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DIGITAL ARCHAEOLOGY

Promises and Impasses

51

ANALECTA
PRAEHISTORICA
LEIDENSIA



edited by
TUNA KALAYCI, KARSTEN LAMBERS
& VICTOR KLINKENBERG



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Contents

7	Preface
9	Introduction: Leiden Perspectives on Digital Archaeology <i>Karsten Lambers</i>
17	Metaphors, Myths, and Transformations in Digital Archaeology <i>Tuna Kalaycı and Piraye Hacıgüzeller</i>
33	Data Exchange Protocol in Dutch Archaeology <i>Milco Wansleeben, Walter Laan and Ronald Visser</i>
47	Digital Data Integration in Mediterranean Field Survey Archaeology: Status Quo and Future Perspectives <i>Tymon de Haas and Martijn van Leusen</i>
57	Isotopes, Isoscapes, and the Search for Geographic Origins: Unrealized Potential or Unrealistic Expectations? <i>Jason E. Laffoon and Till F. Sonnemann</i>
77	From the Jungle to the Lab: Using Remote-Sensing and Deep Learning to Map Archaeological Features in Lab-based Settings <i>Sarah Klassen, Tommaso Pappagallo and Damian Evans</i>
95	Bibliometric Analysis of Agent-Based Simulation in Archaeology: People, Topics, and Future Prospects <i>Iza Romanowska and Fulco Scherjon</i>
113	Critical Miss? Archaeogaming as a Playful Tool for Archaeological Research and Outreach <i>Aris Politopoulos and Angus Mol</i>
129	Reflections <i>Rachel Opitz</i>

Introduction: Leiden Perspectives on Digital Archaeology

Karsten Lambers

1 DIGITAL ARCHAEOLOGY

What is 'digital archaeology'? As lecturers of digital archaeology at Leiden University, we should probably be able to provide a succinct definition. Yet it is a notoriously broad, vague and ambiguous concept, something archaeologists seem to be so fond of – think of often used concepts such as 'culture', 'interaction' or 'landscape' that are hard to define yet undoubtedly productive.¹ In the case of digital archaeology, both the concept and the term have been a matter of considerable debate (Huggett 2013, Tanasi 2020).

On the one hand, 'digital archaeology' seems redundant, as today all archaeology is digital to some degree. Even the most basic fieldwork is usually undertaken with the assistance of digital technology, *e.g.*, in the form of surveying devices, spreadsheets or photographs. In this sense there is no doubt that 'we are *all* digital archaeologists' (Morgan and Eve 2012, 523; emphasis in original). Speaking of photography, it is a good example of how quickly perceptions can change when innovation becomes mainstream. What used to be called 'digital photography' when it was introduced more than two decades ago is now simply known as 'photography'. Is the same happening with digital archaeology?

Apparently not, because, on the other hand, digital archaeology is an expanding field (Tanasi 2020). Numbers of students and faculty positions are on the rise, conferences and publications on the subject abound, and there is an active international community of researchers and practitioners of digital archaeology. Clearly, 'digital archaeology' is an attractive concept that holds many promises for those who engage in it – including students who choose it as their specialization, as we will see later on.

Yet, these promises are not always fulfilled. Over the past decades, digital archaeology has embraced many emerging digital technologies and methods in the hope of making archaeological research into the human past easier, quicker or better in a number of ways, *e.g.*, by making it more efficient, thorough, robust, comprehensive, transparent, quantifiable, reproducible, open, inclusive, or many other things. Often, the uptake of such technologies and methods goes through a hype cycle in which, after an initial trigger, a 'peak of inflated expectations' is followed by a 'trough of disillusionment' before hopefully ascending a 'slope of enlightenment' to reach a 'plateau of productivity' (Fenn and Raskino 2008). In archaeology, probably the most prominent digital technology that has gone

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1 None of these common concepts is defined in *Archaeology – The Key Concepts* (Renfrew and Bahn 2005), although some of them are referred to under other headings.

through such a cycle is GIS. After an initial hype in the 1980/90s, some rather shallow early GIS applications were rightfully questioned before much more solid, theoretically well-founded and genuinely archaeological approaches to spatial analysis and data management in GIS were developed that today are part and parcel of the archaeologist's toolbox (Howey and Brouwer Burg 2017; Verhagen 2018).

