



Research Article

Zachary Batist, Val Masters, Tiffany C. Torma, Michael Carter, Neal Ferris, Isto Huvila, Seamus Ross, Costis Dallas*

Figurations of Digital Practice, Craft, and Agency in Two Mediterranean Fieldwork Projects

<https://doi.org/10.1515/opar-2020-0217>

received January 9, 2021; accepted December 17, 2021

Abstract: Archaeological practice is increasingly enacted within pervasive and invisible digital infrastructures, tools, and services that affect how participants engage in learning and fieldwork, and how evidence, knowledge, and expertise are produced. This article discusses the collective imaginings regarding the present and future of digital archaeological practice held by researchers working in two archaeological projects in the Eastern Mediterranean, who have normalized the use of digital tools and the adoption of digital processes in their studies. It is a part of E-CURATORS, a research project investigating how archaeologists in multiple contexts and settings incorporate pervasive digital technologies in their studies. Based on an analysis of qualitative interviews, we interpret the arguments advanced by study participants on aspects of digital work, learning, and expertise. We find that, in their sayings, participants not only characterize digital tools and workflows as having positive instrumental value, but also recognize that they may severely constrain the autonomy and agency of researchers as knowledge workers through the hyper-granularization of data, the erosion of expertise, and the mechanization of work. Participants advance a notion of digital archaeology based on do-it-yourself (DIY) practice and craft to reclaim agency from the algorithmic power of digital technology and to establish fluid, positional distribution of roles and agency, and mutual validation of expertise. Operating within discourses of labour vs efficiency, and technocracy vs agency, sayings, elicited within the archaeological situated practice in the wild, become doings, echoing archaeology's anxiety in the face of pervasive digital technology.

Keywords: figuration, archaeological practice, digital workflows, craft, DIY archaeology

Article note: This article is a part of the Special Issue on Archaeological Practice on Shifting Grounds, edited by Åsa Berggren and Antonia Davidovic-Walther.

* **Corresponding author: Costis Dallas**, Faculty of Information, University of Toronto, Toronto, M5S 3G6, Ontario, Canada, e-mail: costis.dallas@utoronto.ca

Zachary Batist, Val Masters, Tiffany C. Torma, Seamus Ross: Faculty of Information, University of Toronto, Toronto, M5S 3G6, Ontario, Canada

Michael Carter: Faculty of Communication and Design, Ryerson University, Toronto, M5B 2K3, Ontario, Canada

Neal Ferris: Department of Anthropology, Western University/Museum of Ontario Archaeology, London, N6A 5C2, Ontario, Canada

Isto Huvila: Department of ALM, Uppsala University, Uppsala, 75126, Sweden

ORCID: Zachary Batist 0000-0003-0435-508X; Val Masters 0000-0002-0443-2199; Tiffany C. Torma 0000-0002-1735-9912;

Michael Carter 0000-0003-1360-9213; Seamus Ross 0000-0001-6364-8304; Costis Dallas 0000-0001-9462-0478

1 Introduction

By the late 1950s, archaeology emerged as one of the first disciplines to adopt digital tools and methods among the human sciences (Huggett, 2013; See, e.g.: Chenhall, 1967; Cowgill, 1967; Gardin, 1958; Spaulding, 1953). Seventy years on, archaeologists now regularly use digital devices, software applications, and online services to support all aspects of the research lifecycle from the initial exploration to identify subjects worthy of investigation to final publication and peer validation of research results. The inception of digital technology in archaeological research, communication, and curation ranges from the almost universal use of personal computers and office applications to the limited deployment of large-scale centralized digital infrastructures, and everything in between. The application of digital technologies by archaeologists now includes off-the-shelf tools to construct and curate digital photos, diaries, annotations, reflexive video recording, three-dimensional (3D) models and geographic information system (GIS) representations, databases, blogs, and online reports. Archaeological research is increasingly communicated today via social media and online communication platforms (Huvila, 2014; Kansa, Kansa, & Watrall, 2011).

Scholarly interest in how digital technology can serve the purposes of archaeological research has also steadily grown. Several decades of the proceedings of the Computer Applications in Archaeology conference address how digital technologies are used for archaeological data capture, analysis, and communication, with particular focus on databases (Evans & Daly, 2006; Lock & Brown, 2000), geographic information systems, visualization, and electronic communication (Huggett & Ross, 2004; Richards, 1998; Zubrow, Evans, & Daly, 2006). Yet the tenor of that early study was to share insights and guidance about digital methods, to self-report on new methods or a novel application, or to publicize and support funding agendas supporting technological rather than archaeological priorities (Huggett, 2013). Indeed, digital archaeology research has been criticized for being under-theorized, technocratic, apolitical, and indifferent to social and cultural concerns (Cobb, 2014; Dallas, 2015; Llobera, 2011).

More recently, an “anxiety discourse” (Beale & Reilly, 2017; Huggett, 2013, 2015) has started considering critically the underlying implications digital technologies have for archaeology. This shift is exemplified not only in introspective approaches from within archaeology (Berggren & Hodder, 2003; Caraher, 2019; Chapman & Wylie, 2014; Huggett, 2015; Lucas, 2001, 2012; Morgan & Eve, 2012; Perry & Taylor, 2018; Roosevelt, Cobb, Moss, Olson, & Ünlüsoy, 2015; Shanks & McGuire, 1996; Tanasi, 2020) but also in evidence-based, qualitative, and ethnographic research on archaeological practices derived from information and archival science, sociology, social anthropology, and social studies of science (Buchanan, 2019; Dallas, 2015; Davidovic, 2008; Edgeworth, 2006; Faniel *et al.*, 2018; Faniel, Kansa, Whitcher Kansa, Barrera-Gomez, & Yakel, 2013; Goodwin, 2003; Huvila, 2008a,b, 2016; Huvila & Huggett, 2018; Huvila, Dalbello, Dallas, Faniel, & Olsson, 2019; Olsson, 2016; Richardson & Lindgren, 2017; Richardson, 2014). Our research arises from within this broader reflexive investigation. It is a part of E-CURATORS, a mixed-method, multiple-case qualitative research project, which investigates how archaeological practices as diverse as survey and excavation, digital illustration, data archiving, and public communication are increasingly enacted within pervasive and invisible digital infrastructures, tools and services, fuelled by the turn towards open (Lake, 2012) and community archaeology (Laužikas *et al.*, 2018; Moser *et al.*, 2002). E-CURATORS responds to the rise of a broader phenomenon of digital curation “in the wild”, whereby aspects of the archaeological record are selected, documented, annotated, and shared using pervasive technologies such as off-the-shelf digital tools, personal information devices, and networked infrastructures (Dallas, 2016b).

2 Analysing Archaeologists’ Ideas at Two Fieldwork Projects

In conducting this study, we view archaeological fieldwork as an activity system (Engeström, 1999; Leont’ev, 1978) involving different roles, competencies, and relationships, engaged with the production, management and curation of information, enacted in the context of purposeful activities to construct and negotiate archaeological knowledge and meaning (Carter, 2017; Dallas, 2007a, 2015; Huggett & Ross, 2004;

Huvila, 2008a, 2019a,c). Our interests also include the role of digital technologies in the curation and sustainability of archaeological and cultural heritage within custodial settings, and in the broader context of post-colonial and global communities (Dallas, 2007b, 2016b, 2018; Ferris & Welch, 2016; Huvila, 2016; Laužikas et al., 2018; Ross, 2000, 2020). We are also keenly interested to explore the possibilities of learning about archaeology from the epistemic viewpoint of information (Huvila et al., 2019).

2.1 Research Questions, Sites, and Participants

The object of our inquiry is to establish evidence-based knowledge on how archaeologists think and talk about digitally mediated work, learning and expertise, and roles and relationships in archaeological fieldwork. This differentiates our focus from scholarship providing analysis, critique, or advocacy on the merits, pitfalls, information requirements, and best practices in using digital tools and infrastructures in archaeology (Faniel et al., 2018; Kansa, Atici, Kansa, & Meadow, 2019; Meghini et al., 2017; Opitz & Johnson, 2016; Roosevelt et al., 2015). Similarly, we are not concerned here in the forms, preconditions, and future impact of digitally mediated archaeological work and knowledge (Beale & Reilly, 2017; Carter, 2017; Dallas, 2016a; Huggett, 2021; Huggett, Reilly, & Lock, 2018; Huvila, 2016; Huvila & Huggett, 2018; Llobera, 2011; Morgan & Wright, 2018; Perry & Taylor, 2018; Tanasi, 2020) or on the shortcomings and remedies to acquire digital archaeological competencies and expertise (Cook & Compton, 2018; Derudas & Berggren, 2021; Huvila, 2020; Watrall, 2019).

Our study is based on an analysis of interviews conducted with team members from two archaeological fieldwork projects in the Eastern Mediterranean to address the following research questions:

RQ1: To what extent do project team members discuss different aspects of archaeological fieldwork activity and digitally mediated practice?

RQ2: How do they situate digital technologies, tools, and procedures in their conception of archaeological knowledge work?

RQ3: How do they address issues of expertise, competences, and learning in the context of digitally mediated fieldwork?

RQ4: How do they conceive roles and relationships between team members in the context of digitally mediated fieldwork?

The two fieldwork projects we examine are the Western Argolid Regional Project (WARP) in Greece and the Pyla Koutsopetria Archaeological Project (PKAP) in Cyprus. WARP was established in 2014 as a 5 year interdisciplinary project aiming to survey a contiguous 30 km² area in the Inachos river valley, an area in north-eastern Peloponnese (Gallimore, James, Caraher, & Nakassis, 2017). In the 2019 season, the project was wrapping up fieldwork, and organizing and studying the findings. PKAP was initiated in 2003 as a “diachronic, intensive archaeological investigation of a 5 km² area on the southern coast of Cyprus” (Caraher, Moore, Noller, & Pettegrew, 2005, p. 245), and has conducted multiple seasons of archaeological survey in the Koutsopetria valley before excavating the site of Vigla, an Early Hellenistic fortification (Landvatter, Olson, Reese, Stephens, & Moore, 2018; Olson, Caraher, Pettegrew, & Moore, 2013).

Although they are presently autonomous projects with distinct identities, the histories of WARP and PKAP are intertwined, given that Bill Caraher, one of the current directors of WARP, was the director of the PKAP project up until the mid-2010s. Both projects involve archaeologists teaching in North American universities as directors, PhD students, and early career researchers who are given significant responsibilities in project work. In addition, there is a transient cohort of graduate and undergraduate students who join each season to gain fieldwork experience, in the established tradition of the archaeological field school. Both projects work with an extended network of collaborators, including finds specialists, archaeozoologists, archaeobotanists, conservators, and experts in various modes of analysis, including digital visualization and processing.

Adhering to the ethics protocol for this research, WARP interviewees included project directors Dimitri Nakassis (University of Colorado Boulder), Bill Caraher (University of North Dakota), and Scott Gallimore (Wilfrid Laurier University); we also interviewed three PhD students completing their dissertations and engaged as survey team leaders with several seasons’ experience at WARP: Joey Frankl (University of

Michigan), Machal Gradoz (University of Colorado Boulder; University of Michigan), and Melanie Godsey (University of North Carolina at Chapel Hill). In PKAP, we interviewed again Melanie Godsey, who is a member of both projects, as well as PKAP project directors Brandon Olson (Metropolitan State University of Denver) and Tom Landvatter (Reed College). We also interviewed Dave Masten, an IT specialist and old friend of Brandon's, who was brought on as a volunteer to create a revised archaeological database. All participants provided consent for us to both identify them individually, vital for us to represent the diversity of voices and insights across an archaeological project, and quote their comments in this study.

2.2 Research Design and Methodology

A provisional thematic structure for data collection (interview scripts) and analysis (code system) was developed in Winter 2019, based on earlier conceptual modelling work representing the relationships between archaeological fieldwork activities, individual actors and groups, and ideas expressed by archaeologists (cf. Benardou, Constantopoulos, Dallas, & Gavrilis, 2010; Dallas, 2015). Data collection was based on qualitative interviewing. Our conversations with study participants followed a combination of life histories and semi-open episodic interviews (Flick, 2000). We interviewed participants *in situ*, in June and July of 2019. Interviews were then fully transcribed in Fall 2019, and then coded and analysed using the MaxQDA qualitative data analysis application, in Winter and Spring 2020, followed by interpretation and writing-up in Summer and Fall 2020.

