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Research review

Navigating the digital limes: Transformative practices and challenges in Classical and Mediterranean archaeology

Abstract

This paper examines the profound impact of digital technology on Classical and Mediterranean archaeology, with a focus on digital field recording and infrastructures. Using the “Skeuomorphism of Practice” framework, it traces the integration of technology into our existing methodologies. The Swedish Pompeii Project is used as a case study to illustrate the adoption of 3D models into traditional archaeological practices. While highlighting the benefits, the paper also addresses the tensions between traditional and digital methods. As archaeological practices increasingly generate digital data, the role of infrastructures as collaborative hubs is emphasized. The study questions the adequacy of current pedagogy in preparing students for the digital and technological landscapes and argues for continued critical reflection on the impact of technology.*

Keywords: digital archaeology, digital practice, Skeuomorphism of Practice, 3D visualization

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Introduction

The spread of digital technology in our society represents, at the same time, a major challenge and a driving force for societal progress. Our engagement with the physical world is facilitated by digital media, which effectively provides us with the

tools to manage vast amounts of data at our fingertips. This major shift in the way we access and share information has had a significant effect on our decision-making processes and has forever changed the way we interact with the environment.

The growth of this practice has led to the development of technology that is able to capture, extract and present information in a way that goes beyond our natural ability to perceive data; in fact, perhaps unimaginable less than 20 years ago, today almost everyone carries mobile technology that can provide access to more information than a national library, capture and display high-resolution media, interact with 3D environments, read QR codes and, in some cases, even generate 3D laser-based models.

Since its introduction and diffusion, digital technology has had an impact on society at all levels, and in the field of archaeology, this change has been evident since the end of the last century and has accelerated over time to the point where it now affects every single segment of the discipline. This phenomenon is well described by Ezra Zubrow, who points out that, regardless of different theoretical perspectives, there is a clear convergence between archaeological theory and digital technology,¹ starting with computational aspects of digital archaeology linked to processualist approaches and moving towards post-processualist perspectives, where the dynamics of the human mind and cultural influences intricately shape computation and digital representation.²

The recent diffusion of advanced sensors and spatial recording technologies in Classical and Mediterranean archaeology has stimulated the development of experiments designed to capture and analyse materials and sites scattered over enormous areas of landscape.³ This has made it possible

* I would like to thank the Editorial Committee of the Swedish Institutes at Athens and Rome for the opportunity to write this review. It has been a great learning experience and an inspiration for further engagement with the topic of digital archaeology. I am also very grateful to my colleagues James Taylor, Henrik Gerding, Paola Derudas, Danilo Marco Campanaro and Hallvard Indgjerd for their constructive feedback on the manuscript. The paper's structure was enhanced by the assistance of ChatGPT 3.5, developed by OpenAI, and with the support of DeepL.

¹ Zubrow 2006, 19.

² Zubrow 2006, 18.

³ Moreno Escobar 2022; Casana *et al.* 2023.

to identify large-scale networks⁴ and even to assess qualitative and quantitative aspects of human perception of the past.⁵

This shift in approach has significant implications for how archaeologists collect, analyse, store and reuse archaeological data, and provides a new set of research methodologies and datasets to include in their daily practice.⁶ This transition extends beyond fieldwork, influencing the foundations of how we archive, retrieve and navigate through our evolving datasets. As we grapple with the challenges posed by this surge in data acquisition, modern web-based data management platforms have emerged as revolutionary tools, redefining the way we engage with archaeological information and offering valuable insights into the complexities of archaeological practice.⁷ This transition has been rapid and not without challenges, and many scholars have cautioned against embracing new technologies without carefully considering their implications.⁸ The more we enhance our capabilities with information systems, the more (if we are not careful) we expose ourselves to the very limits of the systems we create.⁹

As the field of archaeology undergoes exponential growth, marked by a surge in engagement with digital tools, it brings with it a diverse range of innovative methods and a substantial influx of data. What are the affordances of these new datasets? How can they be used to address complex questions? And most crucially, what is lost in this transition?