Despite its ups and downs, the history of archaeological GIS applications is probably a best-case scenario. Many other digital technologies and methods in archaeology have not yet reached the plateau of productivity, with varying prospects if they ever will, and a few of them are discussed in this volume. So apart from promises, digital archaeology is also full of (potential) impasses.

2 PROMISES AND IMPASSES

This is why we chose the topic of this edited volume. 'Digital Archaeology: Promises and Impasses' brings together essays that reflect on the use of digital technologies and methods in archaeological research and heritage management as practical tools and as heuristic and epistemological devices. It offers a range of insights into a somewhat underrated aspect of those approaches, namely their unfulfilled promises, underachievements and limitations. We feel that such aspects are important for critical, responsible and appropriate use and the further enhancement of digital technologies and methods. Although we have no data to back this up, our impression is that publications in our field – as in other fields – tend to be skewed towards positive results and success stories, of which undoubtedly there are many. So our own *Analecta Praehistorica Leidensia* (APL) series offers a welcome opportunity to give room to more critical perspectives and reflections.

Following the tradition of edited volumes in the APL series, we invited current and former members of the scientific staff of the Faculty of Archaeology of Leiden University to contribute perspectives from their own research. Many of them followed our internal call in spite of their numerous other commitments, and some of them invited external colleagues as co-authors. All papers were peer-reviewed by external experts. We are immensely grateful for the commitment of all these authors and reviewers. Other colleagues were unable to contribute to this volume at the time of the call for perfectly good reasons, *e.g.*, because they had to defend their Ph.D. theses in digital archaeology (Brandse 2022; Verschoof-van der Vaart 2022). Due to these constraints, this volume cannot claim to

represent the full breadth and depth of research in digital archaeology at our faculty, nor much less so beyond. Still, we hope that it offers valuable insights.

In order to put the contributions from our faculty in a broader perspective, we invited Rachel Opitz to reflect on them in a concluding chapter, and we are extremely grateful that she accepted. Her impressive track record in research in digital archaeology, her long-standing experience as Senior Lecturer in Spatial Archaeology at the University of Glasgow and her former function as chair of the Scientific Committee of CAA (Computer Applications and Quantitative Methods in Archaeology) put her in a unique position to contextualize and discuss the contributions by our authors.

3 THIS VOLUME

The following chapters describe uses of digital technologies and methods at different steps of the workflow of archaeological research, ranging from data collection in the field to data processing and analysis, and to archiving, re-use and dissemination. All the digital approaches discussed are clearly past their initial hype or did not live up to the high expectations with which they were initially received. Often, further testing, development, standardization, and/or critical reflection are required before a given approach can be broadly applied in a productive and meaningful way. To which degree this will happen is not always clear, but in their insightful discussions, the authors attempt to point out ways to move forward.

Across the following chapters, the authors offer a range of different perspectives on the topic of the volume, *i.e.*, on promises and impasses of digital archaeology. Some of them discuss practical, methodological, or philosophical implications of the use of digital technologies and methods in archaeological research, and many of their insights apply beyond the specific approach that they discuss. Others are concerned with the archaeological community's limited uptake of promising methods and possible reasons for it. A recurring theme is obstacles or constraints encountered in the application of digital approaches. These can be technical, financial or regulatory in nature, but often they are rather related to limited education or training on the part of the (intended) users. Clearly, digital skills and computational literacy are not yet as pervasive in the archaeological community as many digital archaeologists may think or wish, and this is perhaps one of the main reasons why promises of digital archaeology remain unfulfilled or are even misguided. From a different perspective, this finding is confirmed by our students at Leiden University.