An account of the methodological paradigm, conceptual modelling work, and research design of E-CURATORS is beyond the scope of this article, but a brief summary is included here as part of a broader elaboration of a protocol for meta-research into digital practices in the humanities (Maryl *et al.*, 2020, paras. 40–47) as well as and justification of key methodological decisions made. Our research starts with a deductive step, used to establish an initial thematic guide and script for semi-open interviewing, and a provisional code system for qualitative data analysis. This was to make explicit our prior understandings, questions, and research orientation, which we consider an essential factor in allowing the transformation of data into evidence. However, evidence can yield new insights; hence, in a further inductive step, we encouraged participants to share topics and ideas beyond our original interview questions and were open to identify new topics for analysis through open coding of interview transcripts.

We adopted a constructionist (Burr, 2015; Restivo & Croissant, 2008; Talja, Tuominen, & Savolainen, 2005) rather than realist (Lincoln, Lynham, & Guba, 2018) ontological position in our investigation. Unlike observation-based approaches aiming to produce knowledge on what archaeologists actually do, our objects of inquiry are archaeologists' sayings on what digital technologies are, how they should be used and how they affect knowledge work, fieldwork practice, and the construction of expertise. We do not regard sayings as mere expressions of some separate materially constituted world of practice but view digital practice in archaeology as an "open-ended, spatially-temporally dispersed nexus of doings and sayings" (Schatzki, 2012, p. 14), and sayings as "discursive doings" (Schatzki, 2017). Far from being inaccurate, and possibly also deceptive reflections of a materially construed archaeological practice, sayings are "reliable guides to existing organised activity nexuses" (Schatzki, 2012, p. 24), and representations of "mental routines [which] are integral parts and elements of practices" (Reckwitz, 2002, p. 252). In other words, we consider what we were told as useful evidence towards establishing the logic of archaeological practice in their respective fieldwork projects.

The following sections present successive steps in our analysis. Initially, we scoped the full corpus of interview transcripts to get a sense of topics that attracted the interest of study participants (RQ1). We then analysed a relevant subset of the full interviews against three thematic areas: (1) digital work, (2) learning and expertise, and (3) data. We further explored how participants conceive of digital tools, workflows, do-it-yourself (DIY), and craft in digital archaeology (RQ2); of digital expertise and learning (RQ3); and of the distribution and recognition of agency through the division of labour, roles, and relationships (RQ4). In what follows, topics in the code system used for our analysis (codes) are printed in italics. References to participant *Sayings* are prefixed

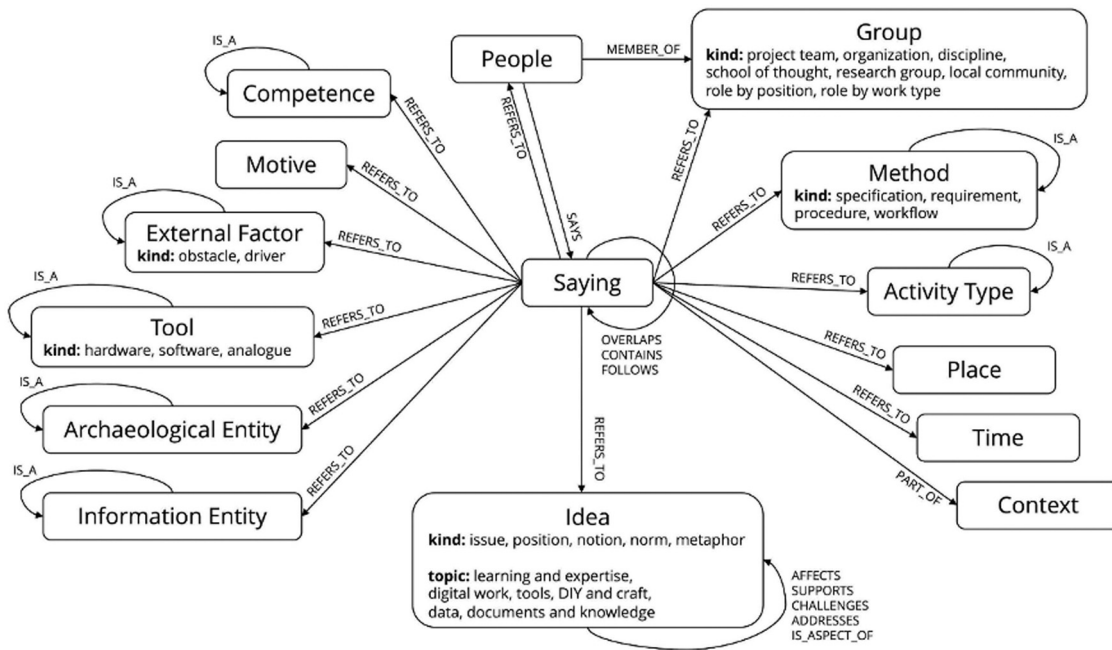


Figure 1: Labelled property graph model representing entities and relationships documented in this study.

with “P” and “W” for PKAP and WARP interviews, numbered sequentially, and referenced within square brackets. A full list of *Sayings* referred to in this article is included in the online supplement¹.

3 Structure and Focus of Conversation Topics

Given the focus of our research, we coded topics referred to within *Sayings* (meaningful, coded segments of text) by means of a provisional code system (hierarchy of topics) falling under the broader domain of archaeological activity, derived from our initial conceptual modelling work. Activity-related conceptual entities, or topics, represented in our coded data include *Activity Type*, *Archaeological entity*, *Information entity*, *Tool*, *Method*, *Competence*, *People*, *Group*, *Motive*, and *External factors*, and their relationships are captured in a labelled property graph model (Figure 1).

The interest of study participants in a particular topic of archaeological and digital practice is reflected in the relative frequency of *Sayings* (text segments) coded with the topic (Figure 2). Based on the number of *Sayings*, the most frequently discussed topics are *Activities* (processes spanning fieldwork, analysis, interpretation and publication, to long-term retention or preservation of data), followed by *Roles* (by work type and by position), as well as *Tools* (software, hardware, and network services), and *Information entities* (and more particularly databases).

3.1 Difference in Topics Between Projects

Comparing interests across the two projects (Figure 3), we can confirm that, despite the fact that the same semi-open interview script was used for both groups of participants, there is a significant difference in their

¹ See <https://doi.org/10.1515/opar-2020-0217>.

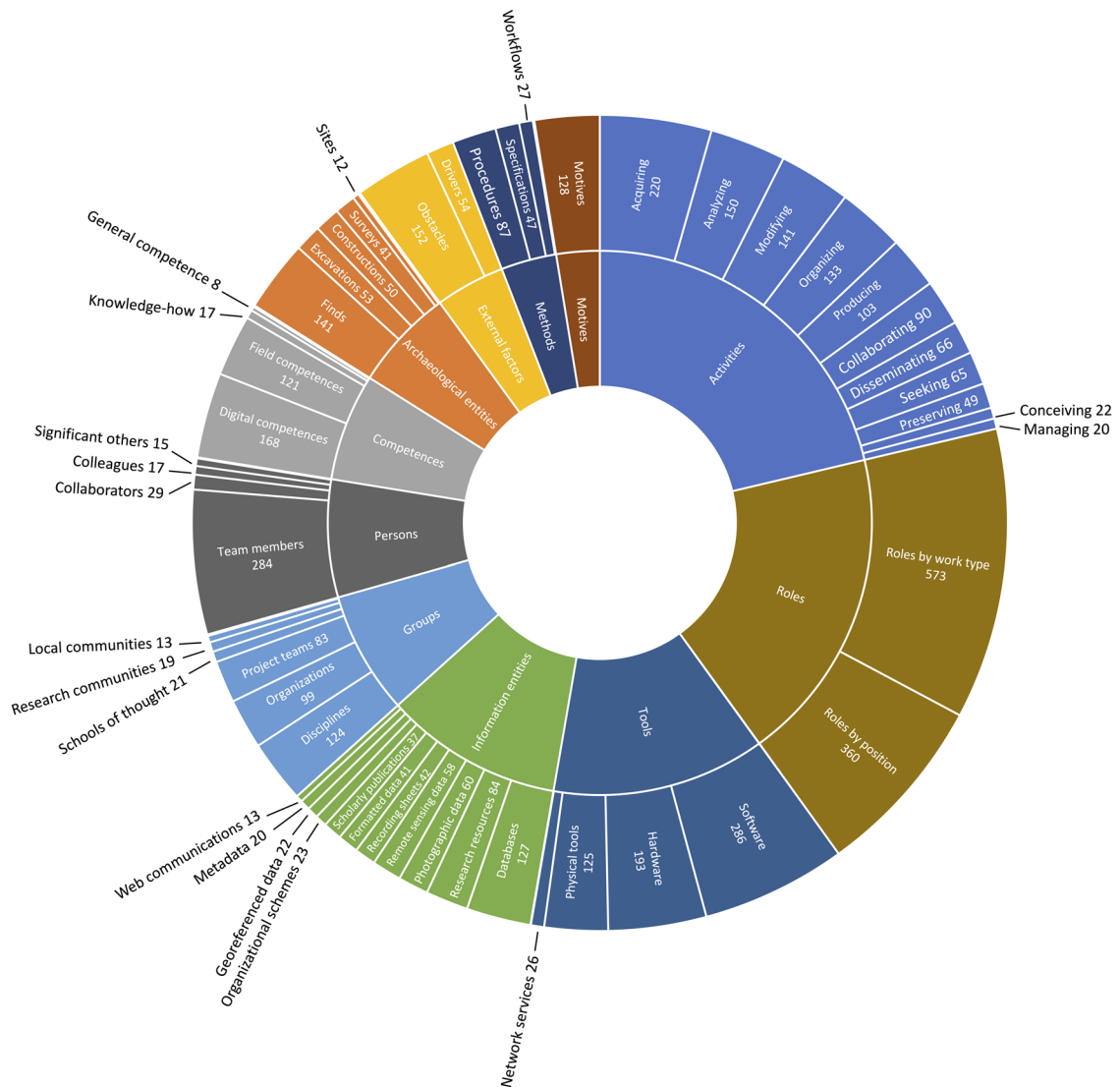


Figure 2: Distribution of topics identified in *Sayings* of study participants across *Activities*, *Archaeological entities*, *Information entities*, *Tools*, *External factors*, *Competences*, *Persons*, *Groups*, *Roles*, and *Motives*.

thematic focus. PKAP interviews refer more often to *Archaeological entities*, *Information entities*, and *Tools*, and, among more specific code categories, to *Modifying activities*, *Constructions*, *Excavations*, *Georeferenced data*, *Remote sensing data*, *Software*, *Network services*, *Procedures*, *Requirements*, and *Research communities*. Conversely, WARP interviews refer more to *Roles* and *Competences*, and among more specific topics, to activities of *Acquiring* and *Organizing*, *Physical tools*, *Field competencies*, *Local communities*, *Roles by position*, and *Roles by work type* (Figure 3). Some of these differences are perhaps unsurprising: for instance, less discussion about *Local communities* in PKAP reflects the fact that the research site is within the military zone controlled by the British in Cyprus. Furthermore, a higher frequency of references to *Constructions* and *Excavations* is to be expected in PKAP, given that this project included a site excavation. But it is noteworthy that PKAP conversations were significantly more often focused on technically oriented topics such as *Georeferenced data* and *Remote sensing data*, *Software*, and *Network services*, whereas WARP conversations were more focused on human-oriented topics such as *Roles* and *Competences*.

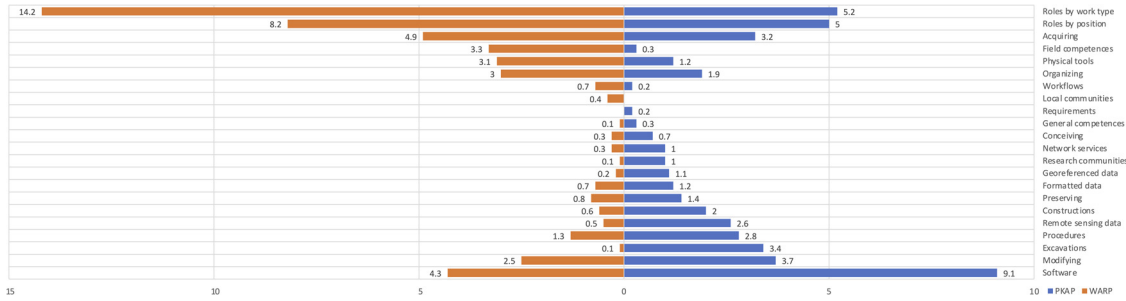


Figure 3: Relative frequency of topics represented in *Sayings* by PKAP and WARP team members. Only topics for which there is a statistically significant difference in frequency between PKAP and WARP, according to an analysis of adjusted standardized residuals ($p > 0.95$), are included.