The infusion of hard science into archaeology has been both transformative and challenging, particularly in terms of interpretation. In 2014, Kristian Kristiansen highlighted what he called the “third scientific revolution” in archaeology, emphasizing the profound impact of hard science on archaeological interpretation and practice.¹⁰ In this evolving landscape, the need for new visualization and analysis paradigms becomes apparent, and the introduction of these tools into our daily practice emerges as the primary solution for accessing and understanding this wealth of data.

The recently published book *Archaeological spatial analysis*, edited by Mark Gillings, Piraye Hacıgüzeller and Gary Lock,¹¹ demonstrates the broad spread and deep integration of digital archaeology into the wider field of archaeology. It shows how digital archaeology has moved from being a specialism to becoming an integral part of how archaeology is practised today, to the point where it is difficult, if not impossible, to delineate a distinct boundary within the two disciplines.

Given the breadth of the topic, this paper focuses on the role of digital field recording, interpretation and analysis in supporting and transforming archaeological practice and briefly discusses the central role of digital infrastructures in shaping archaeological research.

A skeuomorphic journey and transformative practice

The incorporation of digital technology into our investigation methods is better understood as an evolutionary process rather than a revolutionary change, with roots dating back to the mid-20th century. In Classical and Mediterranean archaeology, the need to analyse complex and well-preserved monuments and sites arose very rapidly, leading researchers to experiment early on with the use of data management systems and 3D recording and visualization techniques.

From the very beginning, 3D models and virtual reality have been seen as tools that force researchers to adopt a more structured and logical approach to their work¹² to explore new ideas¹³ and to simulate—rather than visualize—multiple versions of the past.¹⁴ Despite these early expectations, it took several years before archaeologists began to actively and critically use 3D visualization as a tool to support their interpretations.¹⁵ Among the various examples, Bernard Frischer and John Fillwalk provided a remarkable illustration of the use of 3D models to support archaeological investigations. Their work, which integrated 3D reconstruction and computer simulation systems, explored the relationships between different monuments on the Campus Martius in Rome and demonstrated the powerful impact of 3D visualization in supporting archaeological interpretation.¹⁶

Establishing a research practice that integrates new ways of interacting with data requires transformative change. It demands the implementation of innovative research tools that enable scholars to engage deeply and insightfully with digital materials, it depends on the potential for reuse of digital data generated by other researchers, and it involves dynamic interaction and knowledge-sharing with a vastly expanded community of stakeholders. In addressing this challenge, archaeologists find themselves in a major paradigm shift that requires a comprehensive re-evaluation and upgrading of skills. In order to navigate the evolving land-

⁴ Östborn & Gerding 2023; Brughmans & Peeples 2023.

⁵ Landeschi & Betts 2023.

⁶ Dell'Unto & Landeschi 2022.

⁷ Katsianis *et al.* 2021; Derudas *et al.* 2023.

⁸ Huggett 2017; Morgan & Wright 2018.

⁹ Pedersen & Brincker 2021.

¹⁰ Kristiansen 2014.

¹¹ Gillings *et al.* 2020.

¹² Renfrew 1997.

¹³ Gillings 1999.

¹⁴ Reilly 1991; Forte & Silotti 1997; Forte 2010.

¹⁵ Frischer 2008.

¹⁶ Frischer & Fillwalk 2013.