4 STUDENTS' PERSPECTIVES

In keeping with the editorial policy stated above, our internal call was directed at research and teaching staff at our faculty, but we value our students' perspectives on digital archaeology just as much. As future practitioners, they will be responsible for how digital archaeology is shaped in the future. Therefore, we use the opportunity offered by this introductory chapter to review the perspectives of Leiden students of (digital) archaeology based on empirical and anecdotal data. Doing so, we are aware that these perspectives are not necessarily shared by (digital) archaeology students elsewhere.

Thanks to the pioneering efforts of Hans Kamermans and later, Milco Wansleeben and others, digital archaeology – though originally not under that label – has been deeply engrained in our education programmes since the mid-1980s (Kamermans 1987). Today, starting at the undergraduate level, each year the new BA students (2022: >120) take compulsory courses in 'Exploratory Data Analysis' (first year) and 'GIS' (second year). This is complemented by optional specialization courses in the second and third years (e.g., on Predictive Modelling or Programming).

On the graduate level, in 2016 Digital Archaeology was added as the fifth specialization track to the MSc programme 'Archaeological Science', the other four tracks being Material Culture Studies, Osteoarchaeology, Archaeobotany and Archaeozoology. Within this programme, the digital archaeology track quickly gained popularity and has produced 23 MSc graduates so far (as of summer 2022), among them 15 international students. In addition, more than a dozen MSc students are currently working on their theses in digital archaeology.

These students and graduates provide fresh views on digital archaeology that are rather shaped by personal perspectives than by the ongoing academic debate. Reviewing their applications, talking to them in class and discussing their choices of thesis topics gives us valuable insights into their motivations and expectations, which we try to summarize in the following. Many (international) students found our MSc programme by specifically searching for the term 'digital archaeology' on the internet. A clear and easy-to-understand label is thus important for the visibility of our programme. The abovementioned debate about the concept and the term notwithstanding, 'digital archaeology' is a strong brand that enables us to reach our target group.

Two reasons for choosing digital archaeology clearly stand out from our students' feedback: 1) 'It is the future of archaeology' and 2) 'It will help me find a job'.

Optimistic as they are, both statements nicely reflect the promises that digital archaeology holds, the first one regarding the academic discipline as a whole, the second one the personal prospects of its practitioners. From a student's perspective, is there any indication that digital archaeology can keep its promises?

4.1 Students' career prospects

Starting with the prospects on the labour market, we know from around a dozen of our digital archaeology MSc graduates what kind of jobs they found afterwards. About half of them remained in archaeology, some of them pursuing a Ph.D., others working as researchers or managers for academic institutions or heritage agencies. The other half started jobs outside of archaeology in a diversity of fields, ranging from community services to surveying and from data analytics to finance. In spite of this variety, a common feature is that many graduates cite skills acquired during their digital archaeology studies as instrumental in finding their jobs, especially Information and Communication Technology (ICT) skills such as data management, GIS, modelling, or coding. GIS skills in particular seem to be a valuable asset in the labour market well beyond archaeology.

The importance of ICT skills was also an aspect of polls among archaeology graduates in the Netherlands about their job situation that we cite here for context. Femke Tomas, archaeologist and education officer at Saxion University of Applied Science (Deventer) is currently analysing data from two surveys among Leiden and Saxion graduates for her Ph.D. research about labour market perspectives of archaeology students. She kindly agreed to share some partial results here.

The Leiden survey covered graduates from all our archaeology programmes (BA to Ph.D. level) between 2008 and 2018, while the more recent Saxion survey covered graduates from their only archaeology programme (BSc) between 2011 and 2021 (table 1). While the two polls differed in terms of target group, design and scope, both tried to determine, among other aspects, the importance of ICT skills for archaeology graduates. Note that this covers *all* archaeology graduates, whether they specialized in digital archaeology or not.

