making process and that this more passive role prevented them from fully gaining new or different outlooks on collaborative design techniques. In contrast, in Group 2 the more participatory approach and the openness of the brief allowed for a broader adoption of co-design techniques, which engendered a more effective learning by doing and ultimately led to more defined and significant gains for participants.

Specifically, in relation to personal and professional gains, members of both groups valued the networking opportunity offered by the workshop, as stated by Juan: “in terms of networking yes, I have been in touch with people in my group and we are planning collaborations for the future” (3. Reference 9 - Juan 1). They also liked to be able to work with practitioners from different fields, as stated by Costis: “I liked the people and the process and for me it was good because it gave me the opportunity to talk to practitioners in cultural heritage about something that it is central in a way ‘such as’ “how does this ‘participatory process’ play on the construction of knowledge” (2. Reference 2 - Costis). Also, per Ian: “it tends to be productive and useful, as we had the chance to focus on something different from what we usually do in our everyday life. Working together with new people is intellectually rewarding and it's beneficial for thinking” (5. Reference 7 - Ian). Of particular interest in relation to this topic, is Juan’s comment: “it was interesting for me to see professionals from creative backgrounds working with archaeologists in the same room, I found that illuminating. I find it easier to work with archaeologists, so the workshop led me toward the conclusion that there is something between interdisciplinarity and those fields (i.e. the collaboration between archaeologists and designers) that makes things easier” (5. Reference 9 - Juan).

Data gathered through these interviews show how within the same design framework and co-design activities, the process of sharing knowledge and the forms of participants’ involvement varies across groups, confirming my personal observations from the workshop (see section 7.2.4.1). Both groups were, in fact, well balanced in terms of skills and expertise and participants productively shared their skills and knowledge to develop mutual learning and understanding. Moreover, both groups had the same constraints: the time allocated to each activity and the task to develop a prototype at the end of the second day. Such constraints seemed to have influenced the collaborative process, as all participants felt the pressure of having to produce a prototype and that, to some extent, made them feel that it was acceptable that their facilitators exercised power over the final decisions. This seems to have on some level limited participants’ empowerment and consequently affected the gains they experienced from participating in the design process. In Group 1, the facilitator-driven decision-making and the early focus on the prototype development acted as an additional constraint on the creative process, limiting the exploration of ideas; while in Group 2, though still driven by the facilitator’s vision, the process was more participatory as it started from a more open and flexible brief, allowing a more explorative and creative design space. Nevertheless,

the majority of participants recognised that they had some influence on the design process.

8.3 Refining Co-design Strategy and Resources for Archaeology

This research project began with a focus on interactive 3D models, as one of the many forms of digital media whose application within archaeological practice is still problematic in terms of uncritical adoption. The results of the evaluation of my own 3D model aligned with other practitioners' concerns about persistent preconceptions about audiences' needs and expectations in relation to digital products for the heritage sector. To overcome this lack of engagement with our audiences and actively involve them in the design process, I integrated UXD and PD approaches within my project to seek out ways to incorporate them into our discipline. The methodology adopted for the second workshop, while already refined and improved after the first pilot session, can be further enhanced in terms of structure, resources and evaluation strategy. Observations made during the ARKWORK workshop, triangulated with feedback gathered from participants during and after the workshop, indicate that the schedule was too condensed and, in some cases, forced the transition between each design stage in a way that was perceived by some as abrupt. To overcome these issues, I suggest a series of refinements and improvements presented below.

8.3.1 Design Activities Structure

For future implementations of such UXD events, I would suggest a major change to the structure of the kick-off, namely altering the beginning of the workshop (see section 7.2 for an outline of the workshop's original structure). Herein more time, realistically not more than one hour, could be allocated after the introduction, and before each group starts working on the definition of the core elements of the UX, in order to build the trust that is fundamental for each participant to feel safe and comfortable. Adopting a collaborative mindset can be jarring, especially if participants are not particularly familiar with such collaborative approaches, so it is important to allocate time for people to acclimatise and become familiar with each other, taking into account how this process can vary significantly for each person. Relevant to this point is the case of Group 2: Costis, for example, perceived the process as fluid and natural, while Jennifer felt they were rushed into working together on the task at hand without enough time to get more comfortable with the group and the working space. Similarly, Andriana suggested the improvement of adding more time for participants to get to know each

other. A good solution can be found in the guided-tour approach adopted by Group 3, who spent the time allocated for the definition of the case study doing a field trip to the Castlegate area of York: being able to observe and immerse themselves in the physical space while discussing the project's requirements seemed not only to have sparked participants' creativity but also helped to ease the group members into working together. While ideal, this approach cannot always be adopted, especially for projects focused on the design of online experiences. However, time can be allocated to an orientation phase when participants can familiarise themselves with the process and the task at hand on a more embodied level by envisioning the physical space where the UX will take place, for example through bodystorming or embodied storming techniques (Schleicher et al. 2010).

A second improvement for future instantiations of UX events in heritage concerns the ideation stage, when participants focus on the design of the experience, and its connection with the prototyping phase. In design methodologies such as Design Thinking, the creative process is based on divergent and convergent thinking, so a number of possible ideas are identified before refining and narrowing down to the best idea(s). Divergent thinking is defined as a strategy of solving problems focused on generating a large number of alternative responses and original solutions. Divergent thinking is associated with creativity, as this phase is meant for exploring unusual ideas without constraints, criticism or judgment. Convergent thinking is a problem-solving technique aimed at narrowing down options to determine a single best solution to a defined problem. During this phase, the ideas previously generated are analysed and evaluated to select a limited number of solutions for prototyping and testing (Razumnikova 2013; Woolery 2019) (Fig. 8.3).

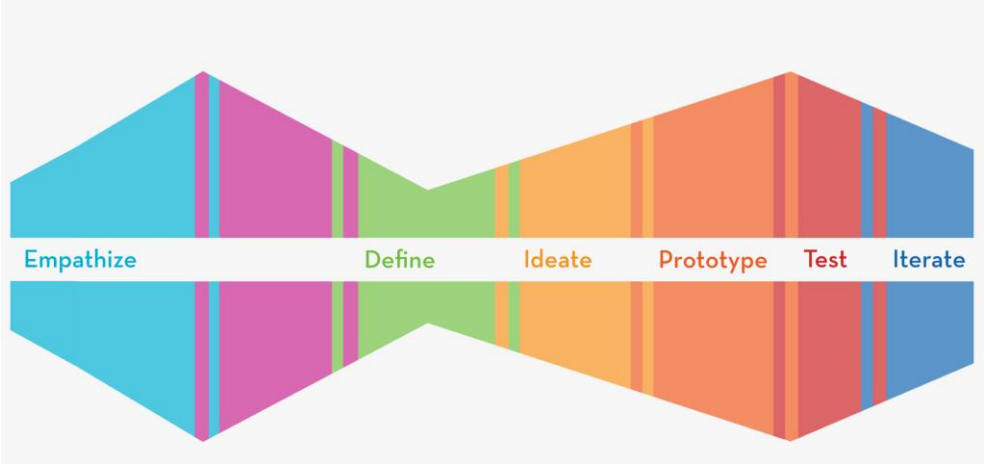


Figure 8.3: An illustration of the design thinking process, showing diverging and converging phases (Woolery 2019).