4 Digital Tools, Workflows, and Agency in Knowledge Work

In their *Sayings* about archaeological and digital practice, participants do not talk of topics, such as *Activity types*, *Roles*, *Tools*, and *Methods* in isolation, but connect them in meaningful *Statements*, identifying *Issues*, and asserting *Positions*, which represent their understanding of what actually happens, and their evaluative and affective dispositions towards different aspects of practice. While looking at collocations related to such topics, we focused further analysis on those *Sayings* that relate to meaningful *Statements* by study participants, which we organized in an open coding hierarchy allowing us to represent different relationships between *Issues* and *Positions* as an issue-based practical argumentation directed graph (Conklin & Begeman, 1988; Kunz & Rittel, 1970). To support the analysis presented in the remainder of this article, we performed searches for the *issues* and *positions* expressed by participants in terms of their thematic focus, and their associations with topics identified from other code hierarchies (*Activity types*, *Roles*, etc.).

4.1 Digital Tools Promote Efficiency

Nearly all participants point to benefits digital tools afford: an increase in efficiency when collecting, processing, and analysing data [W39; W41; W64; P4], greater precision and accuracy [P4; P19; W52; W72; W73; W49; P2; P4; P38; P24; P26], and their capacity to store, copy, integrate, and move large volumes of information [P30; P34; P42; W68; W39]. Participants also identify how digital tools uplift researchers' experiences by making their work easier. For example, Tom describes the practical benefits of digital imaging technologies on the archaeological practice of illustrating burials:

Tom: ...[D]rawing a human skeleton by hand takes forever. I've done it, it's awful. It takes... forever. And it's – this is the kind of thing where it's – it is excruciating and, it really does slow the work down when you're confronted with that kind of thing. It's just too much. And so this is where like seeing how to use the photogrammetry to speed up these sort of things which ... it sort of even, like not everybody is a great like draftsman or drawer, right? ... But I talk to people and they say oh my god I hate baulk drawing, it's just so hard and long and tedious, and there's a good thing to kind of sit – because you are forced to sit through and think about that stratigraphy, and there's that benefit to that. But it also is like, there's just certain skills that like we don't all have the time to develop. And ... [that] technology [can] even the playing field, and allow for more accurate – and it's more accurate. So it – it does a double duty, kind of, [to] speed things up, and be more accurate at the same time [P37].

Participants across both projects express views similar to Scott when he states that digital tools are “important for keeping the records organised” [W57]. They note that digital tools allow data to be copied, transformed, reformatted and refactored with relative ease, and applied to various processes in parallel, or in tandem, in a “kind of hyper linear way” [P40; P21; P23; P46; P4; P15; W29; W58]. Different interviewees also point out that digital media enables some unique ways to engage with archaeological information, for

instance, by using hyperlinks to explicitly relate interpretations with supporting data, or by rendering 3D models using digital graphical processing engines [W61; W22; P32].

4.2 Digital Tools are Good to Think

Participants also note that their engagement with digital tools stimulates critical reflection upon how archaeological entities are constituted as epistemic objects through formal processes of representation and digital manipulation [W33; P20; P22; P12; W66]. Melanie, who is commonly tasked with preparing features for photogrammetric data capture, illustrates this point clearly:

Melanie: Using Agisoft to recreate and reproduce these 3D models is excellent. And that's something that, of course, I don't run myself. I don't have the software. But producing that data is really useful, in addition to actually putting together the model. So that's the side that I'm on, right. Like, what are the choices that need to be made to actually make that model work? And that forces you to stop and think about what really matters, about whatever moment of excavation you're in [P20].

4.3 Future Access and Preservation are Key Considerations

Furthermore, archaeologists in WARP and PKAP consider digital technology useful as a means of specifically supporting future data reuse. Team members from both projects refer to the use of digital infrastructures to make their data openly accessible, extending their value as a collective resource they believe will benefit future archaeological study. Many participants, especially those who are very enthusiastic about sharing their data, imagine potential research applications as being performed in the distant future by scholars whose interests are entirely different from their own, and which cannot be anticipated at present [P33; P30; W65; W78].

Yet, as Bill maintains, details regarding data generation are, as a rule, not documented because “they’re just considered so mundane” [W15]. In fact, several participants from both projects state that simply making the data available online is sufficient [P27; P28; W77; W37; W16], something that might come as a surprise to digital preservation and data curation specialists. Although several people assert that making data freely available will facilitate future research [P28; P33], it is only Dimitri and Bill who, within a more complex conversation, raise the question of the absence of paradata on data constitution, and its implications on the potential for future reuse:

Dimitri: In raw format, I'm saying that without understanding collection protocols and all this kind of stuff, it's hard to... You know what I mean? Even if you could bring up a map of all the late Roman amphoras like found on surveys in the Peloponnese ... No?

Bill: I'm... I tend to be more optimistic that this data has meaning. I spent this last two years working on data from, from the distant past, from 1988 and 1989, that didn't have robust paradata, that you know, didn't have – and its notebooks and boxes of sherds. And I felt like I could construct reasonable, reasonable arguments from it, that didn't go beyond what I felt like the edges of the data, you know? Didn't devolve into speculation. ...And some of these other people really advocate strongly for going back and using, going back and doing things with legacy projects, right? You know, people are willing to do that! Maybe they're aren't, certainly going back and excavating a digital dataset. Doesn't seem inconceivable from an archaeological standpoint....

Dimitri: Is there a huge amount of value added? I mean, people will have different research questions, and there'll all good. You know, there'll be all kinds of reasons why people might go back to look at our data. But I don't know. You're talking about a site that was never – or at least, the neighbourhood you're studying was never published, right? In any meaningful way. So you're, you're doing the basic work of publishing an unpublished site [W36].

The conversation between Dimitri and Bill is considerably more nuanced and complex than this excerpt reveals. It involves considerations of what it means to understand the methodological and context-specific

aspects of data collection, the roles and responsibilities of data creators and re-users, the relevance of tacit knowledge that can be transmitted between a community of practice even in the absence of recorded information, the methodological framing of archaeological work, and even the logistics of recording contextual information when “no one wants to read fourteen pages on how to use a trowel” [W15]. This conversation, overall, seems to confirm and interrogate how digital tools and infrastructures can be valued not only in the instrumental context of the actual project in the present tense but also in the projective context of future access, re-use, and preservation of the archaeological record.

4.4 Digital Tools Enforce Their Own Logic

In both positive and negative evaluative statements about digital tools, participants focus not so much on the abstract capabilities of these technologies but on their agentive, performative role in producing certain outcomes in situated contexts, and in shaping the way archaeological work is conducted. These field archaeologists identify archaeological projects as collective efforts, and their research outputs as a nexus of coordinated, collaborative ties [W24; W32; P35]. They conceive of projects as distributed sets of integrated work, and concede, at the end, that “digital technologies are to a certain extent necessary to accommodate the way that archaeological knowledge is increasingly broken up” [W32].

While team members from both projects recognize multiple areas where digital technology can be useful, they also share significant negative perceptions of digital tools. Dimitri, Bill, and Melanie separately express the view that digital tools are inflexible [W25; P25], and that they have a tendency to impose limitations on researchers’ decisions and behaviours [W29; P47]. Some study participants consider digital tools to be resistant to changes resulting from the dynamic circumstances in which archaeological research occurs, circumstances which may warrant altering routines “on the fly” [W26; W27; P34]. This is complemented by the notion that, conversely, non-digital tools are simple, yielding readily to the fluctuating needs of human users, and fundamentally dependable [W39; P37]. As Tom put it, “paper forms, it turns out that they’re not a bad thing. You don’t have to keep dealing with your Wi-Fi network breaking down as you’re trying to like remotely sync data” [P37]. It is questionable, in this light, if the “synergy of practitioner, tool and material” afforded by physical devices such as paper forms through an embodied coupling of perception and action, which is supported by a long history of past use (Ingold, 2011, p. 56) is also manifested in the case of digital tool use.

In this sense, critical discussion about digital tools is typically framed in terms of the effects that they have in restructuring the work performed by archaeologists:

Bill: I mean, this is going to sound completely banal – and everyone knows, right? But these tools ultimately like, tweak your, your data collection to their strengths, right? I mean, whether it be ArcGIS or Access, that you end up kind of operating by their rules and not only by their rules in the formal sense – you know their rules are usually dynamic enough that you can make it – but like their systems, and how they want you to kind of think and organise your data. It ends up kind of pushing you into doing particular kinds of work [W29].

Bill’s statement suggests that digital tools can influence the process of managing archaeological data by requiring people to anticipate or account for how their work will integrate with and can be shaped by these tools. Team members from both projects reinforce this concern that digital tools can dominate archaeological knowledge work, reducing engagement with archaeological data collection and management, and undermining the acquisition of archaeological expertise [W35; W49; W30; P45]. Overall, participants’ observations reflect more the tool’s agency over makers, rather than Ingold’s (2011) symmetric notion that the tool and maker each influence each other in the mediation of the limitations, capacities, and workarounds of (in this case) off-the-shelf digital tools.

Participants refer often to the activities, rules, processes, systems, and ways of work that digital tools enforce. The most notable notion participants raise is “workflows”: systematizing devices that contribute to the production of better and more complete results. Workflows are conceived by participants as disciplined

ways of working, or knowledge management constructs that channel information along preformulated pathways, and in service of particular desired outcomes [W33]. Participants acknowledged that digital workflows help keep track of, and integrate, large volumes of data drawn from distributed sets of contributors [W32], something that has a positive impact for how archaeological methods are documented, and the facilitation of data integration and reuse.

Yet, while the instrumental usefulness of digital workflows as an index for the algorithmic power of digital technologies is not challenged directly, participants often scrutinize the role of workflows on the construction of archaeological data and knowledge. For instance, Bill introduces workflows as relevant to a broader dilemma between valuing phenomenological fieldwork versus purely data-driven knowledge production in archaeology:

Bill: With this kind of hyper-granular data workflow almost all of these applications, sort of want you to – to use probably an inappropriate term, it's best practice, it's required practice that ... your data is constantly pushed toward increasing granularity. Um, which means then you have to abide by their rules, so to speak [W29].

These comments imply that “hyper-granular workflows” contribute to the increased fragmentation of archaeological data and is a key factor for enforcing their own logic on archaeological work(ers). Moreover, in adding that any “thoughtful archaeologist knows that this is not really how we build arguments” [W29], Bill raises a concern that workflows enforced by digital tools may be poorly suited to the ways archaeology comes to produce good knowledge. The reality of good archaeological knowledge production, according to him, involves an intimate understanding of the mechanisms that frame archaeological research, and a willingness to explore all potential avenues of inquiry, creating a “disconnect, then, between the move from experience knowledge, which is like amorphous, to linear knowledge to these kind of very, very granular and de-linearized tools that we're constantly being asked to use,” which “has made it impossible for me to reconstruct in my head” [W29].

Archaeologists in the two projects we investigated use the notion of workflows in a broader and less precise form than the established definition of workflows as process models, or “scripts” comprising sequences of steps bound by conditions, and amenable to be formally mapped into decision trees in a normative work process (Koolen, Kumpulainen, & Melgar-Estrada, 2020; Malone, Crowston, & Herman, 2003; Wissik & Ďurčo, 2016). Participants are primarily concerned with outcomes as the main object of interest, and with the means of achieving them in an efficient manner. So, their use of “workflow” tends to be as an umbrella concept pointing to the instrumental promises of algorithmic order imposed on users by some typically black-boxed system. The term “workflow” comes thus to be applied metonymically by participants to a whole universe of other things, including datafication of research processes (Richards-Rissetto & Landau, 2019; Schäfer & van Es, 2017) and the agency of digital devices and infrastructures (Benardou, Champion, Dallas, & Hughes, 2018; Ruppert, Law, & Savage, 2013).

5 Reclaiming Agency Through DIY Practice and Craft

In the examples introduced above concerning his advocacy of an “anti-workflow” ethos, Bill recognizes the erosion of expertise and the disconnect with archaeological knowledge proper that comes with wholesale adoption of the instrumentality of digital tools and workflows. The central issue he raises is the challenge that algorithmic instrumentality presents to archaeologists’ agency and autonomy: like the tragicomic protagonist in Charlie Chaplin’s *Modern Times*, archaeologists run the risk of becoming entangled in the cogs of an algorithmic machine whose products have little to do with genuine knowledge, and which reduces the capability of people to muster the kind of expertise necessary for archaeological knowledge production (see also Huggett, 2021). To counter this risk, Bill points to an alternative notion of archaeological knowledge work exemplified by the metaphor of “cats like Dimitri” [W41]: scholars who combine multiple and complementary aspects of expertise including mastery of ancient languages, experience of ancient landscapes, command over field techniques, domain knowledge in Greek and Mediterranean

archaeology, ability to understand and deal with local culture and contexts, and, most importantly, the judgment and *knowledge-how* (Ryle, 2009) stemming from espousing one particular way of doing archaeology.