Of the 657 employed Leiden graduates, 73 or 11.1% worked in ICT-related jobs, 0.6% within archaeology and 10.5% elsewhere. So within archaeology, at the time of the poll, the importance of ICT skills seems limited, although they may play a secondary role in

a) Leiden Archaeology Graduates (BA-MA/MSc-RMA/RMSc-Ph.D.), 2008-2018					b) Saxion Archaeology Graduates (BSc), 2011-2021				
Number of alumni: 955, out of which employed: 657					Number of alumni: 222, out of which employed: 164				
Field	Number	in ICT	Percentage	in ICT	Field	Number	in ICT	Percentage	in ICT
Academia	185		28.2%		Archaeology	84	4	51.2%	2.4%
Archaeology	209	4	31.8%	0.6%	Related	40	19	24.4%	11.6%
Other	263	69	40.0%	10.5%	Non-related	40	8	24.4%	4.9%
Total	657	73	100.0%	11.1%	Total	164	31	100.0%	18.9%

Table 1: Partial results from polls among a) graduates from Leiden University archaeology programmes, 2008-2018, n=657 (employed), and b) graduates from Saxion University of Applied Science archaeology programme, 2011-2021, n=164 (employed). While employing different categories, both polls aimed at determining the job situation of former archaeology students of either institution after graduation and the role of ICT skills. Data courtesy of Femke Tomas, Saxion University of Applied Science, Deventer.

non-ICT jobs as well. Beyond archaeology, ICT skills are more important, accounting for a quarter of the jobs.

A few years later, of the 164 employed Saxion BSc graduates, 31 or 18.9% worked in ICT jobs, more than half of them (14.0%) in archaeology or related fields. This seems to indicate the growing importance of ICT skills within archaeology.

Seeing these numbers in conjunction with the anecdotal feedback from recent Leiden digital archaeology graduates cited above, it seems clear that ICT skills acquired in archaeology programmes are today a valuable asset in the labour market. While not a decisive factor, their importance has grown over time. However, many (digital) archaeology graduates find jobs outside of archaeology, often intentionally due to better working conditions in other sectors (Femke Tomas, pers. comm. 2022). So, while the expectation of finding a job is met, those jobs are not necessarily in archaeology.

4.2 Students' thesis topics

Another line of evidence is provided by the thesis topics that our digital archaeology students choose. MSc theses in digital archaeology usually have a methodological focus. As per the requirements of our MSc programme, the students develop their thesis topics themselves based on their own interests and skills, within the framework of our regulations but otherwise only constrained by the availability of data and tools. While the areas of our own expertise, which certainly do not cover the entire field of digital archaeology, might be considered another constraint, we have so far been able to accommodate almost all thesis topics proposed by our students. These topics can thus serve as an indication of the student's preferences.

Until the time of writing in the summer of 2022, 23 theses in digital archaeology were completed at least to the level of a full draft. On average, four theses were completed each year, with a dip in 2021 due to the Covid-19 pandemic compensated for in 2022. The thesis topics can be broadly categorized into six sub-fields of digital archaeology (figure 1), with most theses spanning multiple sub-fields. Although once again the sample is small, certain trends are evident.

With slight variations, four sub-fields of digital archaeology are more or less constantly present among the students' choices. These include GIS / Spatial Analysis, 3D Modelling / Virtual Reality, Remote Sensing / Image Analysis, and Data Management / Open Science. Most people would probably agree that these sub-fields have formed the stable core of digital archaeology over the past decades, perhaps with noteworthy recent additions such as the growing importance of Open Science or the convergence of the first two topics in 3D GIS. In this sense, our students' choices seem to be in line with the mainstream of our field. This may also be true for minor shifts over time, such as recently a slight decrease in GIS / Spatial Analysis and 3D Modelling / Virtual Reality and a slight increase in Remote Sensing / Image Analysis and Data Management / Open Science.