While in design thinking it is considered fundamental to set a limit for ideation sessions (e.g. brainstorming) to avoid losing impetus and keep participants on topic (Woolery 2019), several participants in my own workshops argued that the time allocated for this activity was not sufficient to allow proper divergent thinking and exploration of ideas. In this case, it seems that the constraint to the creative process was the imperative placed on participants to produce a prototype to be evaluated at the end of the second day. While the majority of participants appreciated the hands-on approach and the creativity offered by low-fidelity paper prototypes, the pressure imposed by this task in some cases seems to have forced the transition to the convergent phase in a way that probably stifled some creativity from participants. Within this scenario, the role played by facilitators as well as their project briefs was pivotal. As previously mentioned, in Group 1, the facilitator's decision to present a detailed brief with tasks defined, according to a design framework previously developed, and the early focus on the prototype meant relieving participants of some pressure and allowing them to enjoy the process. However, it also meant, at least for some group members, a limited influence on the design process. Even in Group 2, while the project brief was more open-ended and flexible and all participants appreciated that the facilitator guided them from divergent to convergent thinking without imposing his vision, the process was still perceived by some as product-driven, thus limiting the potential exploration of wilder ideas in order to meet the project's requirements.

For Group 3, moving from the conceptual phase to the prototype development was perceived as a natural transition. Similarly to Group 2, the project brief was quite open-ended and the facilitator intervened only when necessary, mainly to mediate the group dynamic and ensure that each member had equal power and influence over the process. In this case, the adoption within the ideation phase of a creative matrix to visualise the core elements of the design suggested by one participant seemed to have helped the group to seamlessly move to the convergent phase (see Fig. 8.7 below).

In regard to Group 4, the openness of the brief proved to be counterproductive for the creative process: since both aims and target audience for the project were quite broad, the group struggled from the outset with the definition of the main components of the design. Moreover, during the brainstorming session the conversation often went off topic and the mindset was often more critical than generative, preventing the group from exploring wilder ideas and sharing knowledge in a productive way. Consequently, the

group had to rush through the prototyping phase without having had the opportunity to move beyond more obvious solutions.

Despite these issues, prototypes proved to be fundamental in supporting the design process not only as a tangible representation of design ideas and concepts, but also as vehicles for sharing knowledge and combining participants' expertise (Mason 2015). As discussed in Chapter 7 (section 7.2.4.2), going through the ideation and prototyping phases fostered very meaningful discussions among participants concerning audiences' needs, the importance of social presence in archaeogames, the pivotal role played by the emotional and social components within UX, as well as the need to take into account the physicality of the experience and embed as much as possible the digital components within the physical space.

In order to better frame the prototyping activity within the design process and to further promote cross-contamination of ideas and meaningful discussions among participants, the final activity - focused on the presentation of prototypes - should be structured in a different way in the future. Specifically, we should aim to adopt more reflexive evaluation practices (Galani and Kidd 2019), removing the performative pressure of having to produce an actual prototype, even if a low-fidelity one, by focusing on the process rather than the product. For example, instead of just presenting the prototype to other participants I could have instructed each group to use or take a picture of all the materials produced at the end of each activity (e.g. post-it notes, white paper boards or persona cards) and use them as prompts to explain how they have conceived, developed and then prototyped the digitally mediated experience. This way, I could have asked each group to outline how they worked as a team, what kind of decisions were made during each activity and how such decisions led to the final prototype. Allowing participants to present their designs though a retrospective narrative of the creative process would have enabled them to continue to reflect on their own work within the group, while offering other participants useful insights on how the collaborative process unfolded in their group and how their decision-making process shaped the design outcome.

This evaluation approach can potentially lead participants to more meaningful and critical collective reflections on design and participatory practices and the ways in which they can be integrated within archaeological practice, while providing more

effective evaluation outputs through understanding of participants' gains and frustrations. Structured this way, the final activity would also improve the overall evaluation strategy, allowing to gain an even more nuanced understanding of the different ways PD processes can unfold. In this regard, observations and recordings of group activities have also proven to be extremely helpful. Both focus groups prompted meaningful discussion among participants and provided valuable feedback on the event; however, the high number of participants in the ARKWORK event was not ideal for a focus group discussion as it left several voices unheard. Large groups, in fact, can be intimidating and make people uncomfortable, limiting each person's opportunity to share insights and observations (Krueger 2009).

Letting each group present their design journey rather than just the prototype itself, using it more as a prompt to renew the collaborative design experience and reflect on it, while also gathering feedback from other participants and providing them insights into their own work, would constitute in fact a better approach to evaluate both design outputs and the participatory process itself. Recording the discussions fostered by this approach, while more time-consuming in terms of analysis, is more likely to capture interesting reflections on the value of co-design approaches. Recordings should be accompanied by in-depth one-on-one interviews with participants, to investigate mutual learning and deepen understandings of whether, what and how participants actually gained from their involvement. Moreover, longitudinal studies should be conducted to better understand how participation in collaborative design processes is understood and valued over time (Bossen et al. 2012; Mann 2016). In my case, interviewing participants several months after the workshop provided invaluable insights on how the experience shaped the way they approach their own work or will conduct future research. In particular, it allowed me to investigate strengths and weaknesses of different facilitators' approaches and the actual impact each one had on participants, thus enabling me to understand what kind of facilitation approach to select to better meet the specific requirements of future collaborative design events.

8.3.2 Design Tools

In terms of resources, the tools adopted for both the design and prototyping activities are well-established within PD and have proved to be helpful in supporting participants' creative and decision-making processes. Moreover, the choice of using low-fidelity paper prototypes was particularly appreciated as it promoted creativity, while also offering a democratic approach to design since it does not require technical skills. Tools

like personas cards, scenarios and storyboarding were particularly valuable for focusing on audience needs and interests, user interaction, and for embedding the experience within the physical space where the proposed design is supposed to be used. In particular, the development of personas facilitated the transferring and sharing of knowledge, as each participant contributed to the process with their own expertise and experience. However, results from the ARKWORK workshop also highlight issues with the design toolkit adopted for the event, e.g. design cards, that in my opinion can be addressed through the improvements discussed in the following sections.

8.3.2.1 Design Cards

The design cards deck was primarily used for creating personas and only Group 2 employed them from the beginning to facilitate the design phase. Within the broader design field, card-based approaches are a long-established tool that have been developed since the 1970s and have proved to be valuable in promoting equal participation, while encouraging critical thinking and innovative ideas. As Deng et al. (2014, 696) put it "cards can help structure design discussions, ensuring a design space is viewed from different perspectives. Cards can help speed up the refinement and iteration of ideas [...] and foster focus shift when the discussion becomes unproductive". However, design cards also present weaknesses as "they can be overloading in terms of information" (Roy and Warren 2019). Some participants in my study, in fact, considered them too detailed and overburdening and advocated a more playful and heuristic use of the cards, to stimulate creative thinking rather than just supporting the design process.