Participants use diverse terms to identify this alternative approach: “slow archaeology,” “embodied knowledge,” “craft,” and “DIY archaeology.” Craft, in particular, seems to be a common term they use to illustrate their understanding of archaeological expertise and knowledge. The term has been a major critical force in archaeology’s long turn towards post-processualism, most notably by Michael Shanks and Randal McGuire (Shanks & McGuire, 1996), which inspired a vibrant exchange of views on Bill Caraher’s blog (Caraher, 2014; Graham, 2014; Morgan & Eddisford, 2014). In our study, participants claim that craft is what enables archaeologists to engage with their material (physical stuff and digital media), and make sense of it all, as informed by their own personal experiences and talents. For Joey, craft is an intuitive, holistic, and embodied mode of engagement that does not prioritize efficiency [W46]. Several different traits of doing research mentioned by participants seem to be related to their recurrent reference to craft, including embodied knowledge, slow archaeology, and DIY archaeology.

5.1 Embodied Knowledge Trumps Digital Intermediation

Participants’ statements about embodied knowledge and the archaeologists who possess it reflect a generally positive association with the notion [W41]. Affect, both emotional and sensory, is recognized as essential [W45; W43]. This is much in line with Michael Olsson’s findings on the importance of sensory engagement and embodiment in practices of haptic analysis, drawing, and recording practices in two archaeological excavations in Scotland (Olsson, 2016). The participants recognize, further, that there is legitimate debate within archaeology as to if embodied knowledge should be prioritized, who gets it, and how it can be imparted [W31; W13]. Bill and Dimitri assert the importance of embodied knowledge, emphasizing that it can only be gained through time and experience. They draw attention to archaeological work being conducted within a phenomenological approach in Britain – in apparent reference to Chris Tilley’s landscape phenomenology (Tilley, 1994) – characterized as “wandering around the countryside and imagining”, as a potential method that could be applied to Greek archaeology [W13]. However, Bill points to the inherent problem of even such a method when “attempting to access voices that rich white guys have systematically suppressed” when imagining the lives of women in the Neolithic [W14].

Yet embodied knowledge is not seen as independent from the digital technologies archaeologists use. Although Bill asserts that the large amount of time and labour needed to acquire embodied knowledge can be greatly reduced by using digital tools, he places more faith in an internal understanding produced by *in situ* observation than relying on a digitally captured version of the land [W30]. In fact, digital data collection is seen as an impediment to achieving the knowledge obtained by being in the landscape in an experiential manner – which, to Bill, is the very essence of the beauty of archaeology [W12; W29]. By paying attention to one’s surroundings, practicing manual data collection such as site drawing, and simply spending time in the field, an archaeologist can see things that others do not, Bill claims [W43]. He stresses that the method impresses strong memories of the landscape in one’s mind and helps one understand the data, especially compared to “digitally mediated representations of the site.” [W30; W12]. Interestingly, in his more recent response to COVID, Bill has had to re-negotiate his desire for being in the field through digital representations of the project (Caraher, 2021a,b).

5.2 Slow Archaeology Pits Craft Over Efficiency

Another closely related concept to craft that participants’ mention is *slow archaeology*—a term that has been an emblematic focus of Bill Caraher’s more recent theorization of archaeological practice (Caraher, 2019).

The dimension of time – time spent practicing in the field and “get[ting] your hands dirty with data” – is central to Bill’s statements about craft [W42]. This notion of slow archaeology does not prioritize extreme intelligence or formal training: they are not seen as either necessary or sufficient to achieve craft. Only by “walk[ing] around the Greek countryside for 20 years”, Bill notes, can an archaeologist perceive the full extent of the information the landscape has to offer [W43], reiterating a long-standing claim by many earlier archaeologists (e.g. Myres, 1989; Tilley, 1994).

Joey defines another aspect of slow archaeology: its association with “pen and paper” over digital technology as a recording device:

Joey: In the field, we are actually recording everything with pen and paper. Which is kind of part of you know, I mean, I think it started off with the fact that we couldn’t really afford to have iPads. And then it became kind of part of the some – the, you know, the orientation of the project is slow archaeology. This idea, the emphasis of the craft over efficiency [W46].

Although Dimitri (personal communication) disputes cost as the original reason for not adopting iPads, Joey’s statement is revealing on how slow archaeology came to be identified with the project, as did craft. He specifically pits craft against efficiency, evidence that resistance to workflows and digital tools is an aspect of study at WARP. Bill also upholds slow archaeology as a value, defined in opposition to the “really elaborate and fancy bespoke systems” discussed at digital archaeology conferences [W38].

5.3 DIY Practice Reclaims Algorithmic Agency

Participants assert that archaeological craft involves assembling materials and methods in an *ad hoc* manner and making modifications as new needs arise [W42; W48; P44]. They widely use phrases such as “bricolage,” “hodgepodge,” “on the fly,” “trial by fire,” “learning by doing,” getting your “hands dirty,” and “playing around” with tools and data to characterize the approach to much of their work [W23; W41; W42; W69; W48; W49; W51]. These notions are marks of a DIY archaeology and broader maker culture that was first noted by Colleen Morgan and Stuart Eve emerging from digital archaeological practices (Morgan & Eve, 2012). Several participants mention DIY archaeology as a notion defining their work with digital technology. In general, participants characterize archaeology as a discipline that is particularly adept at working in a manner that befits DIY. They attribute this to limited budgets, the compressed time frames of fieldwork, and the methodological medley of approaches and tools that are adopted within any given archaeological project [P43; P44; P45; W50; W42]. Archaeologists manage to deal with the challenges of this approach by stretching tools beyond their prescribed uses. They value a DIY approach for its potential to be simple, functional, and transparent, qualities, which they feel enhance researchers’ control over their data and make producing research quicker [W20]. Participants such as Joey explicitly recognize WARP as a DIY-driven project, but PKAP workers such as Tom also define their practice (and good archaeological practice, in general) in terms of DIY [W50; P45].

A DIY approach is defined by participants in terms of identifying how tools may be created and tweaked to optimally serve desired ends [W42], not with total freedom, but within the expectations imposed by technical constraints and professional expectations. For instance, Brandon states his preference for embedding 3D models within PDFs as this is the format widely used to publish journal articles, which archaeologists rely upon in order to advance their careers [P3]. In this case, the creative agency that goes into DIY making of digital tools seems to be framed as innovation, that is, the production of a ground-breaking novel product, but perhaps also as a process of cultural improvisation, working with conventions to make something that works (Ingold & Hallam, 2007).

In general, PKAP and WARP team members characterize the ability to work with digital systems in DIY archaeology as a power-laden relationship between the archaeologist and the digital tools or processes they engage with. They express a need to take control of digital tools and processes, which are generally thought to be somewhat demanding, in order to steer them towards desired archaeological outcomes [W79; W80].

They acknowledge that ‘buying in’ to the use of digital tools and systems requires awareness of the potential that they may provide, adequate understanding of how the tools work, and a willingness on the part of archaeologists to leverage them [W52; W76] in ways appropriate for addressing their own research interests [W48; W35]. Ignorance about the capabilities of digital technology may impede the ability of archaeologists to address important research questions, as Machal asserts while sharing her frustration that some projects do not use GIS to the full, but just “to do density maps” [W75].

Although some participants frame DIY practice in opposition to digital workflows [W29; W40; W46], this dichotomy may be obscuring more nuanced connections. For example, Brandon, in the context of PKAP, stresses the potential for wielding control over digital workflows while effectively increasing the agency of archaeologists over technology, as he discusses his process of “refining” and “tweaking” photogrammetry and GIS software and their interactions [P2]. In fact, makers like Brandon and Bill who develop their own digital workflows view this activity as an empowering practice, which, nevertheless, requires deep practical familiarity with the tools and context of their work [P2; W42]. In fact, they acknowledge that DIY solutions may be most effectively implemented only when one has deep familiarity and direct experience with the tools and practices used, and with the materials being acted upon [W42; W43]. They note that while using “off the shelf” systems may be convenient, these systems typically do not afford the introspection that occurs when they themselves design tools from scratch – a hallmark for them of a DIY approach [P45; W34]. In this light, it is those archaeologists who are actively involved in the making of DIY solutions – tools, and procedures such as workflows – rather than those who merely use them, that provide an adequate response to Jeremy Huggett’s call for “an introspective turn in Digital Archaeology” (Huggett, 2015, p. 94), and reclaiming the algorithmic agency and autonomy in digitally mediated practice (Huggett, 2021).

5.4 Expertise is Acquired Across Time As Craft

Archaeologists at WARP and PKAP positively frame the role of craft in how they personally acquired digital skills and assess how those skills are learned by students today. Two venues for learning digital skills in archaeology are typically discussed: formal learning environments, and while on-the-job or experimentally. As Melanie and Joey reveal, the current generation of graduate archaeology students did not become expert users of digital technology from their formal education, and to a large extent have had to learn things in the field, building on prior familiarity with digital technologies picked up by growing up with access to computers [W74; P29; W48]. Melanie views learning as “playing around”, taking time with the technology, and collaborating with others [P29]. Participants from both projects concur that, despite inherent frustrations, this approach has the benefit of introducing workers to new questions and necessary ways of using the tool that is currently not taught in school [P31; P14; W42].

Several senior members in both projects confess to being early adopters and advanced users of various digital tools despite not having any formal digital education [W63; W1; W42]. As Tom explains, he acquired competencies with digital tools due to necessity, noting that only recently have digital tools designed for the needs of archaeologists been released [P44]. Given the necessity-driven and informal nature of digital skill acquisition, Dimitri suggests that the resulting tools and methods were messy and did not always work [W2; W6]. However, Bill counters that a good deal of the digital work was useful, and has lived on through re-use and updating [W19].

For some participants, there is also great resistance to digital workflows in how digital archaeology is taught, based on broader ideological grounds [W41]. The most powerful sentiments stem from Bill, who takes issue with the industrialization of North American universities, which he believes minimizes the power and accumulated expertise of individual students and scholars in favour of viewing them as interchangeable commodity objects. He asserts that this workflow-based system undervalues well-rounded workers who have built their own unique and complex knowledge bases over the course of their careers. In opposition to this model, he holds up “a cat like Dimitri” as a prime example of an expert archaeologist

who is conversant in a unique blend of competencies and holds irreplaceable expertise [W41], and who could not be replaced by a worker simply trained to follow workflows.

Although both the emerging professionals and established archaeologists interviewed claim that craft was the dominant learning mode in their digital education, older archaeologists frame a generational difference in the level of craft and DIY present in digital skill acquisition. Older team members, who did not grow up in a fully digital world like that of the graduate students, value their method of learning, which is distinguished by a lifelong process of tinkering and experimentation driven by a distinctive personal trajectory [P16; P29; P31; P14; P10]. They claim that some graduate students entering the field have received extensive formal education in digital methods and have learned the workflow for digital tools but still cannot effectively use them in practice [W42; P9]. This reveals a perceived distinction between the ability to do fundamental rote work and working with the intention of achieving certain targeted outcomes while truly understanding how information is being processed [W40]. For instance, by using the Jenks natural breaks function on ArcGIS (ESRI, 2007) with only a limited understanding on how the mathematics behind the clustering algorithm work.

This distinction is clear in Scott's and Bill's different views on how students are taught to use drones. Scott sees the students learning a valuable skill that is quickly becoming ubiquitous among archaeologists. However, Bill, reluctant to give full control of such an expensive tool to inexperienced students, sees this as a hollow activity lacking any creative agency that would help them learn about the tool's utility [W47; W66; W67]. In another participant's words, holding a pole does not make one a surveyor, as the latter requires a long and slow process of apprenticeship and practice. For Bill, to truly learn a skill as a craft, it is necessary to exert creative control over tools and to be given the opportunity to experiment with the risk of failure; these aspects of apprenticeship were clearly absent in his piloting lessons. He adds:

Bill: Becoming a skilled craftsperson takes time. In fact, it can be a lifetime experience, whereby one is constantly learning. It can only be gained by doing the work. [W42]

Opportunities to learn digital archaeology in this manner are currently limited, according to Brandon. He claims that some archaeology schools push digital workflows and tools more than others, but the overall orientation in the academy is traditional [P9]. This means that a student seeking to become what Brandon identifies as a “really good archaeologist,” a well-rounded professional versed in digital technologies and “on the ground” interpretive skills, will be unsupported in most universities [P11]. Furthermore, Brandon asserts that learning digital archaeology in a short-term field school is entirely ineffective, as “GIS isn't something you're going to pick up in a field school of four or six weeks. That's something that you need to work on for a semester or two to get a basic understanding of it and the functionality there” [P9]. He expresses the fear that students that do receive a digital-focused education in university will not have enough time to gain the interpretive skills necessary to use digital tools in a meaningful way, potentially causing a drift away from “the craft that is archaeology” [P8].