While it remains to be seen if these subtle trends stabilize, two other sub-fields of digital archaeology have clearly gained popularity in recent years, namely Agent-based Modelling and Machine Learning. This trend is noteworthy as these sub-fields are more narrowly defined in methodological terms than the other four, although their range of applications is at least as broad. Thesis research in these sub-fields is also more ambitious in the sense that students usually have

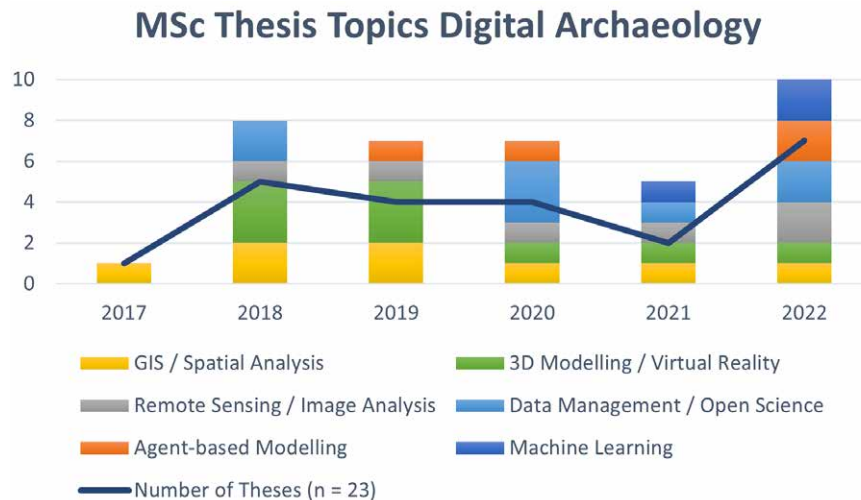


Figure 1: Sub-fields of digital archaeology that best capture the methodological focus chosen by students of the Digital Archaeology track of the MSc programme Archaeological Science at the Faculty of Archaeology, Leiden University, from 2017 to 2022. Number of theses: 23. Multiple sub-fields per thesis possible and common. All theses available in Leiden University's Student Repository at <https://studenttheses.universiteitleiden.nl/>. Graph: K. Lambers.

no prior skills (*e.g.*, modelling, coding) when entering our MSc programme, contrary to the abovementioned four sub-fields of which some basic concepts are usually taught at the undergraduate level. It seems that more and more students deem the required learning effort worthwhile and are willing to take on this challenge. This indicates that our students have a keen sense of the opportunities afforded by these advanced fields.

Absent from this overview are two further sub-fields of digital archaeology, though for different reasons. One of them is Quantitative Data Analysis / Statistics. Rather than a real absence, this is a classification problem, as virtually all theses in digital archaeology include quantitative data analysis at varying degrees, some more explorative, others more analytical. Yet few theses focus on these methods, which is why they did not receive their own category here. In fact, the use of quantitative and statistical methods is a common feature of all theses across the five tracks of our MSc programme in Archaeological Science.

The other absent sub-field of digital archaeology is Archaeogaming. While there are no completed MSc theses in this sub-field yet, it is safe to assume that this will change soon, considering how Archaeogaming recently gained popularity among our students.² Many

of our students are active or even passionate gamers and as such are quick to grasp the potential of games for simulating the past in an interactive, immersive and fun way and for engaging audiences that might be difficult to reach through more traditional channels.

4.3 Students' essays

The choice of the thesis topic is relevant for the second of the abovementioned promises of digital archaeology, namely the prospects of our students in the labour market after graduation. The overview so far may seem to indicate that our students are purely skill and job oriented. But in fact, their main motivation to choose digital archaeology is rather related to the first promise mentioned above, namely that it is the future of archaeology. Beyond their personal situation, students are very much interested in current trends within our field, but also beyond, trends in academia and in society at large.

A valuable source for students' interest in these matters are the final assignments of our digital archaeology specialization course in the MSc programme. In this course, offered once each academic year, we discuss the nature and future of digital archaeology with the students and ask them to write an essay about this topic. There are two reasons for doing so. One is the ongoing scholarly debate about digital archaeology (see above), of which our graduate students should be aware and on which they should reflect. The other reason is that their opinions on this topic matter.