For this reason, I started a process of revision and refinement of the design cards in collaboration with Dr. Sara Perry and fellow University of York (Archaeology Department and Digital Creativity Labs) PhD candidate Claire Boardman. The new deck is meant to help archaeologists and heritage professionals unfamiliar with the design process to develop digital resources for practitioners and wider audiences, by going through three design stages: vision, concept and design. Each stage terminates in a checkpoint designed to record design decisions made in phase, prevent premature exiting of the stage without consensus, and avoid solutionising. Drawing on some core principles of reflective design (Sengers at al. 2006), such checkpoints are also aimed at integrating evaluation throughout the entire process, rather than just during the final step, in order to inspire rich feedback and to make critical reflection an inherent component of the design. Moreover, while the co-design events I organised were not specifically focused on creating UXs guided by values, they fostered a critical reflection

on the values and biases that oftentimes unconsciously drive our designs. An example is provided by Group 2 in the ARKWORK workshop, where mainly male personas were developed for the UX, thus limiting the group's discussion around the needs and interests of different audiences (see section 7.2.2). Stemming from this and subsequent collective reflections with Dr. Sara Perry and Claire Boardman on how to explicitly embed values in our archaeological outputs, the first step of this card-based design approach is to select a set of guiding values for the following three design stages to consciously reflect on and implement them in the design process. By using the term 'values', I refer to moral principles that focus on and foreground human and environmental well-being.

Value-led practices concerned with supporting human values have a long tradition within the design field. PD originated as a design movement committed to the values of democracy and empowerment of end users in the systems development process, by addressing unequal power relationships within the workplace. However, according to Iversen et al. (2012) it has not always made explicit how values are embedded within the design process. In order to address this issue, they propose a values-led participatory design approach to achieve core engagement with values considered to be the ultimate aim of PD. In their approach, values, defined as "enduring beliefs that we hold concerning *desirable modes of conduct* or *end-state of existence* in different situations, societies and cultural contexts (italics theirs)" (2012, 89) are considered to be the driving force of the design process.

Value sensitive design (VSD) started emerging during the early 1990s as an approach explicitly integrating human values and social context within the design process. According to Friedman and Hendry's definition (2019, 4), "value sensitive design provides theory, method and practice to account for human values in a principled and systematic manner throughout the technical design process […] Value sensitive design has come to rest on the following definition of human values: *what is important to people in their lives, with a focus on ethics and morality* (italics theirs)". Critical reflections developed during the past thirty years in HCI have led to the recognition of blind spots when it comes to unconscious assumptions with design and the potential negative impact of these blind spots on people's lives. Sengers et al. (2006) argued that critical reflection on unconscious values embedded in computing should be the foundation of technology design. Building upon existing critical approaches in HCI,

including participatory and value-sensitive design, they define reflective design as a set of design principles and strategies that support critical reflections from both designers and users about the impact of technologies in human life, by analysing how the way technology is designed actually perpetuates unconscious cultural assumptions.

However, as highlighted by Iversen et al. (2012), values are considered too difficult to articulate and actualise in design activities, and so they are often taken for granted and not explicitly confronted. In order to address these issues, for our design approach we have decided to integrate within the cards deck a set of value cards developed by Gispen (2017) as part of the Ethics for Designers toolkit (Fig. 8.4). Gispen's cards offer one of the very few examples in the field of design of explicitly value-led approaches where a template-based toolkit has been developed with the specific purpose of encouraging designers to incorporate ethics into their design process.

Figure 8.4: example of value card from Ethics for designers toolkit (Gispen 2017).

The aim of our card-based design approach is to make practitioners consciously reflect on and select guiding values that will then shape their output, in order to embed ethical

considerations into all stages of their design processes. Finally, the deck also includes a set of challenge cards with a series of provocative questions aimed at promoting critical reflection on each stage of the design process and ensure that the developed resources are reflecting the chosen values. Furthermore, challenge cards are meant to uncover unconscious biases or assumptions (as in the aforementioned case of Group 2 in the ARKWORK event), and that the wider social, cultural, political and environmental impacts of potential designs are made visible and actively evaluated.

To avoid the risk of being overwhelming in terms of content, as reported by some participants during focus groups and follow-up interviews (sections 7.2.4.3 and 8.2.2), instructions on each card have been replaced with a set of two or three questions. Using questions, rather than prescriptive instructions, also makes the design approach more flexible and tailorable to the specific needs of users (Fig 8. 5). Moreover this card-based approach is being developed as a board game completed with instructions, to add a more playful aspect and to ensure that it can be self-guided and adopted without the presence of a facilitator (Fig 8.6).

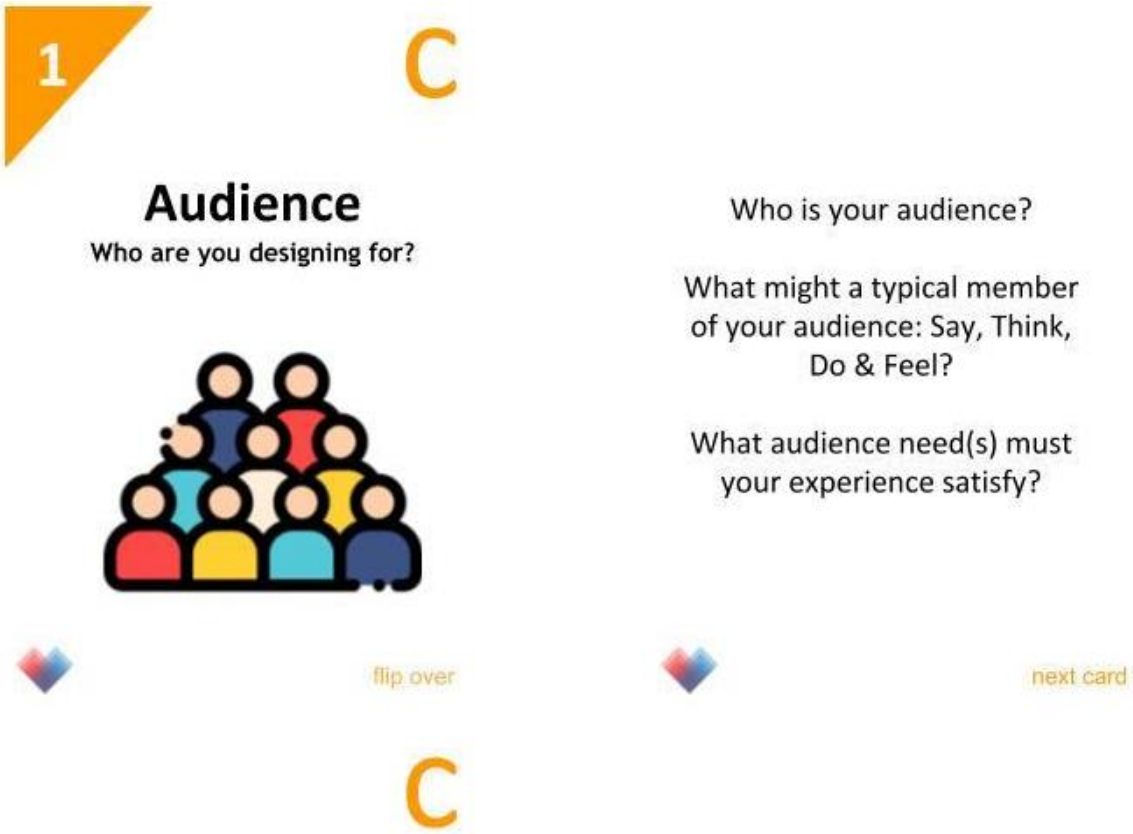


Figure 8.5: Example of cards from the value-led card-based design approach. Concept card (top) and challenge card (bottom) (credits: Francesca Dolcetti and Claire Boardman).