6 Distribution and Recognition of Agency

According to study participants, the adoption of digital tools influences the ways in which different kinds of work are distributed, acknowledged, and valued. Conceiving of digital tools as entities that operate according to sociotechnical arrangements has implications both on how people we interviewed construct a figured system of practice, as well as on how they establish and internalize interpersonal or comparative experiences.

6.1 Team Members Assume Variable Expertise-Based Roles

Workplace and epistemic practice studies indicate the reliance of individual roles on the mastery of particular tools, expertise in specific processes, or the order imposed by diverse functional contexts. In other

words, the way a pattern (Alexander et al., 1977; Coplien, 1996) connecting a given situation with a chosen course of action to achieve a desired effect while satisfying local constraints, rules and norms, will condition how various aspects of work are performed. Work roles assumed within a regime of such settings are situationally variable, multiple, and overlapping, rather than stable and singular.

Field archaeologists we interviewed seem to adopt work role identities in line with such situational variability. For example, while being a project co-director, Tom admits to a few different roles in PKAP: “I’m sort of managing the students on my end. along with doing photography [and also] visiting trenches, kind of giving some help and direction, and then also like digging and helping out”, especially when opening or closing stratigraphic units [P38]. However, although Tom identifies himself as the “photography” person in the project, Brandon indicates that it is he who grapples with taking photos for photogrammetric processing in the field [P1]; this is not surprising, given the recognition Brandon enjoys, both within PKAP and beyond, for his expertise and broader scholarly contribution to the methods of photogrammetric capture [P18; P36; P7]. Besides, Tom states that casual, “just like general” photos taken by diverse team members are retained as well. As he says, “we will encourage people to take them with their phones or whatever, and then share them, and we’ll create a Dropbox folder” [P41]; we may assume that such “general” photos are kept largely as records that might help contextualize prior working experiences, but, as Tom describes the process, it seems that no metadata is recorded pertaining to these collections. While recognizing that anyone can take photos, Tom asserts his role is as the “official” field photographer by demonstrating the methodical way he captures each feature, and his role in associating these images with other official documentation, specifically the photo log that he maintains that acts as a bridge to other important records stored in the project’s database [P39].

Meanwhile, in WARP, Dimitri assumes the responsibility for taking the “official” field photos for the project, whereas Bill is recognized as someone who does lots of hands-on number-crunching, and who maintains the databases [W17; W62; W54; W71; W11]. Project participants assume such roles in accordance not only to their perceived capabilities but also to situational needs, similar to the assumption of the role of osteology expert by a student participating in a Nordic excavation, within a broader context of situational appropriation (Huvila, 2019b).

Although each individual co-director oversees a particular domain of work corresponding with their own strengths, a common thread among them is the degree with which they have invested in all aspects of the project [W5; P7; P12; W18]. Similarly, Scott recalls that each ceramicist’s distinct areas of expertise is formally acknowledged and relied upon to assess degrees of confidence in the interpretations of each find [W59]. It is striking that both PKAP and WARP project directors have a direct responsibility over what Dimitri refers to as “the lowest level work, which is like photographing stuff and measuring” [W44], data processing and backups, which otherwise might be delegated to junior team members. We could not identify in our study participant’s ideas that would point to a kind of “machine-like organization of human labour” whereby “tools’ are actual people,” as recognized by Mary Leighton in her comparative study of Andean and British archaeological fieldwork (Leighton, 2015, p. 86). However, the recognition of different kinds of work, division of tasks, allocation of responsibilities, and ensuring that all team members are interactionally aligned in performing meaningful positions in the project given the tasks and tools at hand – in other words, what Anselm Strauss called the articulation process (Strauss, 1988) – seems to be more fluidly and dynamically distributed among people with different expertise in these two archaeological projects, in an identity play that sets work boundaries while providing for professional freedom.

6.2 Decisions on Digital Work Depend on Team Buy-In

Participants in both projects recognize that specific people, all of whom are project directors, hold the capacity to make decisions regarding the design and implementation of digital infrastructures, which are deemed necessary to account for the distributed manner in which archaeological knowledge is produced [W32; P13; W71; W3; W21; W7; W53; W28]. Archaeologists whose work typically requires digital expertise

explicitly are responsible for how the tools selected for the project, the work protocols formulated, and the distributions of labour established either support or oppose their goals, by trying to anticipate how they will affect “downstream” processes [P45; P17; P16; W60; W55].

For instance, here is how Scott describes the workflow that he and Sarah had established to process a batch of finds in the laboratory:

Scott: we would dump it out on the table ... we would then organise it into these batches. ... And then we would read it in, where essentially, we would have one of the students at the computer with the access database open, and we would stand there and read in all of the different fields, kind of talk about it. ... And then we would move on to the next batch [W56].

Meanwhile, those who regularly perform routine tasks typically find value in the capacity of digital tools to facilitate day-to-day operations, with little attention paid to how well the tool integrates with other components of the project’s infrastructure [W44; W70; W73; W64; P48; P5; W46]. Directors in both PKAP and WARP recall situations when rote practitioners rejected tools that were purchased specifically to streamline their work because the particular tool got in the way of the tasks at hand [W8; W9; P6; W10]. In a similar vein, Bill and Dimitri recall making explicit efforts to involve students in the broader systems of knowledge creation by asking them to compile weekly reports derived from the data they collected in the field. They feel doing so would help the students reflect on the purpose of their work and understand it within a broader context, one that characterizes them as creators of valued records [W38]. Bill adds that granting autonomy to these rote workers, and recognizing their agency, “helped transition to a more collegial relationship” [W4].

7 Figured Worlds of Digital Archaeological Fieldwork

Our aim has been to provide answers to the four research questions mentioned at the start of this paper. Firstly, we asked to what extent do project team members address different aspects of archaeological fieldwork activity and digitally mediated practice (RQ1). As our analysis of coding frequencies showed, conversations among study participants evolve more often around *Activities* (particularly related to acquiring and analysing processes such as collecting, scanning, photographing, doing photogrammetry, identifying, and comparing), *Roles* (such as students, finds specialists, and field workers), *Tools* (software and hardware, but also non-digital tools), and *Information entities* (including paper recording sheets, digital photos, and databases). However, all other topics represented in different hierarchies of our code system – *Groups*, *Persons*, *Competences*, *Archaeological entities*, *External factors*, *Methods*, and *Motives* – also appear in conversations, albeit less often. Participants do consider these topics, and the underlying dimensions of practice, as interrelated, connecting them regularly in discursive structures of issues they identify, and related positions they express.

In addition, while topical interest is shared across the two projects, PKAP participants more frequently raise technical topics such as georeferenced and remote sensing data, software and network services, and advance more frequent arguments (issues and positions) related to doing fieldwork, whereas WARP conversations are drawn more to human-oriented topics such as roles and competences, and arguments about learning and expertise. Although the two projects, directors, and team members are bound together by shared histories and concrete ties, their figured worlds of fieldwork practice seem to be different, considering both the frequency of topics addressed in the interviews and the meaning of their *Sayings*: PKAP team members seem to be more concerned about process (as shown by procedures and workflows, digital tools, and privileging of information objects such as data) and WARP members seem more concerned about intentionality (of people, roles, motivations, and beliefs). Although both projects appear equally concerned about knowledge work, PKAP participants engage more with pragmatic knowledge on the application of digital methods and technical topics, in line with Brandon and Tom’s research interests and methodological contributions in photogrammetry, GIS, and data constitution in digital archaeology (Olson, Gordon, Runnels, & Chomyszak, 2014; Roosevelt *et al.*, 2015). WARP participants engage more with a critical,

sociotechnical, or even political approach to digital work and learning, privileging questions of epistemological fit, researcher agency, epistemic division of labour, and the nature of archaeological knowledge. This engagement is more in line with Dimitri's affiliation with multiple epistemic communities and breadth of substantive research interests, and in Bill's vigorous record of publication and informal scholarly activism on DIY and slow archaeology (Caraher, 2016, 2019; Caraher, Kourelis, & Reinhard, 2014; Caraher & Reinhard, 2015). The identity of the two projects is shaped, to a great extent, by the overlapping interests and dispositions of project directors.

Our second research question asks how participants situate digital technologies, tools, and procedures in the context of their conception of archaeological knowledge work (RQ2). By examining issues and positions advanced by participants regarding digital tools, methods, and information objects, we revealed how digital tools may expand the capabilities of archaeologists, allowing them to work faster and more accurately, "even[ing] the playing field" [P37] and facilitating preservation and re-use of archaeological data. At best, these tools are considered to be good to think with, enabling better archaeological analysis of collected data. However, at the same time, these tools are considered as severely constraining the autonomy and agency of researchers as knowledge workers by enforcing their own logic on archaeologists.

Like Bernard Stiegler's "pharmakon," digital tools are framed here both as a poison and as a cure (Stiegler, 2012; cf. Stobiecka, 2020), but importantly their ability to do good or harm is tied to their agentive, performative role in producing outcomes in situated contexts, and in shaping the production of knowledge. This shift is captured in the centrality of the notion of workflows. Participants use "workflows" as a free-floating signifier, a metonymic term indexing the instrumentality of algorithmic power shaping the encounter between researcher and archaeological record, the hyper-granularization of archaeological data, the erosion of expertise, the mechanization of work, and the alienation of human labour. Reclaiming agency and autonomy is conveyed through notions describing concrete situations or ways of doing: embodied practice as a counter to the obscuring effects of digital intermediation, slow archaeology as a trade-off between craft and efficiency, and a digital DIY creating and repurposing of digital technology for archaeological goals as an effective way of wielding back agency from the algorithmic logic of infrastructures.

In conversations with PKAP and WARP participants on digital technology in fieldwork, DIY practice is advanced as an approach to counter the domination of digital tools and workflows. Craft also occupies a co-extensional conceptual space, being both a way of doing archaeology, and an accomplishment: a form of holistic archaeological knowledge that goes beyond the instrumental action of operating the tools or going through the steps of a pre-established workflow. Archaeologists who draw on a DIY approach in their work can be thought of here as forming a community of practice (Wenger, 1999), using craft to inform decision-making in the application of digital technologies in archaeological practice with the goal of protecting researcher agency. Although participants advance the idea that digital workflows have the potential to undermine craft and DIY practice, they also recognize that these creative and agentive ways of working can introduce greater flexibility and reflexivity to digital work. When named by participants, craft and DIY are usually framed in opposition to digital workflows. However, in broader discussions of agency and digital work, the two are not framed as being so mutually exclusive.

Thirdly, we asked how participants address issues of expertise, competences, and learning in the context of digitally mediated fieldwork (RQ3). Countering the model of a technician who merely knows how to replicate a set of mechanical instructions, study participants frame the archaeologist as needing to be a nimble "cat," who can navigate different contexts of knowledge and expertise: someone equally at home with substantive research in Aegean prehistory and Classical antiquity, as with archaeological and social theory, the praxis of field work, and with the use of digital tools and methods. Participants associate expertise with a slow process involving immersion and hands-on engagement in the field or in the lab rather than a quick fix achieved through training in a university classroom. The very practice of digital archaeology in the field, for project directors and instructors, is therefore framed as a form of vital experiential learning beyond the classroom, obtained over a longer-term apprenticeship doing fieldwork and making archaeological knowledge. However, agency in the form of DIY practice and craft is not available to all but rather hinges on the socioeconomic and political contexts within which archaeology operates (cf. Richardson, 2014; Richardson & Lindgren, 2017; Thorpe, 2012). The shortcomings of formal academic

learning in digital archaeology noted by Brandon [P11], and the disconnect between proficiency in both what is traditionally valued in an archaeologist and what is needed for digital work, points, therefore, to a critical challenge in attaining well-rounded archaeological expertise of the holistic nature envisioned by Bill, Dimitri, and other study participants. As an approach that is primarily concerned with reclaiming agency from systems of control, the integrity of archaeology-as-craft hinges, ultimately, on how well it may support a more inclusive and equitable *modus operandi* (Caraher, 2019; Morgan & Eddisford, 2014; Perry & Taylor, 2018; Richardson, 2017; Zorzin, 2015).

Finally, the fourth research question asks how participants conceive of the roles and relationships between team members in the context of digitally mediated fieldwork (RQ4). A key finding of our analysis has been that work roles and professional identities related to digital practice tend to be variable, multiple, and overlapping, rather than stable, exclusive, and singular. However, even if the project team members are ascribed specific roles in particular task contexts – as field walkers, as data entry workers, as co-authors of publications down the line – their identities appear to be stabilized through tacit negotiation of the limits of expertise of each other and the mutual recognition of boundaries. Decision making is a hugely important dimension of enacting agency, and criteria for making decisions about digital tools and practices differ among participants according to their role in the project. Professional identities are validated through the accounts of situated discursive activities of participants as they grapple with concrete aspects of their encounter with digital technology in the field, and mutual recognition comes in ways that conform to each members' expectations, and their understandings of value and acquired expertise.