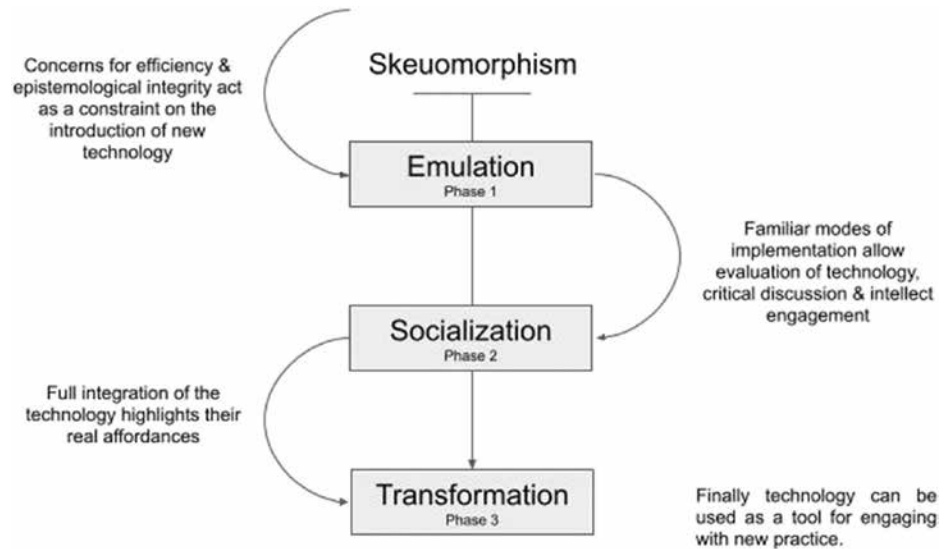


Fig. 1. Diagram showing the phases of the Skeuomorphism of Practice analytical framework. Image from Taylor & Dell'Unto 2021, fig. 1; CC BY-NC 4.0.

scape of digital archaeology, they will need to give up some (more traditional) skills, while at the same time embracing the acquisition and refinement of new ones.

Within archaeological field practice, scholars have raised awareness of the implications of the digital age on the organization of work, emphasizing its impact on the delicate interplay between tools, individuals, practices and methods.¹⁷ Jeremy Huggett argues for a deep and critical understanding of the cognitive impact of digital tools in archaeological practice, asserting that “the tools we use to examine our objects of study change our relationship to them”.¹⁸ In exploring the impact of digital technology on Classical and Mediterranean archaeology, this paper employs the “Skeuomorphism of Practice” analytical framework. This approach encompasses three distinct phases of technological development: emulation, socialization and transformation, and is based on the principle that each of these phases plays an equal and crucial role in the advancement of practice (Fig. 1).

The Skeuomorphism of Practice analytical framework is built on the assumption that its explicit recognition as a central element in adopting and integrating new technologies is more likely to foster a reflexive development of practice beyond traditional research paradigms.¹⁹ While the recent use and development of new digital methods in archaeology have not always followed a linear and constant progression, a similar implementation following these three phases can be observed in various case studies.²⁰

An excellent example of this shift in practice can be seen in the development of the Swedish Pompeii Project. The project, initiated in 2000 by the Swedish Institute of Classical Studies in Rome, was conceived to document and analyse an entire Pompeian city block, Insula V 1. The archaeological documentation produced over the years by the research team has been meticulously organized and shared through the project’s website (<https://www.pompejiprojektet.se/>), which cleverly presents a complete record of every house, room, wall and feature identified during the survey. Over the years, the project has engaged with new forms of digital documentation, such as orthoimages and 3D models, that have been merged with the rest of the records and made available through the same web platform.

The website is structured to mimic a traditional publication and provides archaeological reports (in the form of digital text and images) describing the work carried out over the years. When the project began, digital publishing was in its infancy, and the increasing availability of archaeological records in digital form presented an opportunity for researchers and practitioners to actively engage with and explore this emerging mode of documentation and archiving. Emulation was key to providing continuity and encouraging the transfer of established practice into the digital realm. The original idea was to structure the website as a constantly updated book accessible to scholars who have access to the internet.

This process allowed the integration of new data representations into the Swedish Pompeii Project’s research framework, broadening the project’s methodological horizons and fostering a dynamic synergy between digital archaeology and conventional archaeological practices. This symbiotic relationship between cutting-edge data approaches and established methods has enriched the understanding of the com-

¹⁷ Caraher 2019, 381.

¹⁸ Huggett 2017, 1.

¹⁹ Taylor & Dell’Unto 2021.

²⁰ See Taylor & Dell’Unto 2021.

plex chronological relationships between the structures that constitute Insula V 1, paving the way for a more comprehensive and nuanced site exploration.²¹

One of the first results of this shift can be observed during the synergetic use and interplay between orthoimages and 3D models. In 2011, a 3D acquisition campaign was developed in collaboration with the Visual Computing Laboratory, CNR-ISTI. This work (still experimental at the time) resulted in the complete 3D acquisition of Insula V 1. The 3D models were made available through 3DHOP (<https://3dhop.net/>), an open-source framework for creating interactive web presentations of high-resolution 3D models and then connected to the Swedish Pompeii Project website.²² The system was customized with measurement tools, made available through the project website, and used to support scholars interested in performing detailed measurements and observations of the structures described through the models.