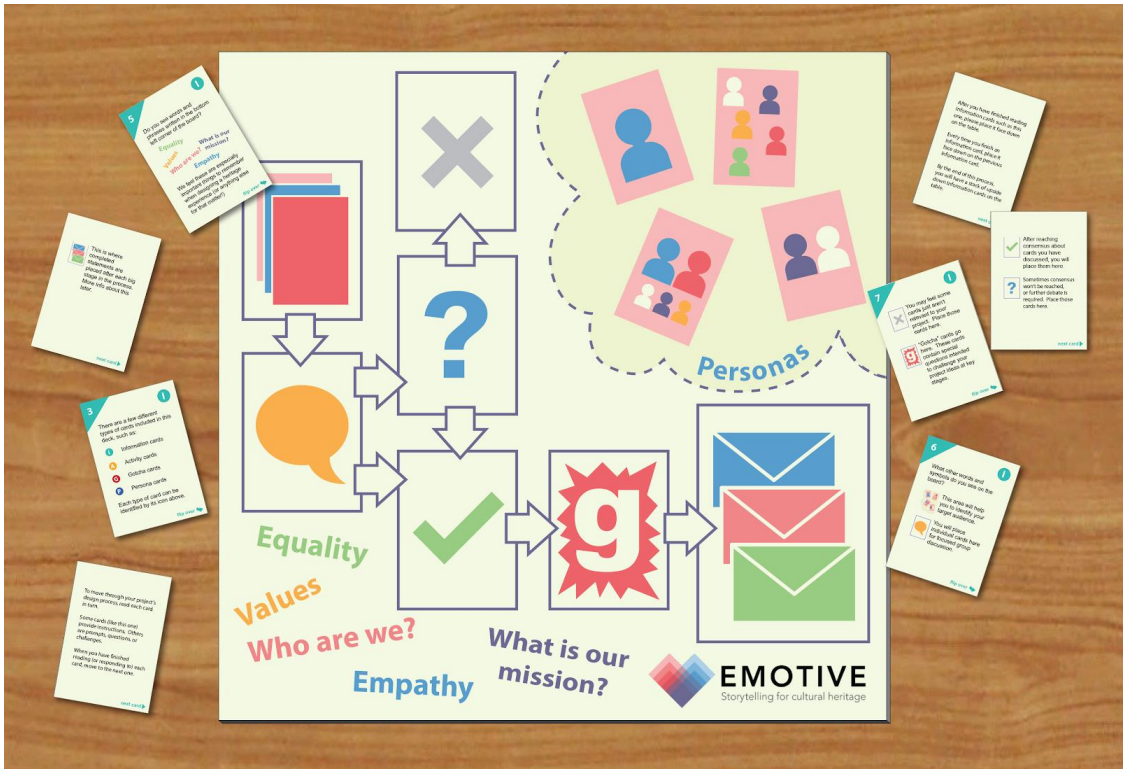
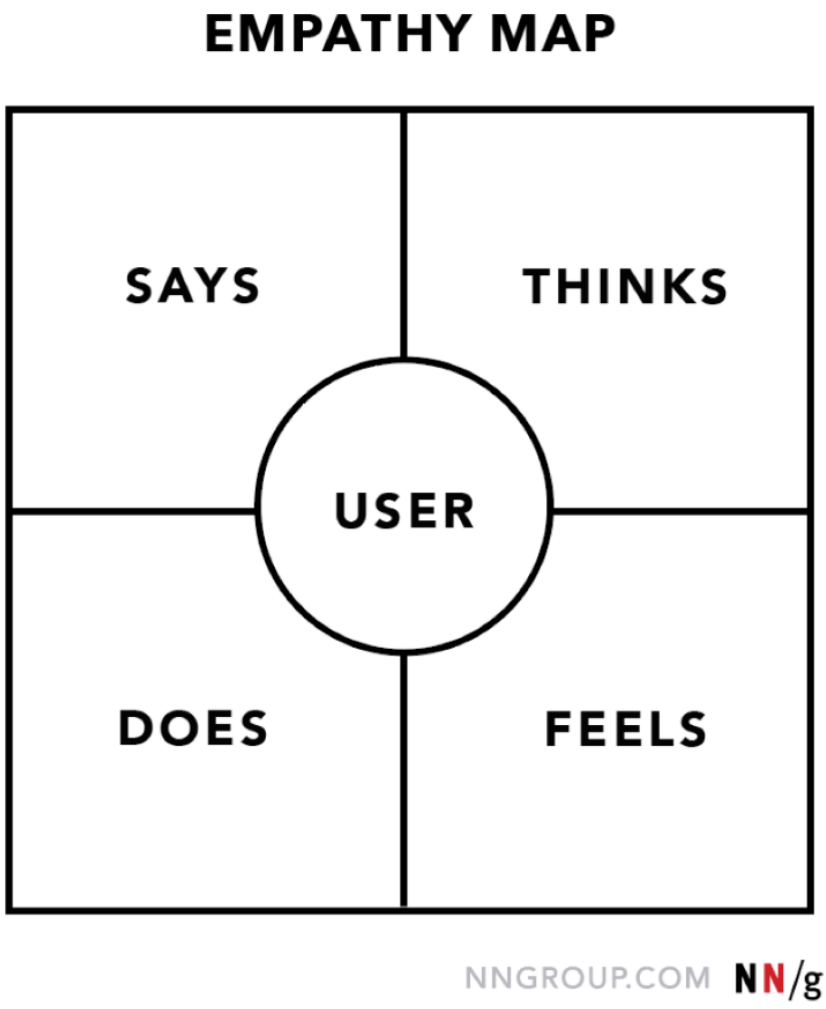


Figure 8.6: Value-led card-based design approach. Board game layout prototype layout (credit: Dr. Sara Perry; graphic by Ian Kirkpatrick).

A first prototype of this card-based design approach was tested during the Digital Data in Practice – Now and in the Future PhD Workshop, hosted at the University of York Archaeology Department in December 2019. Data collected throughout the event will be used for a further refinement and improvement of the design cards (Dolcetti et al. 2021).

8.3.2.2 Empathy Map and Matrix Framework

To further refine and improve the toolkit assembled for my research, other techniques that were effectively adopted upon the suggestion of both facilitator and participants in Group 3 should be integrated (see Chapter 7.2.2). First, empathy mapping is a meaningful means to help participants focus on users and define their needs and desires as it usually entails the definition of what users might say, think, do and feel (Nielsen Norman Group 2020) (Fig 8.7).