Sayings of team members about digital tools, workflows, DIY practice and craft in work and learning are relevant for our understanding of PKAP and WARP as knowledge organizations. As noted by Theodore Schatzki, “sayings are intentional, oriented to ends, parts of tasks and projects and variously emotional [...] they are carried out in light of rules and [...] they, to varying degrees, articulate general understandings” (Schatzki, 2017, p. 130). In the *Sayings* we analysed in this study, participants represent WARP and PKAP as projects that have normalized the use of digital tools and the adoption of digital processes in their work. They reveal motivations and ends of ensuring that available tools, digital and non-digital alike, can play a pragmatically useful role in the archaeological process, while reclaiming agency and autonomy within archaeological fieldwork. As collective imaginings for the future of digital archaeology, these *Sayings* retain a healthy ambiguity in conceiving of digital tools and processes. The strength and co-extensional meanings of the key notions they represent, be it workflows, craft, or DIY archaeology, belies their ambiguity, metonymic power, and a very fluid, context-dependent significance.

The ideas of the archaeologists we interviewed represent two distinct figured worlds in PKAP and WARP. The way digital tools and workflows, the acquisition of expertise, and the shaping of roles and relationships unfolds in each of these two projects is related to the different generations, professional identities, and schools of thought of the directors for these two projects. As clear from their public record, the archaeologists we interviewed belong to a broader, recognizable thought collective within archaeology (Fleck, 1979), meeting virtually in the same blogrolls and edited volumes, which keeps a distance from positivism and solutionism; they all seem to recognize the continuing relevance and value of non-digital aspects of archaeological work both for acquiring expertise and for countering the distance introduced by digital intermediation; and they all recognize the primacy of researcher autonomy vs algorithmic agency. However, it is also possible to recognize a difference, whereby PKAP directors are much more invested in wielding their own expertise in photogrammetry and GIS to harness the algorithmic power of digital technology, whereas WARP directors appear much more geared towards projecting a critical discourse about social and human aspects of technology use, its pitfalls and implications.

We might be tempted to suggest that, of the four alternative scenarios for the “unstable futures” of digital archaeology put forward by Jeremy Huggett, Paul Reilly, and Gary Lock, PKAP, with its advocacy of home-grown photogrammetry and GIS solutions and expertise, might be recognized as part of the “School of Digital Citizenship” eager to make potentially disruptive, low-cost “substantive contributions and receive recognition in the discipline,” whereas WARP, with its critical approach to the wholesale adoption of digital technology, steampunk ethos of experimentation, and cultural improvisation bringing together traditional archaeological craft with digital expertise, might be thought of as a “Commune of Digital Anarchy ... an

alternative loc[us] of knowledge creation enliven[ing] the ebb and flow of critical discourse” (Huggett et al., 2018, pp. 48–49). Yet, our findings point to a more complex and nuanced situation, with ambiguous and sometimes even contradictory ideas, and with potentially significant internal differences in how, for instance, participants who design the workflows and decide on the digital tools used in fieldwork might view things differently from those involved in the routine use of those very same tools. At any rate, this study is meant to be idiographic rather than nomothetic (Windelband, 1980): the validity of our findings holds only for the two fieldwork projects we investigated, and we would expect different figured worlds among archaeologists working in different archaeological projects. As broader implications go, it may be more justified to trace the contingent cultural biography of figurations for workflows, craft, embodied knowledge, DIY, and slow archaeology as they may be negotiated and adopted by other archaeological teams, rather to lay claim to any ambition of generalization or prediction.

In the field of practice, *Sayings* are also “doings,” albeit of a discursive kind (Schatzki, 2017). The figured worlds of digital fieldwork practice enacted by *Sayings* in these two eastern Mediterranean fieldwork projects constitute different worker identities in the bundle of archaeological practice, involving participants of differing statuses in terms of archaeological and digital expertise, situationally dependent and multiple work roles, and the ability to decide and act vis-à-vis digital technology. They constitute figurations: ideations of practice through discourse transcending actual and normative domains, but also “webs of interdependence” between project team members “linked with each other in the most diverse ways [and] characterized by power balances of many sorts”, with some relationships realized in practice and others as “open (unattached) valences” (Elias, 1978, pp. 14–15, Figure 2).

In the context of considering work that needs to be performed under financial, time, and logistical concerns, workflows and digital tools that are central to such figurations may be conceived as useful, instrumental extensions of the archaeologists’ self, serving local purposes within a *discourse of craft vs efficacy*: the team needs to produce publications and field seasons need to be wrapped up, PhD students need to learn the ropes and develop expertise to be accepted as peers, and to secure a career. In a critical context, where the nature of archaeological expertise and knowledge work is in question, digital technology may, conversely, be viewed in the context of a *discourse of technocracy vs agency*: a mediation of the angst around the recognition that archaeological knowing cannot be attained through shortcuts, instrumentality is not the same as knowledge, digital technology brings promise but also challenges to authority and agency. *Sayings* about craft, DIY, bricolage, and related notions shared by participants in the PKAP and WARP projects emerge as mediating tools towards establishing a middle ground between these two dissonant discourses: as semiotic echoing of the wider theoretical debates on archaeology’s “anxiety” (Huggett, 2013, 2015) by “excavating” them from within the situated practice and figured *Sayings* of field archaeologists in the wild.

8 Conclusion

Important questions remain open in our inquiry. We have been confident, in our analysis, in representing key notions of participant *Sayings* regarding the specificity of “good” digital practice in fieldwork – tweaking, workarounds, cobbling together, working “on the fly”, getting hands “dirty” – and recognize clearly the conceptual cluster of umbrella notions that participants bring forth to characterize such practice – craft, DIY, and slow archaeology. However, we are challenged in tallying these representations with theorizations and historical accounts that cover the same conceptual terrain in the literature. Are the fluid and reciprocal learning processes, roles, and relationships manifested in these archaeological projects really similar to the routine-bound, structured aspects of historically attested practices of craft and the strict, hierarchical relationships and power differentials between the “craftsman” and the apprentice characteristic of guilds (Sennett, 1978; Shanks & McGuire, 1996)? Or, rather, are they more akin to communities of practice, supporting situated learning through legitimate peripheral participation (Davidovic, 2008; Lave & Wenger, 1991; Olsson, 2016; Wenger, 1999)? When participants assert the need to reclaim agency from

technology, do they envision digital tools and workflows as efficacious extensions of a distributed person (Gell, 1998; Strathern, 1992), or as black-boxed hybrids, or monsters (Latour, 1993; Morgan, 2019)? Does digital work in archaeology hinge overall on innovation or on cultural improvisation of traditional knowledge (Hallam & Ingold, 2007)? Are members of these archaeological projects akin to bricoleurs, dealing with digital tools by shrewdly cobbling together locally available materials, digital tools and competencies, or like engineers, designing and implementing rational specifications and methods of action (Chapman & Wylie, 2014; Johnson, 2012; Lévi-Strauss, 1962; Lucas, 2012; Wylie, 2002)? These questions remain central to our concerns and point to fruitful directions for future work.

In line with the constructionist ontological commitments of our study, our focus has been not so much to advance claims about the actual effects of digital tools and workflows, or the adequacy of digital skills acquisition in the classroom. It has been, rather, on how to make sense of the “figured worlds” of participants we interviewed in Cyprus and the Peloponnese: the socially generated and culturally figured “collective imaginings,” that is, “socially and culturally constructed realm[s] of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (Holland, 2001, p. 53). In this light, we may interpret the frequent references of our participants to specific archaeological *Activities*, *Roles*, digital and non-digital *Tools*, *Information entities*, *Groups*, and *Competences* as discursive acts of constructing a world that bridges their perception of reality (e.g. what digital workflows actually do) with imagined archaeological futures (e.g. what will be an archaeology driven by digital workflows). *Sayings* of PKAP and WARP project team members about digitally mediated work, learning and expertise are not therefore considered in this study as “actuarial records” providing forensic evidence of their actual archaeological activity but rather as discursive representations pointing to evaluative positionings, norms, affects – as “contracts” of participants towards better future digital practice in archaeology (cf. Garfinkel, 1967, pp. 194–195).

One broader objective of the E-CURATORS project is to contribute to the current debates on digital archaeology and the digitally mediated work of archaeological data curation, research and communication from a position of epistemological humility. By shifting, in this study, from a nomothetic to an idiographic framing of claims to knowledge, from a normative to an empirical methodological approach, and from a research focus on how fieldworkers (should) use digital tools and infrastructures to their imaginings on digitally mediated fieldwork, learning, and expertise, we hope to encourage a reflexive and open digital archaeology, which takes the voices of field archaeologists seriously, and recognizes the crucial role their agency and intentionality plays in shaping digital archaeological practice.

Acknowledgements: Authors extend warm thanks to E-CURATORS project collaborators Prof. Panos Constantopoulos and research assistant Erin Canning for contributing to aspects of conceptual modelling informing the study, and to research assistants Danielle Crecca, Andres de los Rios, and Rohith Sothilingham for supporting early stages of qualitative data analysis and data management. Moreover, we thank Fiori Dalla for her assistance while conducting interviews. We are also grateful to the anonymous reviewers for their diligent critical attention and useful feedback to our work.

Funding information: This study was funded by Canada’s Social Sciences and Humanities Research Council Insight grant E-CURATORS – Pervasive digital curation activities, objects and infrastructures in archaeological research and communication: process modelling, multiple-case studies, and requirements elicitation. (Grant No. 435-2017-0446). Additionally, IH and CD have been chair and vice-chair, respectively, of ARKWORK – Archaeological practices and knowledge work in the digital environment (COST Action CA15201) and acknowledge support by the European Cooperation in Science and Technology – COST Programme.

Author contributions: CD and ZB defined the scope of the study and identified suitable cases for inclusion. ZB, CD and SR conducted interviews with participating informants. VM, TCT and ZB transcribed the interviews, and ZB formatted the transcripts and prepared them for qualitative analysis. ZB, VLM and TCT coded the transcripts and performed extensive memoing. ZB was responsible for migrating the results of

qualitative analysis to Neo4j, and ZB, VLM, TCT and CD designed and executed queries to support our investigation. TCT and CD performed quantitative analysis. CD, ZB, VLM and TCT met regularly to draw out sensitizing concepts, and NF, IH, SM and MC provided additional insight at this stage as well. CD, ZB, VLM and TCT wrote preliminary drafts of the written manuscript, which were enriched through extensive comments provided by NF, IH, SM and MC. ZB, CD and NF integrated contributions provided by all authors and edited the manuscript into its final form. ZB created the figures and prepared the appendix. CD is the principal investigator and oversaw all the work.

Informed consent: Informed consent was obtained from all individuals included in this study, in compliance with RIS Human Participant Ethics Protocol #36452 approved by the Research Ethics Board of the University of Toronto.

Conflict of interest: Authors state no conflict of interest.

Data availability statement: The data generated and analysed during the current study are included in this published article's supplementary information files. They are also available in a Zenodo repository: <https://doi.org/10.5281/zenodo.5831760>.