The platform was employed to gather observations, identify information and form new interpretations. After working—and thus socializing—with the models for a number of years, the researchers actively involved in the project concluded that the use of 3D models was central to gaining a clearer perspective on the different phases that characterized the development of the structures and to promoting a comprehensive understanding of the entire *insula*.²³

They also argue that if they have to continue their work in another *insula*, they will use 3D recording from the beginning in order to enable “remote assessment and team interpretation as soon as possible”.²⁴ This statement illustrates how a transformation occurred at the end of a skeuomorphic process, highlighting how the slow, critical, and experimental introduction of new technology led to a successful change in practice. This transition was critically scrutinized by the Swedish Pompeii Project team and entailed meticulous discussions involving various specialists.

This skeuomorphic process has not only opened up new avenues but has also paved the way for unforeseen paths of research. It has enabled archaeological interpretations to encompass a wider range of elements, including but not limited to light, visibility, sound and other factors that were previously beyond the scope of exploration.²⁵ This expanded spectrum enriches our understanding and allows for a more comprehensive and nuanced analysis of archaeological phenomena, contributing to a higher level of knowledge production in the field.

Transformative tensions: Balancing the complexity of digital archaeology in archaeological field practices

We are living in a time when digital practices are being tested, used and integrated to support field interpretation. The many experiments developed in recent years and the systematic coupling with new technologies have facilitated and encouraged the establishment of new cognitive processes that have significantly improved our ability to identify, process and analyse information and have expanded our cognitive capabilities.²⁶ However, this integration also increases the amount of time we spend with acquired materials and the volume of data that requires careful storage and curation. For these new practices to be seamlessly integrated into archaeological investigations, their results must be effective aids to interpretation and should play a central role in identifying and establishing new research directions. The tension between traditional practice and digital data is well described by Eric Poehler in the framework activities of the Pompeii Quadriporticus Project (<https://www.umass.edu/classics/pompeii-quadriporticus-project>) and the Pompeii Bibliography and Mapping Project (<https://digitalhumanities.umass.edu/pbmp/>). In particular, he discusses how digital technology is dissolving the boundary between fieldwork and library research and observes that the implications of this process on future research are not yet fully understood.²⁷ This remark highlights that the integration of digital technology is not just an additional tool but rather a transformative change that will have a profound impact on the very fabric of archaeological practice. Poehler’s article demonstrates how linking spatial and bibliographic information in a single representation allows new data to be identified in an intuitive way. Poehler’s insightful discussion goes beyond breaking down the walls between fieldwork and library research, delving into the uncharted territory of time management within these evolving methodologies. He raises a critical question: how to compensate for the additional time required to add these operations during the field investigation?

The article suggests that one solution lies in finding efficiencies in other parts of the archaeological process. The use of technology to speed up operations that typically take a considerable amount of time can free up valuable resources. This reclaimed time, it is suggested, can be redirected to secondary research in the field or at the desk of the specialist.²⁸ However, while the integration of technology is undoubtedly underway, there is a potential danger in this shift if it is done passively

²¹ Leander Touati *et al.* 2021.

²² Dell’Unto *et al.* 2015.

²³ Leander Touati *et al.* 2021; 2024.

²⁴ Leander Touati *et al.* 2021, 224.

²⁵ Campanaro 2023.

²⁶ See Clark & Chalmers 1998, for a more detailed discussion of this issue.

²⁷ Poehler 2016.

²⁸ Poehler 2016.

and without critical reflection. Poehler's article encourages us to consider what might be sacrificed in the process and what aspects of traditional practice should be retained. This raises the fundamental challenge of balancing technological efficiency with the preservation of essential elements of archaeological research methodology and well represents how we constantly both duel and couple with technology for the establishment of new and effective cognitive processes.