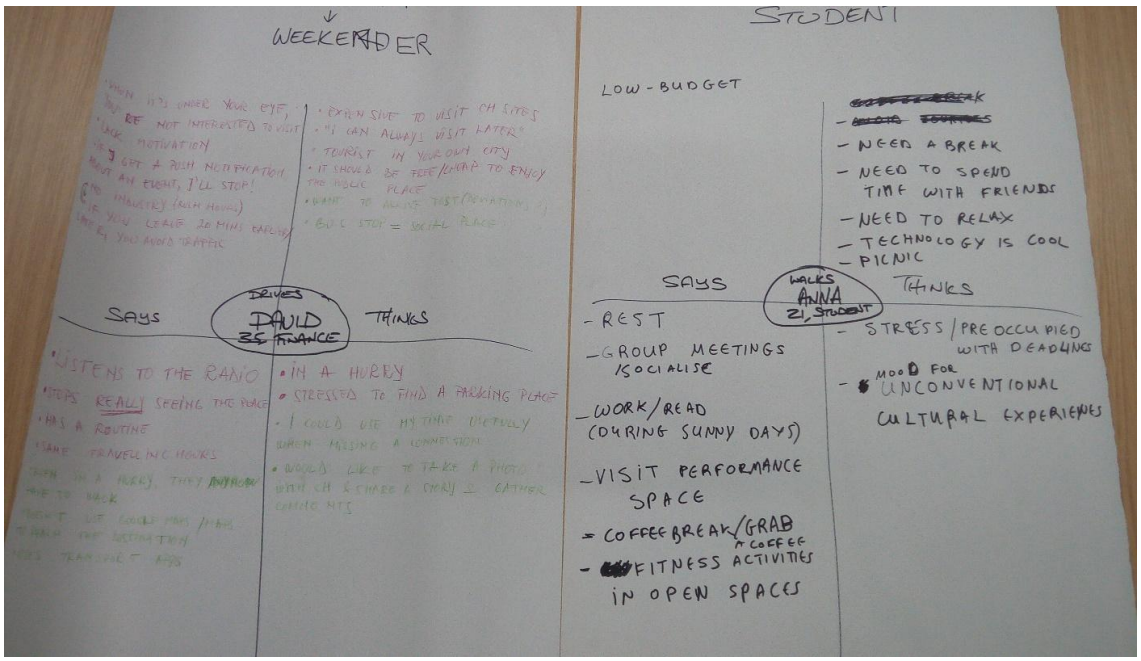


Figure 8.7: example of empathy map from Nielsen Norman Group website (Nielsen Norman Group 2020) (top); empathy map developed by Group 3 (bottom).

Often used as a background for the persona cards, empathy maps can be a useful way to visualise information about users in a clear and organised way. Group 3 adopted the empathy map to identify and visualise possible attitudes and behaviours of two macro user groups, commuters and students, within their target audience of York residents: for example commuters might be interested in weekend events when they have more time to enjoy the city, while students might be more interested in a place to socialise with friends after classes. This first step helped them to further reflect on their audience's needs by developing a user persona for each group.

Second, especially for UXD involving urban heritage, matrix frameworks such as those adopted within UNESCO's approach to managing historic urban landscapes (see Chapter 7, section 7.2.2) could be employed to visualise the design's concepts and components in a more holistic way. In Group 3, the creation of a grid where each column represents a component of the human environment during the ideation phase was considered pivotal for the UXD development, as it helped participants to take into account not only the physical environment in which the experience was set to take place, but also intangible heritage, cultural and socio-economic factors. Claire, in fact, during the focus group at the end of the first day pointed out that, for her, the development of the matrix represented a real breakthrough, as it allowed them to better

contextualise the heritage component within a more comprehensive and engaging UX (Fig 8.8).

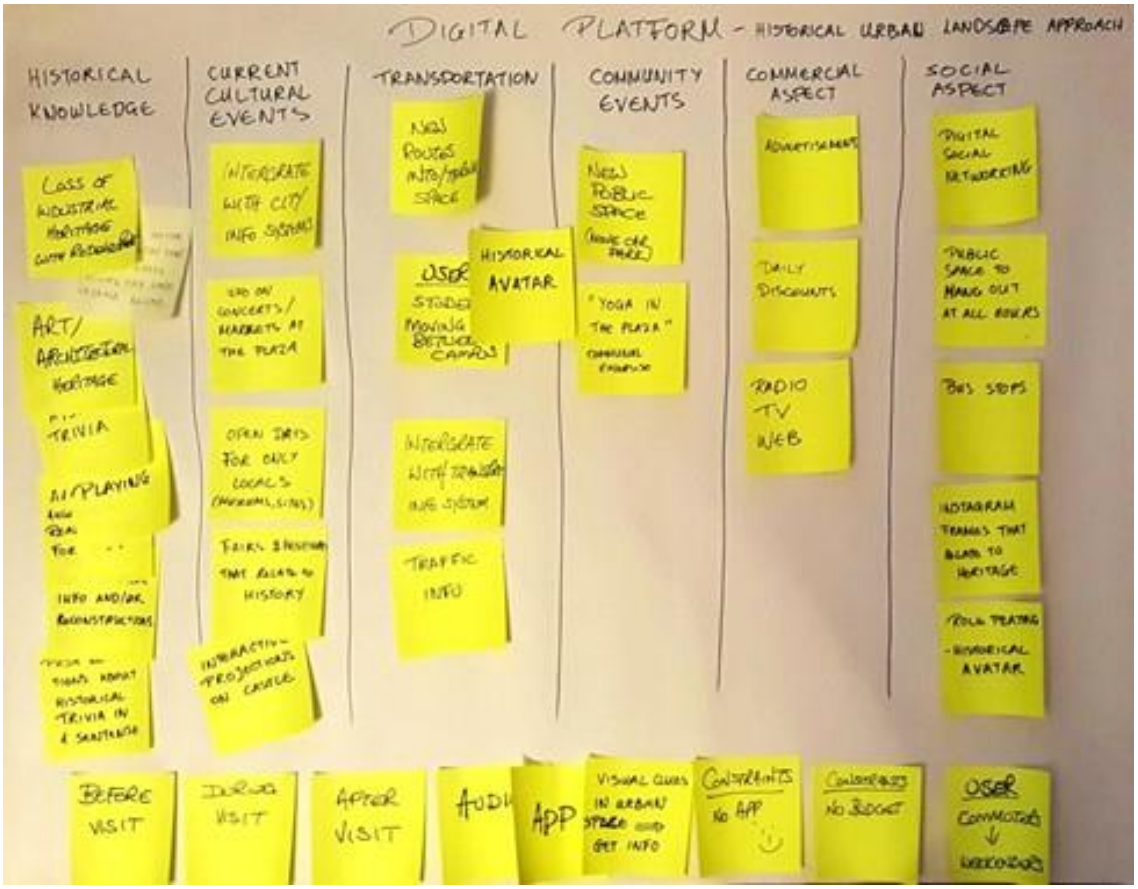


Figure 8.8: Design Resources. Matrix framework developed by Group 3.

Moreover, bodystorming techniques to experience the prototype (Brandt and Sanders 2012) should be adopted, as evidenced by the analysis of Group 1's activities: playing with the board game, in fact, prompted interesting and important reflections on the educational and ethical aspects of archaeogames and how to use game rules to convey the gravity of sensitive topics such as slavery. Bodystorming should also be integrated alongside the other design methods as a means to provide a more embodied presentation of the prototype and allow other participants to physically explore the design. Finally, as suggested by facilitators during both focus groups and follow-up interviews, a preliminary co-design stage needs to be undertaken to coordinate with facilitators to discuss strategy and tools in order to not only tailor the toolkit in accordance with each project's specific requirements and needs, but also to ensure that each facilitator has all the resources necessary to support the group throughout the design process (Fig. 8.9).