References

- Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., King, I. F., & Angel, S. (1977). *A pattern language: Towns, buildings, construction*. Oxford: Oxford University Press.
- Beale, G., & Reilly, P. (2017). Digital practice as meaning making in archaeology. *Internet Archaeology*, 44. doi: 10.11141/ia.44.13.
- Benardou, A., Champion, E., Dallas, C., & Hughes, L. M. (Eds.). (2018). *Cultural heritage infrastructures in digital humanities* (1st ed.). London & New York: Routledge. doi: 10.4324/9781315575278.
- Benardou, A., Constantopoulos, P., Dallas, C., & Gavriliis, D. (2010). A conceptual model for scholarly research activity. In J. Unsworth, H. Rosenbaum, & K. E. Fisher (Eds.), *iConference 2010: The fifth annual iConference* (pp. 26–32). Urbana-Champaign, IL: University of Illinois. http://nora.lis.uiuc.edu/images/iConferences/2010papers_Allen-Ortiz.pdf.
- Berggren, Å., & Hodder, I. (2003). Social practice, method, and some problems of field archaeology. *American Antiquity*, 68(3), 421–434. doi: 10.2307/3557102.
- Buchanan, S. A. (2019). The assemblage of repository and museum work in archaeological curation. *Information Research*, 24(2). <http://informationr.net/ir/24-2/paper816.html>.
- Burr, V. (2015). *Social constructionism* (3rd ed.). London: Routledge.
- Caraher, W. (2014, August 4). A proposed blog series: Archaeology and craft. *Archaeology of the Mediterranean World*. <https://mediterraneanworld.wordpress.com/2014/08/04/a-proposed-blog-series-archaeology-and-craft/>.
- Caraher, W. (2016). Slow archaeology: Technology, efficiency, and archaeological work. In *Mobilizing the past*. Grand Forks, ND: The Digital Press at the University of North Dakota. http://dc.uwm.edu/arthist_mobilizingthepast/18.
- Caraher, W. (2019). Slow archaeology, punk archaeology, and the “archaeology of care.” *European Journal of Archaeology*, 22(3), 372–385. doi: 10.1017/eaa.2019.15.
- Caraher, W. (2021a, June 3). WARP 2021 study season. *Archaeology of the Mediterranean World*. <https://mediterraneanworld.wordpress.com/2021/06/03/warp-2021-study-season/>.
- Caraher, W. (2021b, June 23). More on WARP data (part two). *Archaeology of the Mediterranean World*. <https://mediterraneanworld.wordpress.com/2021/06/23/more-on-warp-data-part-two/>.
- Caraher, W., Kourelis, K., & Reinhard, A. D. (2014). *Punk Archaeology*. The Digital Press at The University of North Dakota.
- Caraher, W., Moore, R. S., Noller, J. S., & Pettegrew, D. (2005). The Pyla-Koutsopetria Archaeological Project: First preliminary report (2003–2004 Seasons). In *Report of the Department of Antiquities, Cyprus* (pp. 245–268). Nicosia: Department of Antiquities, Cyprus.
- Caraher, W., & Reinhard, A. (2015). From blogs to books: Blogging as community, practice, and platform. *Internet Archaeology*, 39. doi: 10.11141/ia.39.7.
- Carter, W. M. (2017). Getting to the point: Making, wayfaring, loss and memory as meaning-making in virtual archaeology. *Virtual Archaeology Review*, 8(16), 97–102.
- Chapman, R., & Wylie, A. (Eds.). (2014). *Material evidence: Learning from archaeological practice*. London & New York: Routledge.

- Chenhall, R. G. (1967). The description of archaeological data in computer language. *American Antiquity*, 32(2), 161–167. doi: 10.2307/277901.
- Cobb, C. R. (2014). The once and future archaeology. *American Antiquity*, 79(4), 589–595. doi: 10.7183/0002-7316.79.4.589.
- Conklin, J., & Begeman, M. L. (1988). gIBIS: A hypertext tool for exploratory policy discussion. *ACM Transactions on Information Systems*, 6(4), 303–331. doi: 10.1145/58566.59297.
- Cook, K., & Compton, B. (2018). Canadian digital archaeology: On boundaries and futures. *Canadian Journal of Archaeology*, 42, 38–45.
- Coplien, J. O. (1996). *Software patterns*. New York: Sigs.
- Cowgill, G. L. (1967). Computer applications in archaeology. *Computers and the Humanities*, 2(1), 17–23. doi: 10.1007/BF02402460.
- Dallas, C. (2007a). Archaeological knowledge, virtual exhibitions and the social construction of meaning. In P. Moscati (Ed.), *Virtual museums and archaeology: The contribution of the Italian national research council* (pp. 31–64). Firenze: Insegna del Giglio. http://www.archcalc.cnr.it/indice/Suppl_1/4_Dallas.pdf.
- Dallas, C. (2007b). An agency-oriented approach to digital curation theory and practice. In J. Trant & D. Bearman (Eds.), *The International cultural heritage informatics meeting proceedings*. Toronto: Archives & Museum Informatics. <http://www.archimuse.com/ichim07/papers/dallas/dallas.html>.
- Dallas, C. (2015). Curating archaeological knowledge in the digital continuum: From practice to infrastructure. *Open Archaeology*, 1(1), 176–207. doi: 10.1515/opar-2015-0011.
- Dallas, C. (2016a). Jean-Claude Gardin on archaeological data, representation and knowledge: Implications for digital archaeology. *Journal of Archaeological Method and Theory*, 23(1), 305–330. doi: 10.1007/s10816-015-9241-3.
- Dallas, C. (2016b). Digital curation beyond the “wild frontier”: A pragmatic approach. *Archival Science*, 16(4), 421–457. doi: 10.1007/s10502-015-9252-6.
- Dallas, C. (2018). Heritage encounters on social network sites, and the affiliative power of objects. In S. Antoniadou, I. Poullos, G. Vavouranakis, & P. Raouzaiou (Eds.), *Culture and perspective at times of crisis: State structures, private initiative and the public character of heritage* (pp. 116–131). Oxford & Philadelphia: Oxbow Books.
- Davidovic, A. (2008). Die Wirkung archäologischer Ausgrabungsmethoden auf die Herstellung archäologischen Wissens. In U. Freikamp, M. Leanza, J. Mende, S. Müller, P. Ullrich, & H.-J. Voß (Eds.), *Kritik mit Methode? Forschungsmethoden und Gesellschaftskritik*. Berlin: Karl Dietz Verlag. <http://edoc.vifapol.de/opus/volltexte/2008/813/>.
- Derudas, P., & Berggren, Å. (2021). Expanding field-archaeology education: The integration of 3D technology into archaeological training. *Open Archaeology*, 7(1), 556–573.
- Edgeworth, M. (2006). *Ethnographies of archaeological practice: Cultural encounters, material transformations*. Lanham, MD: AltaMira Press.
- Elias, N. (1978). *What is sociology?* New York: Columbia University Press.
- Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engeström, R. Miettinen, & R.-L. Punamäki-Gitai (Eds.), *Perspectives on activity theory* (pp. 19–37). Cambridge & New York: Cambridge University Press.
- ESRI. (2007, August 15). *Natural breaks (Jenks)*. ArcGIS Desktop Help 9.2. http://webhelp.esri.com/http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?topicname=natural_breaks_%28jenks%29.
- Evans, T. L., & Daly, P. T. (2006). *Digital archaeology: Bridging method and theory*. London: Routledge.
- Faniel, I., Kansa, E., Whitcher Kansa, S., Barrera-Gomez, J., & Yakel, E. (2013). The challenges of digging data: A study of context in archaeological data reuse. *Proceedings of the 13th ACM/IEEE-CS joint conference on digital libraries* (pp. 295–304). New York: ACM. doi: 10.1145/2467696.2467712.
- Faniel, I. M., Austin, A., Kansa, E., Kansa, S. W., France, P., Jacobs, J., ... Yakel, E. (2018). Beyond the archive: Bridging data creation and reuse in archaeology. *Advances in Archaeological Practice*, 6(2), 105–116. doi: 10.1017/aap.2018.2.
- Ferris, N., & Welch, J. R. (2016). Beyond archaeological agendas: In the service of a sustainable archaeology. In S. Atalay, L. R. Clauss, R. H. McGuire, & J. R. Welch (Eds.), *Transforming archaeology: Activist practice and prospects* (pp. 215–238). London & New York: Routledge.
- Fleck, L. (1979). *Genesis and development of a scientific fact* (Repr. 11. Aufl). Chicago & London: University of Chicago Press.
- Flick, U. (2000). Episodic interviewing. In P. Atkinson, M. W. Bauer, & G. Gaskell (Eds.), *Qualitative researching with text, image and sound: A practical handbook* (pp. 75–92). London: SAGE Publications.
- Gallimore, S., James, S., Caraher, W., & Nakassis, D. (2017). To argos: Archaeological survey in the western Argolid, 2014–2016. *From maple to olive: Proceedings of a colloquium to celebrate the 40th anniversary of the Canadian Institute in Greece, Athens, 10–11 June 2016* (pp. 421–438). https://hcommons.org/deposits/download/hc:18160/CONTENT/gallimore_james_caraher_nakassis_2017_maple-to-olive.pdf/.
- Gardin, J.-C. (1958). Four codes for the description of artifacts: An essay in archeological technique and theory. *American Anthropologist*, 60(2), 335–357. doi: 10.1525/aa.1958.60.2.02a00090.
- Garfinkel, H. (1967). “Good” organizational reasons for ‘bad’ clinic records.” In *Studies in ethnomethodology* (pp. 186–207). Englewood Cliffs, NJ: Prentice Hall.
- Gell, A. (1998). *Art and agency: An anthropological theory*. Oxford: Clarendon Press.
- Goodwin, C. (2003). The body in action. In J. Coupland & R. Gwyn (Eds.), *Discourse, the body, and identity* (pp. 19–42). UK: Palgrave Macmillan. doi: 10.1057/9781403918543_2.

- Graham, S. (2014, September 11). Craft in archaeology: Is digital archaeology craft? *Archaeology of the Mediterranean World*. <https://mediterraneanworld.wordpress.com/2014/09/11/is-digital-archaeology-craft/>
- Hallam, E., & Ingold, T. (Eds.). (2007). *Creativity and cultural improvisation*. London & New York: Routledge.
- Holland, D. (Ed.). (2001). *Identity and agency in cultural worlds*. Cambridge, MA & London: Harvard University Press.
- Huggett, J. (2013). Disciplinary issues: Challenging the research and practice of computer applications in archaeology. In G. Earl, T. Sly, A. Chrysanthi, P. Murrieta-Flores, C. Papadopoulos, I. Romanowska, & D. Wheatley (Eds.), *Archaeology in the digital era* (pp. 13–24). Amsterdam: Amsterdam University Press. <http://dare.uva.nl/document/516092>.
- Huggett, J. (2015). A manifesto for an introspective digital archaeology. *Open Archaeology*, 1(1), 86–95. doi: 10.1515/opar-2015-0002.
- Huggett, J. (2021). Algorithmic agency and autonomy in archaeological practice. *Open Archaeology*, 7(1), 417–434. doi: 10.1515/opar-2020-0136.
- Huggett, J., Reilly, P., & Lock, G. (2018). Whither digital archaeological knowledge? The challenge of unstable futures. *Journal of Computer Applications in Archaeology*, 1(1), 42–54. doi: 10.5334/jcaa.7.
- Huggett, J., & Ross, S. (2004). Archaeological informatics: Beyond technology. *Internet Archaeology*, 15.
- Huvila, I. (2008a). Information work analysis: An approach to research on information interactions and information behaviour in context. *Information Research: An International Electronic Journal*, 13(3). <http://informationr.net/ir/13-3/paper349.html>.
- Huvila, I. (2008b). The information condition: Information use of archaeologists in labour, work and action. *Information Research*, 13(4). <http://informationr.net/ir/13-4/paper369.html>.
- Huvila, I. (2014). Archaeologists and their information sources. In *DIVA* (pp. 25–54). Uppsala: Department of ALM, Uppsala University. <http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-241835>.
- Huvila, I. (2016). Awkwardness of becoming a boundary object: Mangle and materialities of reports, documentation data, and the archaeological work. *The Information Society*, 32(4), 280–297. doi: 10.1080/01972243.2016.1177763.
- Huvila, I. (2019a). Management of archaeological information and knowledge in digital environment. In M. Handzic & D. Carlucci (Eds.), *Knowledge management, arts, and humanities* (Vol. 7, pp. 147–169). Cham, Switzerland: Springer International Publishing. doi: 10.1007/978-3-030-10922-6_8.
- Huvila, I. (2019b). Genres and situational appropriation of information: Explaining not-seeking of information. *Journal of Documentation*, 75(6), 1503–1527. doi: 10.1108/JD-03-2019-0044.
- Huvila, I. (2019c). Learning to work between information infrastructures. *Information Research*, 24(2). <http://informationr.net/ir/24-2/paper819.html>.
- Huvila, I. (2020). Quality, working conditions, education and communication concerns in European contract archaeology. *The European Archaeologist*, 63, 18–19.
- Huvila, I., Dalbello, M., Dallas, C., Faniel, I. M., & Olsson, M. (2019). Editorial: Archaeology and information research. *Information Research*, 24(2). <http://informationr.net/ir/24-2/ArchaeolEditorial.html>
- Huvila, I., & Huggett, J. (2018). Archaeological practices, knowledge work and digitalisation. *Journal of Computer Applications in Archaeology*, 1(1), 88–100. doi: 10.5334/jcaa.6.
- Ingold, T. (2011). Walking the plank: Meditations on a process of skill. In *Being alive: Essays on movement, knowledge and description* (pp. 51–62). London & New York: Routledge.
- Ingold, T., & Hallam, E. (2007). Creativity and cultural improvisation: An introduction. In E. Hallam & T. Ingold (Eds.), *Creativity and cultural improvisation* (pp. 1–24). London & New York: Routledge.
- Johnson, C. (2012). Bricoleur and bricolage: From metaphor to universal concept. *Paragraph*, 35(3), 355–372. doi: 10/ghkfs5.
- Kansa, E. C., Kansa, S. W., & Watrall, E. (Eds.). (2011). *Archaeology 2.0: New approaches to communication and collaboration*. Los Angeles: Cotsen Institute of Archaeology Press. <http://www.escholarship.org/uc/item/1r6137tb#page-82>.
- Kansa, S. W., Atici, L., Kansa, E. C., & Meadow, R. H. (2019). Archaeological analysis in the information age: Guidelines for maximizing the reach, comprehensiveness, and longevity of data. *Advances in Archaeological Practice*, 8(1), 40–52. doi: 10.1017/aap.2019.36.
- Koolen, M., Kumpulainen, S., & Melgar-Estrada, L. (2020). A workflow analysis perspective to scholarly research tasks. *Proceedings of the 2020 conference on human information interaction and retrieval* (pp. 183–192). New York: Association for Computing Machinery. doi: 10.1145/3343413.3377969.
- Kunz, W., & Rittel, H. W. (1970). *Issues as elements of information systems*. Berkeley, CA: Institute of Urban and Regional Development, University of California.
- Lake, M. (2012). Open archaeology. *World Archaeology*, 44(4), 471–478. doi: 10.1080/00438243.2012.748521.
- Landvatter, T., Olson, B. R., Reese, D. S., Stephens, J., & Moore, R. S. (2018). Pyla-Koutsopetria archaeological project: Excavations at Pyla-Vigla in 2018. In R. Rosenthal-Heginbottom & P. Kögler (Eds.), *Journal of hellenistic pottery and material culture* (Vol. 3, pp. 179–186). Oxford: Archaeopress.
- Latour, B. (1993). *We have never been modern*. Cambridge, MA: Harvard University Press.
- Laužikas, R., Dallas, C., Thomas, S., Kelpšienė, I., Huvila, I., Luengo, P., ... Vaitkevičius, V. (2018). Archaeological knowledge production and global communities: Boundaries and structure of the field. *Open Archaeology*, 4(1), 350–364. doi: 10.1515/opar-2018-0022.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