² Not the least thanks to the activities of the Leiden-based VALUE Foundation (<https://value-foundation.org/>).

The students choose digital archaeology for a reason, and many of them even come to Leiden from abroad for doing so. So their perspectives can shed light on what digital archaeology is or potentially can be.

From these essays, it becomes clear that the students are keenly aware of current trends in our field.³ The most pervasive of them is digitalization, something that students experience not just in archaeology but in their daily lives. As digital natives, they do not question this trend but regard it as a given. That is an important difference for many digital immigrants, ourselves included (Visser *et al.* 2016). The students experience what digitalization means for the way we inquire about the human past (see *e.g.*, archaeogaming, above). In their courses, internships and thesis research they experience the huge potential of digital data, tools and methods, but just as often they face constraints such as those things not being openly available. Among our students, restricted access is widely regarded as a detrimental and outdated concept that should be overcome, the sooner the better. Most students embrace and support the principles of open science fervently, perhaps more so than some of their teachers.

In this context, students are quite aware of the data deluge that archaeology is facing (Bevan 2015), maybe more so in the archaeological sciences that (re-)use lots of digital data from the environmental sciences than in other fields of archaeology. While digital archaeology students are willing to take on this challenge, they feel that archaeology as a discipline is inadequately equipped and prepared for doing so. Consequently, they expect and demand more formal education and training in data management, data science and general computational literacy. They do not want to lag behind the trend but get ahead of it in order to give it shape and direction. In this sense, they want to be much more than technicians, in line with Llobera's (2011) vision.

At the same time, the students are aware of the ethical challenges that digital archaeology faces or even causes. The 'digital divide' is not just an abstract concept for them, but something they experience first-hand, *e.g.*, when doing digitally assisted archaeological fieldwork in different sociocultural environments. This

makes many students reflect on for instance power hierarchies, inclusiveness or the need to decolonize archaeological practice, and they seek meaningful ways to address these topics in their own research and practice. But there are also ethical challenges posed by the nature of certain digital technologies, *e.g.*, the lack of transparency of how certain data or results are generated, as exemplified by general-purpose LiDAR data or the black box problem of deep learning. Here again, students understand the problem and are willing to take on the challenge, but expect to be better prepared, educated and trained.

All in all, we see a lot of clarity, sincerity and foresight in the way our students view digital archaeology and its role in the wider discipline. It is thus perhaps unsurprising that few of them are appreciative of the academic 'anxiety discourse' as diagnosed by Huggett (2013), which they tend to consider as detached, unproductive and moot (and they are not shy of saying so in their essays). They are generally more interested in what they consider practical solutions to problems that they experience. In this sense, they firmly believe that digital archaeology can keep its promises, provided more is done to facilitate this, especially through education and training.

5 CONCLUDING / OPENING REMARKS

The present volume reviews promises and impasses of digital archaeology based on research and teaching experience at our faculty. As such, it is a small and biased contribution to the ongoing debate about digital scholarship in archaeology (*e.g.*, Huggett *et al.* 2018). The following chapters provide insights into the limitations of certain digital technologies and methods, but also productive and reflective ways of dealing with them. In this sense, we hope that they also help to better understand where these approaches stand in the hype cycle, if at all.

Zooming out from specific problems, it is clear that digital archaeology is still an attractive field that holds many promises for those who engage in it. The following chapters written by current practitioners, but even more so the perspectives of future practitioners cited above showcase what is required to keep those promises and to avoid impasses. The current generation of students demands loud and clear that we step up our game of education and training in digital skills and computational literacy, not just to enhance their career perspectives but also to future-proof archaeology.

We invite our readers to keep this challenge in mind when enjoying the following chapters.

3 Due to regulatory reasons, it is not possible to cite those written assignments here. Which is unfortunate, as they are inspiring and rewarding to read, and the students' valuable contributions to this chapter through their essays and other feedback are gratefully acknowledged.

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