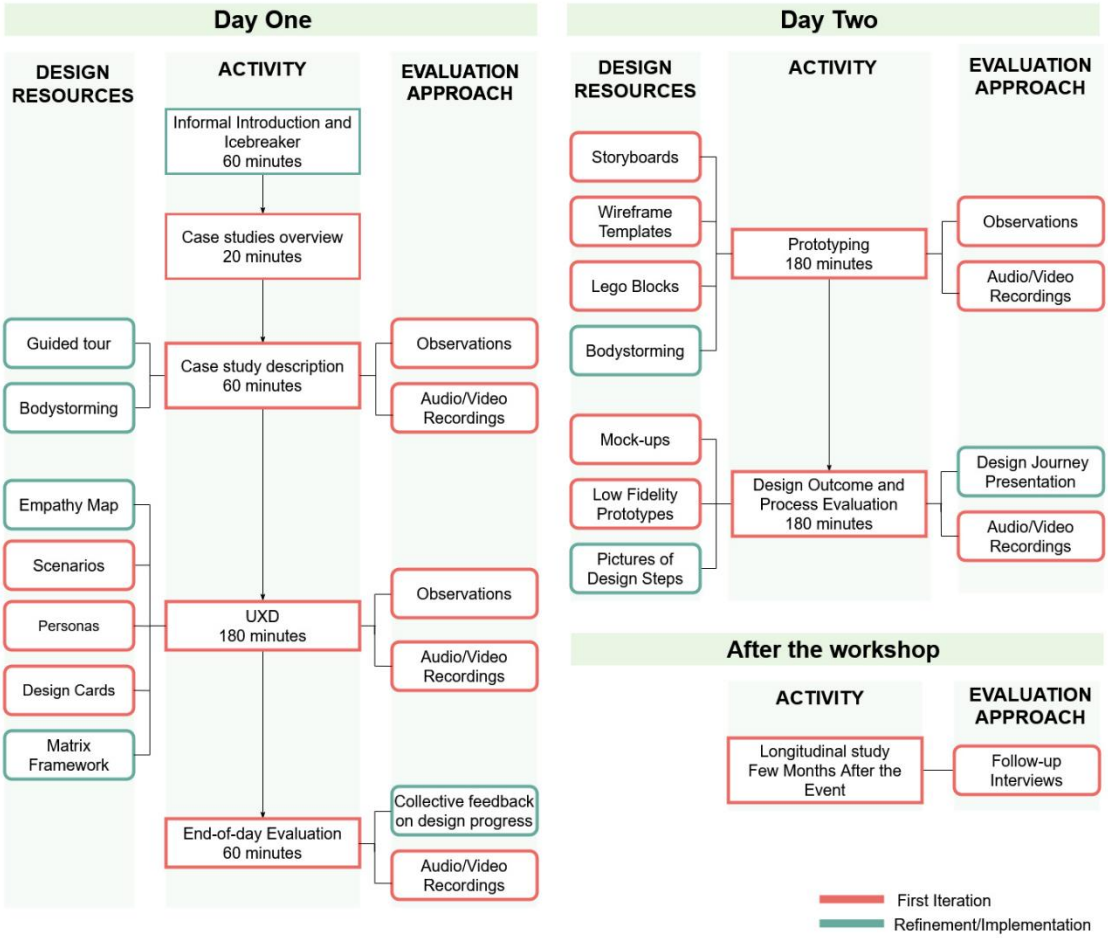


Figure 8.9: Diagram illustrating workflows, design techniques and resources, and evaluation approaches for co-design workshops (credit: Francesca Dolcetti).

8.4 Summary

The research presented here has highlighted issues concerning the application of digital technologies and the development of digital resources and experiences in both archaeological and heritage sectors. This research has also demonstrated the benefits of integrating UX and collaborative design processes into archaeological practice, while offering concrete examples of what workflows, design resources and evaluation approaches to adopt in order to actualise such practices and assess their efficacy, as visualised in Fig. 8.9.

In the following chapter (Chapter 9) I will present critical reflections on my own design process, discussing the challenges encountered and what I would have done differently, in light of the lessons learned and insight gained through the process. I will also suggest future research directions and state final conclusions.

9 Conclusion

The work presented in this dissertation has attempted to create a more meaningful kind of engagement with UX and PD practices in archaeology. By reflexively examining the decision-making and design processes behind my 3D interactive visualisation of Erimi-*Laonin tou Porakou* it was possible to establish a greater understanding of the non-linear and iterative nature of these processes, the conscious and unconscious choices I made along the way and more broadly the role that archaeologists play within the design workflow. It also promoted critical reflection on the possible implications of not integrating such processes within archaeological practice, in terms of meaningful forms of knowledge production and exchange, as well as engagement with audiences. Furthermore, the practical experience and insights gained through the co-design workshops showed me the value of adopting collaborative practices and how beneficial it is to integrate them in our workflows. In the following sections, I present an overall reflection on my research study (section 9.1) and discuss future curatorial and research directions (section 9.2) followed by final remarks (section 9.3).

9.1 Overview of Chapter Conclusions

This research has examined the problematic application of interactive digital media for both specialist and non-specialist audiences, which is most obvious in terms of the lack of consideration that is typically given to UXs and to how diverse are the needs of such audiences. My research also demonstrated the benefit of adopting UXD and PD practices for the design and co-creation of digital resources and digitally mediated experiences in both archaeological and heritage sectors. The final implementation of my own 3D model remains to be evaluated in the context of the Turin exhibition, however the design methodologies applied to its various iterations have offered key insights of relevance to all practitioners. For example, the creation and evaluation of the 3D model, originally conceived as a tool for research purposes, challenged some of the persisting preconceptions around the universal efficacy of such digital resources in conveying archaeological interpretation to diverse audiences and highlighted the tensions between perceived outcomes and actual audiences' responses. In the first instance, the modelling work was conducted in a participative way in the sense of including feedback from the archaeologists and various experts working at Erimi, although such 'participation' was perhaps performed at a somewhat unconscious level rather than as explicit intention to adopt PD practices. In retrospect, however, the way in which the experience was designed lacked consideration of diverse audiences' needs and expectations and was

still grounded in an authoritative approach to archaeological interpretation and in the notion of the 3D model as a means to deliver mainly informational content. Nevertheless, it was considered suitable for both expert and non-expert users as it was somehow implicitly assumed that other people would have experienced and perceived it through the lens of those involved in its creation. Problematically, it did not take account of the important component of emotional engagement, assuming that the Erimi research team's own personal attachments with the site were sufficient to captivate the audience. In other words, external users (i.e., people not affiliated with the Erimi team) could not experience the 3D model in an emotionally-resonant fashion, because it had not been designed for them, using evocative storytelling to generate such enchantment specific to their needs (Perry 2019).

When presented to different users and evaluated, feedback on the 3D model contradicted the Erimi team's preconceptions, as described in Chapter 5, and highlighted how we as practitioners still harbour preconceptions around audiences and the perception of the digital resources we design. Such issues were also confirmed by digital heritage practitioners and museum curators themselves working on the design and assessment of interactive digital media, as presented in Chapter 6. Although, in fact, there are a multitude of digital products developed for various audiences in archaeology and heritage, the way in which they are conceived and designed is rarely informed by reflections on the overall experience.

Several scholars have argued that to ensure the needs of users and stakeholders are truly addressed it is necessary to take their views into account and include them in the process as co-designers via PD practices (see for example Mason 2015, 394; Roussou et al. 2015; Pujol-Tost 2017; Avram et al. 2019, 251-252; Jeffrey et al. 2020, 886). Drawing from these studies, this research has sought to actively address the above-mentioned issues examining practical means to incorporate PD within archaeological practices though hands-on co-design workshops, described in Chapter 7 (Fig. 9.1).

Figure 9.1: Select images from ARKWORK workshop. UXD and prototyping activities (credit: Sara Perry).