- Leighton, M. (2015). Excavation methodologies and labour as epistemic concerns in the practice of archaeology. Comparing examples from British and Andean archaeology. *Archaeological Dialogues*, 22(1), 65–88.
- Leont'ev, A. N. (1978). *Activity, consciousness, and personality*. Englewood Cliffs, NJ: Prentice-Hall. <http://www.marxists.org/archive/leontev/works/1978/index.htm>.
- Lévi-Strauss, C. (1962). *La pensée sauvage*. Chicago & London: Plon.
- Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2018). Paradigmatic controversies, contradictions, and emerging confluences, revisited. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (5th ed., pp. 213–263). Los Angeles: SAGE Publications.
- Llobera, M. (2011). Archaeological visualization: Towards an archaeological information science (AISc). *Journal of Archaeological Method and Theory*, 18(3), 193–223. doi: 10.1007/s10816-010-9098-4.
- Lock, G. R., & Brown, K. (Eds.). (2000). *On the theory and practice of archaeological computing*. Oxford: Oxford University Committee for Archaeology.
- Lucas, G. (2001). *Critical approaches to fieldwork: Contemporary and historical archaeological practice*. London & New York: Routledge.
- Lucas, G. (2012). *Understanding the archaeological record*. New York: Cambridge University Press.
- Malone, T. W., Crowston, K., & Herman, G. A. (Eds.). (2003). *Organizing business knowledge: Cambridge, MA & London: The MIT process handbook*. MIT Press.
- Maryl, M., Dallas, C., Edmond, J., Labov, J., Kelpšienė, I., Doran, M., ... Grabowska, K. (2020). A case study protocol for meta-research into digital practices in the humanities. *Digital Humanities Quarterly*, 14(3).
- Meghini, C., Scopigno, R., Richards, J., Wright, H., Geser, G., Cuy, S., ... Vlachidis, A. (2017). ARIADNE: A research infrastructure for archaeology. *Journal of Computing and Cultural Heritage*, 10(3), 18:1–18:27. doi: 10.1145/3064527.
- Morgan, C. (2019). Avatars, monsters, and machines: A cyborg archaeology. *European Journal of Archaeology*, 22(3), 324–337.
- Morgan, C., & Eddisford, D. (2014, October 9). Craft in archaeology: Who digs? Craft & non-specialist labor in archaeology. *Archaeology of the Mediterranean World*. <https://mediterraneanworld.wordpress.com/2014/10/09/craft-in-archaeology-who-digs-craft-non-specialist-labor-in-archaeology/>.
- Morgan, C., & Eve, S. (2012). DIY and digital archaeology: What are you doing to participate? *World Archaeology*, 44(4), 521–537. doi: 10.1080/00438243.2012.741810.
- Morgan, C., & Wright, H. (2018). Pencils and pixels: Drawing and digital media in archaeological field recording. *Journal of Field Archaeology*, 43(2), 136–151. doi: 10.1080/00934690.2018.1428488.
- Moser, S., Glazier, D., Phillips, J. E., el Nemr, L. N., Mousa, M. S., Aiesh, R. N., ... Seymour, M. (2002). Transforming archaeology through practice: Strategies for collaborative archaeology and the Community Archaeology Project at Quseir, Egypt. *World Archaeology*, 34(2), 220–248. doi: 10.1080/0043824022000007071.
- Myres, J. N. L. (1989). *The English settlements*. Oxford & New York: Oxford University Press.
- Olson, B. R., Caraher, W., Pettegrew, D. K., & Moore, R. S. (2013). The Pyla-Koutsopetria archaeological project: A preliminary report of excavations at Pyla-Viglia, a fortified settlement dating to the Hellenistic Era. *Journal of Ancient Egyptian Interconnections*, 5(3), 74–82. <https://journals.uair.arizona.edu/index.php/jaei/article/view/17629>.
- Olson, B. R., Gordon, J. M., Runnels, C., & Chomyszak, S. (2014). Experimental three-dimensional printing of a lower Palaeolithic handaxe: An assessment of the technology and analytical value. *Lithic Technology*, 39(3), 162–172.
- Olsson, M. (2016). Making sense of the past: The embodied information practices of field archaeologists. *Journal of Information Science*, 42(3), 410–419. doi: 10.1177/016555151515621839.
- Opitz, R. S., & Johnson, T. D. (2016). Interpretation at the controller's edge: Designing graphical user interfaces for the digital publication of the excavations at Gabii (Italy). *Open Archaeology*, 1, 274–290. doi: 10.1515/opar-2015-0017.
- Perry, S., & Taylor, J. S. (2018). Theorising the digital: A call to action for the archaeological community. In M. Matsumoto & E. Uleberg (Eds.), *CAA2016: Oceans of data – Proceedings of the 44th conference on computer applications and quantitative methods in archaeology* (pp. 11–22). Oxford: Archaeopress.
- Reckwitz, A. (2002). Toward a theory of social practices: A development in culturalist theorizing. *European Journal of Social Theory*, 5(2), 243–263. doi: 10.1177/13684310222225432.
- Restivo, S., & Croissant, J. (2008). Social constructionism in science and technology studies. In J. A. Holstein & J. F. Gubrium (Eds.), *Handbook of constructionist research* (pp. 213–229). New York & London: Guilford Press.
- Richards, J. D. (1998). Recent trends in computer applications in archaeology. *Journal of Archaeological Research*, 6(4), 331–382. doi: 10.1023/A:1022879819064.
- Richardson, L.-J. (2014). Understanding archaeological authority in a digital context. *Internet Archaeology*, 38. doi: 10.11141/ia.38.1.
- Richardson, L.-J. (2017). I'll give you 'punk archaeology', sunshine. *World Archaeology*, 49(3), 306–317.
- Richardson, L.-J., & Lindgren, S. (2017). Online tribes and digital authority: What can social theory bring to digital archaeology? *Open Archaeology*, 3(1), 139–148. doi: 10.1515/opar-2017-0008.
- Richards-Rissetto, H., & Landau, K. (2019). Digitally-mediated practices of geospatial archaeological data: Transformation, integration, & interpretation. *Journal of Computer Applications in Archaeology*, 2(1), 120–135. doi: 10.5334/jcaa.30.

- Roosevelt, C. H., Cobb, P., Moss, E., Olson, B. R., & Ünlüsoy, S. (2015). Excavation is [destruction] digitization: Advances in archaeological practice. *Journal of Field Archaeology*, 40(3), 325–346. <http://www.tandfonline.com/doi/abs/10.1179/2042458215Y.0000000004>.
- Ross, S. (2000). *Changing trains at Wigan: Digital preservation and the future of scholarship*. London: National Preservation Office. http://eprints.erpanet.org/45/01/seamusross_wigan_paper.pdf
- Ross, S. (2020). Beyond place: Data curation possibilities for post-custodial archives and libraries. In P. A. Demers & T. Samek (Eds.), *Minds alive: Libraries and archives now*. Toronto: University of Toronto Press. <http://www.degruyter.com/document/doi/10.3138/9781487531881/html>.
- Ruppert, E., Law, J., & Savage, M. (2013). Reassembling social science methods: The challenge of digital devices. *Theory, Culture & Society*, 30(4), 22–46. doi: 10.1177/0263276413484941.
- Ryle, G. (2009). *The concept of mind*. London: Routledge. doi: 10.4324/9780203875858
- Schäfer, M. T., & van Es, K. (Eds.). (2017). *The datafied society. Studying culture through data*. Amsterdam: Amsterdam University Press. doi: 10.5117/9789462981362.
- Schatzki, T. R. (2012). A primer on practices: Theory and research. In J. Higgs, R. Barnett, S. Billett, M. Hutchings, & F. Trede, *Practice-based education* (pp. 13–26). Rotterdam: Sense Publishers.
- Schatzki, T. (2017). Sayings, texts and discursive formations. In A. Hui, T. R. Schatzki, & E. Shove (Eds.), *The nexus of practices* (pp. 126–140). London & New York: Routledge.
- Sennett, R. (1978). *The craftsman: An anthology*. London: Yale University Press.
- Shanks, M., & McGuire, R. H. (1996). The craft of archaeology. *American Antiquity*, 61(1), 75–88. doi: 10.1017/S0002731600050046.
- Spaulding, A. C. (1953). Statistical techniques for the discovery of artifact types. *American Antiquity*, 18(4), 305–313. doi: 10.2307/277099.
- Stiegler, B. (2012). Relational ecology and the digital pharmakon. *Culture Machine*, 13, 1–19.
- Stobiecka, M. (2020). Archaeological heritage in the age of digital colonialism. *Archaeological Dialogues*, 27(2), 113–125. doi: 10.1017/S1380203820000239.
- Strathern, M. (1992). Parts and wholes: Refiguring relationships in a post-plural world. *Conceptualizing Society: Refiguring Relationships in a Post-Plural World*, 1, 75–103.
- Strauss, A. (1988). The articulation of project work: An organizational process. *The Sociological Quarterly*, 29(2), 163–178. JSTOR. <http://www.jstor.org/stable/4121474>.
- Talja, S., Tuominen, K., & Savolainen, R. (2005). “Isms” in information science: Constructivism, collectivism and constructionism. *Journal of Documentation*, 61(1), 79–101. doi: 10.1108/00220410510578023.
- Tanasi, D. (2020). The digital (within) archaeology. Analysis of a phenomenon. *The Historian*, 82(1), 22–36.
- Thorpe, R. (2012). Often fun, usually messy: Fieldwork, recording and higher orders of things. In H. Cobb, O. J. T. Harris, C. Jones, & P. Richardson (Eds.), *Reconsidering archaeological fieldwork* (pp. 31–52). US: Springer. http://link.springer.com/10.1007/978-1-4614-2338-6_3.
- Tilley, C. Y. (1994). *A phenomenology of landscape: Places, paths, and monuments*. London: Bloomsbury.
- Watrall, E. (2019). Building scholars and communities of practice in digital heritage and archaeology. *Advances in Archaeological Practice*, 7(2), 140–151. doi: 10.1017/aap.2019.1.
- Wenger, E. (1999). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.
- Windelband, W. (1980). History and natural science (G. Oakes, Trans.). *History and Theory*, 19(2), 165–168. doi: 10.2307/2504797.
- Wissik, T., & Đurčo, M. (2016). Research data workflows: From research data lifecycle models to institutional solutions. *Selected papers from the CLARIN annual conference 2015, October 14–16, 2015, Wrocław, Poland* (Vol. 123, pp. 94–107).
- Wylie, A. (2002). *Thinking from things: Essays in the philosophy of archaeology*. Berkeley, Los Angeles & London: University of California Press.
- Zorzin, N. (2015). Dystopian archaeologies: The implementation of the logic of capital in heritage management. *International Journal of Historical Archaeology*, 19(4), 791–809. doi: 10.1007/s10761-015-0315-4.
- Zubrow, E. B. (2005). Digital archaeology. In P. Daly & T. L. Evans (Eds.), *Digital archaeology* (pp. 10–31). London: Routledge.