An example of the benefits of such an approach can be observed in the framework activities of the Keros–Naxos Seaways Project, led by Colin Renfrew and Michael Boyd. The project implemented an advanced digital documentation methodology designed to provide researchers with an infrastructure capable of managing and linking all records and activities undertaken throughout the investigation.

The authors highlight how the adoption of this digital approach greatly contributed to establishing a multivocal environment where data, once implemented in the system, were used by specialists and field archaeologists to support decision-making and data interpretation.²⁹ This case study illustrates a well-balanced approach in which technological efficiency is seamlessly combined with the preservation of essential elements of archaeological research methodology, enriching both the process and the results of the investigation.

How can we manage all these new datasets, and how should we expect to practise archaeology in the future?

The slow and steady change in practice has generated an incredible amount of digital data that suddenly needs to be stored, curated and organized. With the growing acceptance of digital infrastructures,³⁰ there has been a remarkable upsurge in their creation to support studies in Classical and Mediterranean archaeology. As this digital transformation unfolds, it is becoming clear that these digital platforms play a central role in mediating access to data, serving as dynamic hubs that foster a more interconnected and collaborative landscape of archaeological data. More than just advanced data archives, digital infrastructures are evolving into sophisticated research environments, often used by researchers to formulate new questions, build networks, facilitate knowledge transfer and identify new research directions. However, the increasing volume and variety of data available poses a challenge.

Structured data provide significant assistance in navigating large and diverse sets of digital information, and the increasing

use and spread of natural language processing to identify and link data (although still in its early stages) has great potential.

Viewing digital infrastructures through the lens of the Skeuomorphism of Practice suggests that going through the processes of emulation and socialization can facilitate a more seamless and constant transformation, enhancing the coupling of these platforms with human practices. By engaging directly in the construction and critical evaluation of these digital environments, we address one of the discipline's most important challenges: ensuring their effectiveness and adaptability in the ever-evolving landscape of archaeological research.

Digital infrastructures are used by practitioners to share different forms of knowledge. An interesting example can be observed within the framework activities of the Tracing the Potter's Wheel (TPW) project (<https://tracingthewheel.eu/page/home>). This project not only aims to assess the appearance of the potter's wheel as a technological innovation in the Bronze Age Aegean but also serves as a valuable learning resource. It incorporates various educational elements, together with a comprehensive digital reference collection. All this valuable material is shared through the TPW Knowledge Hub, a database designed to serve a large community of users, including specialists and non-specialists. This collaborative platform facilitates the generation and dissemination of knowledge and data related to wheel-thrown pottery. Through the TPW Knowledge Hub, the project not only explores the historical innovation of the pottery wheel but also provides a significant source of information for future studies of pottery wheel technology.³¹

As an archaeology educator, I am impressed by the potential and possibilities offered by these platforms,³² and I wonder if we are adequately preparing our students to navigate the vast digital resources now available through these new infrastructures. Are we integrating this valuable material into our courses? Are we cultivating critical skills in this area? Is our pedagogical approach evolving with the dynamic digital landscape? Addressing these questions is a daunting task, especially given the speed at which technology is affecting our current practice and the limited direct experience many of us possess with digital resources.

Conclusions

In summary, the profound impact of digital technology on Classical and Mediterranean archaeology is unmistakable, marking a significant evolution in practices and methodologies. The ongoing merging of traditional methods with digital

²⁹ Boyd *et al.* 2021.

³⁰ Huggett 2023.

³¹ Hilditch *et al.* 2021.

³² Garstki *et al.* 2019.

tools is prompting critical considerations regarding time management, increased data production and potential trade-offs in conventional approaches. Within this dynamic, digital infrastructures are emerging as key players in shaping the future of the discipline, transforming themselves into dynamic hubs that foster collaboration, facilitate knowledge transfer and pave the way for exploring new research directions.

In the area of education, this paper critically questions the effectiveness of current pedagogical approaches in adequately preparing students for the dynamic challenges of the digital landscape. It underlines the need for a comprehensive examination of how educational methods adapt to the evolving nature of technology. Furthermore, the paper makes a strong case for an ongoing process of critical reflection, emphasizing the need for educators to continually evaluate and adapt their teaching strategies in response to the profound impact of technology on archaeological methodologies.

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