The research has demonstrated that multidisciplinary (archaeology, heritage, gaming, design and architecture) co-creation leads to new and meaningful forms of knowledge production and sharing, as well as mutual learning. Moreover, it promotes collective and critical consideration of users' needs, the importance of the emotive component of UXs and story-based approaches, and the need to integrate digital elements within physical spaces.

This research project has been a process of trial and error and each iteration allowed me to gain a deeper insight into the issues and complexities of developing digital experiences in archaeology that are truly informed by critical reflections on design theory and participatory practices. Having the possibility to start over, I would revise the design of the Erimi interactive 3D model and UI along the following steps. First, I would devise from the beginning a design strategy that takes into account the needs of diverse audiences – such as experts in Prehistoric Cyprus, students or the local Erimi community - and allows me to develop digital resources and experiences, accordingly. Specifically, I would have created a more structured and clear definition with the Erimi

research team of why, what, how and whom they are wanting to engage. By this I mean I would decide with them from the outset what kind of digital resources they felt were needed, for what purpose, and for which audience. This would have allowed us to design and personalise the experience in a way that was meaningful not only to the research team, but also to other archaeologists and non-specialist audiences. For example, we should had been working together to outline what language to use, the amount and depth of information to provide and which media are better suited for their purposes. Second, I would incorporate a more structured PD approach from the outset by planning several iterations of co-design, evaluation and refinement sessions with archaeologists and experts working on the Erimi research project, as well as other stakeholders. In particular, the local community at Erimi, which to my utmost regret was not involved in the process. Finally, I would adopt a less didactic approach to content development, focusing more on the overall experience rather than mere delivery of information. In other words, I would develop a more nuanced narrative about the site, reflecting the uncertainty and sometimes messiness of the archaeological interpretation process and enabling a more reflective and critical engagement with the archaeological record.

As for the evaluation process, I would revise the strategy particularly in relation to the survey. Firstly I would refine the questionnaire as it was probably too long for an online survey as proved by the number of incomplete answers registered by Qualtrics. Secondly I would rethink the medium for the experience, as the loading time required by the web application Unity WebGL was sometimes too long and dependent on users' system specs and network, thus discouraging or not accessible to people with limited technology availability (see also Chapter 4, section 4.2.4.3).

In regards to the co-design workshops, as discussed in Chapter 8, I would work more closely with facilitators before the event to better ensure the suitability of case studies and briefs for the context and nature of the workshop. Then, I would revise the structure adding more time at the beginning for participants to socialise and get acquainted to ensure an easier and more comfortable transition into the collaborative design activities, for example by adopting guided tours or bodystorming exercises. Finally, I would devise a more open and fluid evaluation strategy replacing UX prototype questionnaires with a presentation of design journeys, as a more nuanced approach to evaluate both

design outputs and the design process itself by engendering collective discussion and reflection on the UX creative process.

9.2 Future Curatorial and Research Directions

My curatorial work for the exhibition "Cipro. Crocevia delle Civiltà", mentioned in the previous chapters, was recently completed and the content submitted for the thematic section 7.7: 'From fieldwork to virtual reconstruction: 3D models and immersive experiences'. Drawing from the ideas developed during the first co-design workshop (see Chapter 7, section 7.1) and working in collaboration with colleagues at the University of York Archaeology Department and The Centre for the Study of Christianity & Culture, the museum experience was developed as a multi-sensorial visit of the archaeological site of Erimi-*Laonin tou Porakou,* with the aim of enhancing visitors' perceptions of and engagements with ancient material culture through different media.

The visitors' pathway starts with 3D printed replicas of three artefacts selected from the Erimi assemblage: a goat-shaped askos, a comb-shaped pendant and a decorated spindle whorl. The aim is to provide visitors with a tactile, embodied experience with the objects, enabling them to grasp material qualities of the artefacts and improve understanding of their possible functions in the past. This experience aims to transform the passive learning process into an active performance, which enables people to make sense of artefacts and their past functions through physical manipulation. Along with the 3D prints, visitors can engage with 3D digital replicas of the same objects, while retrieving more contextualised information on their function via interactive tablets (Fig. 9.2). Then, the gallery space presents an interactive touch screen kiosk to allow visitors to engage with the 3D model of the workshop complex. The original 3D model, which was designed as a computer-based standalone feature, has been refined and enhanced in order to be explored via the touchscreen while also providing contextual information about the site, the life of the community and the objects on display within the gallery space (work carried out by Patrick Gibbs and James Osborn at The Centre for the Study of Christianity & Culture). The touchscreen kiosk interpretation software allows visitors to familiarise themselves with Erimi through a more active, exploratory method of introduction to the site, while also enabling them to better contextualise and engage with the rest of the exhibits in the gallery space.

Figure 9.2: Exhibition tablet app. View goat-shaped askos digital replica (credit: Patrick Gibbs).

To further enhance visitors' experiences and convey a sense of a lived place, the 3D model is populated with animated characters (work carried out by Ben Paul at the Theatre, Film, Television and Interactive Media Department, University of York), performing working activities supposedly carried out at the workshop complex. Moreover, associated with the touchscreen installation are both human and natural

sounds, designed to complement and enhance the screen-based visuals. The design of the exhibition path is meant to offer a journey into the site of Erimi and its community through the stories and lives of the artefacts displayed, encouraging visitors to reflect on what these artefacts tell us about the identity of the community who made them (Dolcetti 2021 forthcoming). The exhibition will also allow me to conduct further evaluation and data collection on audience reception of the Erimi interactive 3D model when experienced alongside other digital and physical media. In regard to COVID-19, as I am no longer involved in any decision regarding the exhibition I am unaware whether or how the museum curators are planning to manage this interactive and tactile museum experience in light of the challenges presented by the coronavirus pandemic.

As a personal observation and critical reflection on digital heritage and museum practices, this curatorial work has been a very intense, and oftentimes frustrating, learning experience. Several issues emerged with the project's organisation, as would be expected in a situation where several major heritage institutions and stakeholders are involved (Royal Museums, University of Turin and the Department of Antiquities of Cyprus). The most notable issues include the lack of collaboration and proper support from the museum curators and staff, the underlying misconception from their part that interactive digital installations do not need to be curated (see section 7.1.1), as well as requests halfway through the project for implementations of technology and modalities of interaction that were impossible to achieve with the time and budget available (e.g., use 3D prints as smart replicas and connect them to tablets via expansive sensor pads). Moreover, section 7.7 was considered somehow separate from the rest of the exhibition, in the sense that it was not deemed necessary for the design of this section to be coherent with the others. As a result, I found myself in the very difficult position of working isolated from the design process of the rest of the exhibition while trying to create a transition as seamless as possible to the visitor experience I was designing.

Even though a series of understandable and necessary compromises had to be made, in my opinion some concepts included in the first project outline were too hastily dismissed by the curators, in particular the idea of moving past the traditional one-way transfer of information to encourage active participation from visitors, by allowing them to be to be more in control of their own meaning-making process. The original concept in fact was based on the premise of engaging visitors who are interacting with the 3D replicas in a dialogue around the significance of the objects displayed by asking in their

opinion, what they can tell us about the identity of the Erimi community based on the replicas. In order to bridge the gap, the idea was to prompt the conversation by asking visitors what objects are representative of their hometown and what is the meaning and value of such objects for the community that lives in that place. Moreover, it was suggested to include the possibility for visitors to leave behind their feedback and present them to other visitors. This proposal was not considered viable as it would have required additional costs for personnel to be present in the room and engage with visitors, while the museum curators preferred a self-explanatory pathway that did not require allocated staff. As for the idea of allowing for visitors' feedback to be collected and displayed, it was deemed problematic for fear of inappropriate content and the solution of a weekly display to review and eventually filter visitors' comments was considered too time consuming to be worthwhile.

While I realise that the co-design work carried out during the pilot workshop had the privilege of remaining on a more abstract and less confined level (e.g. without budgetary constraints), the highly compartmentalised approach adopted by the museum curators by not providing space for true collaboration not only was disheartening but ultimately precluded the possibility of at least exploring more creative ideas. This experience has proved to me how necessary it is to rethink the way in which archaeology and heritage core practices are conducted, by creating spaces where participatory and collaborative approaches to design are given priority.

For this reason, as for future research directions, I will continue working on the refinement and testing of values-led co-design strategies and resources for the wider professional community through a series of workshops and events. The overall aim of such work would be then to offer theoretical and practical grounding for the discipline on flexible co-design methodologies for archaeology and heritage practitioners, including tailorable toolkits for actualising co-design work; as well as promoting values-led design and co-design as conceptual models.

Within the discipline, we are witnessing an increasing attention to UX, with the focus shifting from the awe of digital technologies to critical reflection about how such technologies shape people's encounters and engagement with archaeology and heritage. A more critical approach is in fact growing within and outside the discipline, with scholars and practitioners advocating for the adoption of a more reflective and

participative design that encourages critical self-awareness of the unconscious values embedded in design, enables users to engage in a more reflective and emotional fashion and gives them control over the decision-making process. The call for more critical use of digital heritage applications by communities and stakeholders and value-led design, should be followed alongside the tendency in contemporary design field that suggests a move away from engagement of limited stakeholders towards more community-driven involvements as a sustainable practice of social change (Quanjer 2013; Economou 2015, 225; Smith and Iversen 2018; Di Giuseppantonio Di Franco et al. 2019, 2).

Within the design field, in fact, a growing body of work has been raising ethical concerns around the social, political and environmental consequences of design in general and technology in particular. To quote Kranzberg (1986, 545) “technology is neither good nor bad; nor is it neutral”, meaning that technology has environmental, social and human consequences. Thus design matters and should be driven by values that foreground the well-being of all human beings. More and more practitioners have been speaking out on the pitfalls of design, especially the lack of accountability for designers' assumptions and methods, while also voicing their concerns about who is left out of the design process. Jen (2017), for example, bluntly calls for designers to engage in self-criticism around their work, while Monteiro (2019, 22) provocatively states that, “empathy is a pretty word for exclusion. I’ve seen all-male all-white teams taking “empathy workshops” to see how women think. If you want to know how women should use something you’re designing, get a woman on your design team. They’re not extinct. We don’t need to study them. We can hire them!”. In her critique on design thinking in HCD, particularly on empathy, Benjamin (2019, 174) points out that in order to tackle issues of discriminatory design in technology, we need to ask ourselves “*which humans* are prioritized in the process (italic hers)”. The concept of design justice, presented by Costanza-Chock (2020), aims at addressing this issue by rethinking the design process in a way that centres marginalised people and communities and uses collaborative practices. Design justice principles have been developed within a community of practice to offer design practitioners practical guidelines that avoid replicating existing inequalities and ensure the development of sustainable and community-led outcomes.

To this matter, a very interesting example is provided by the research carried out by Dr. Paola DiGiuseppantonio DiFranco (University of Essex) and Dr. Fabrizio Galeazzi

(StoryLab Research Institute, Anglia Ruskin University) for the Italia Terremotata project, a VR interactive documentary featuring members of the Italian community of Senerchia telling their experiences (many of them for the first time in decades) of being uprooted from their lives and homes after the 1980 earthquake in the South of Italy (University of Essex nd). Here, digital resources (360 panoramas of Senerchia integrated with soundscapes, archival materials and video interviews) have been developed with and for community members as a means to reconnect with their lost tangible heritage and recollect aspect of their intangible heritage, such as cultural identity and sense of place. I believe this project reflects what design justice should be and look like in our discipline, building grassroot projects where the community decide what heritage is relevant for its cultural identity.

As for design, archaeology does not exist in a vacuum, but positions itself as relevant for contemporary society. Thus, we as practitioners should consider first and foremost the consequences of our work, what biases we are unconsciously embedding in our designs and who we are excluding. Recent events, such as the Black Lives Matter protests, have once again foregrounded the call for decolonialising archaeology and heritage practice and holding institutions accountable for their actions. As such, the adoption of value-led methods ensuring that social, cultural, political and environmental impacts of potential designs are made visible and actively evaluated have become even more imperative.

9.3 Final Conclusion

As a discipline, the field of archaeology needs to explore ways to include critical reflection on design and participation within the process of knowledge creation, dissemination and meaning making. As Economou (2015, 225) states in her review of digital heritage applications "in order for heritage organizations and custodians to maintain contact with diverse audiences and ensure that heritage remains relevant in a rapidly changing world, it is necessary to examine openly the questions that digital heritage brings up and invite user communities to participate in this continuous process of reinterpretation and mutual exchange".

Incorporating PD and co-design principles into archaeological practice enables practitioners to reflect on why, what and for whom they are designing. Reflection can make them be more aware of their role in the development of digital resources for the discipline, while identifying what conscious and unconscious values and assumptions

drive and shape the decision-making process. Moreover, these approaches can highlight ways in which practitioners can design experiences that better reflect the fluidity, multivocality and sometimes messiness, of the interpretive process and engage audiences more meaningfully with the archaeological record.

Collaborative practices, though, are not free of risks nor costs, as pointed out by Flinders et al. (2016, 266): "coproduction is a risky method of social inquiry for academics. It is time-consuming, ethically complex, emotionally demanding, inherently unstable, vulnerable to external shocks, subject to competing demands and expectations, and other scholars (journals, funders, and so on) may not even recognise its outputs as representing 'real' research". Similarly, Oliver et al. (2019) argue that while PD and co-design practices have a profound impact on research practices, there are challenges and costs that need to be carefully considered, not to mention the fact that this kind of research is often carried out by (mostly female) junior researchers without proper support and resources from institutional management and senior academics.

While the costs of coproduction can be quantified - in economic, professional and even personal terms - the costs of not engaging with collaborative design practices are more difficult to gauge, a situation that is worsened by the paucity of evaluation studies and outcomes assessment. However, as archaeology foregrounds its relevance for contemporary society and potential in delivering public (social, economic and environmental) benefits, it needs to demonstrate how such benefits are delivered and why public funds should be allocated for it. As such, collaborative practices engendering wider inclusion and active participation are essential to claim archaeology worthiness of public funding (CIfA 2020; Kiddey 2020).

As this research has demonstrated, engaging with core design epistemologies provides meaningful opportunities in terms of knowledge production and exchange. Adopting a critical, values-led and participatory approach is challenging, as it involves a steep learning curve and requires commitment, a supportive and nurturing work environment, as well as good facilitators to guide the design process. Nevertheless, especially when supported by resources such as values-led design cards (Dolcetti et al. 2021), the approach is worth the cost as it offers a means to rethink digital heritage experiences, generating resources that are truly critically engaged and meaningful both for designers and the users of these resources.