

CULTURAL HERITAGE VIRTUALIZATION: A Collaborative Hands-on Approach for Training Students in Archaeological Preservation

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Abstract

The present paper shares the experience of collaboration among the Universitat Rovira i Virgili (URV), the National Archaeological Museum of Tarragona (MNAT), and the Catalan Cultural Heritage's 3D digitization project, Giravolt. The aim that drove the partnership was to train students in 3D techniques while simultaneously building a learn-by-doing environment that could benefit an approach to digital heritage deeply engaged with the sociotechnical, ethical, and geopolitical issues entailed in virtualization processes.

Keywords

Archaeological Heritage; Virtual Heritage; Digital Literacy; Undergraduate education; Photogrammetry; Laser Scan; Learn-by-doing; Collaboration; Interdisciplinarity.

Introduction

The UNESCO defines digital heritage as unique resources of human knowledge and expression, including both digitally born objects and those resulting from a digitization process. In the former case, there is no other format than the digital object. In the latter, digital objects might be considered representations of a variety of analog heterogeneous resources. However, regardless of the origin of the digital asset, " they are frequently ephemeral, and require purposeful production, maintenance and management to be retained" (2009 - Ref.: CL/3865)

'Retaining' digital assets requires much more than addressing the challenging technological aspects of their conservation in an ever-changing technoscientific landscape. It also necessitates performing detailed documentation tasks that allows future understanding of the object itself, its cultural context, and the relation with its contemporary audience. In addition to material conservation and documentation, the success in avoiding heritage disappearance and/or oblivion is closely connected with the way in which communities related to their material past. Heritage that is not known, not used/visited, or has no impact on the community is as if it did not exist, regardless of whether it is tangible or digital (Torres Barragán 2017).

However, digital heritage has an additional handicap: it does not reveal itself in a monumental form (simply by being present), but rather, revealing its 'essence' needs decoding (Ernst 2011). Tangible heritage might be abandoned, but digital heritage can just disappear in front of us, hidden in an old industrial CD-ROM, 'saved' in the latest hard disk on the market, or just mixed with a growing amount of Internet debris.

Digital files are giving rise to new ways of disappearance, malfunctioning, and oblivion in the heritage realm, but at the same time, they are enabling groundbreaking approaches to documentation, preservation and remembering.

The three-dimensional representation of archaeological objects and sites has opened a unique new way of approaching the past. Although 3D modeling has been with us for a long time, it has only become more accessible in recent years. This means that 'heritage museums and institutions can now realistically consider having complex 3D reconstructions for a fraction of what it would have cost only a few years ago, and with infinitely better results' (Sierra, Albert, Gabriel de Prado 2017). Students enrolled in Art History and Archaeological degrees should not be left aside in this radical transformation of documentation and preservation; instead, they should actively participate in producing and disseminating heritage through digital means.

With this landscape in mind, during the second semester of the 2020-2021 academic year, [authors] launched the first edition of the course 'Digital Humanities and Cultural Heritage' as part of the relatively new degree in Art History and Archaeology (URV).

The aim of this course is to train students to approach the preservation of digital heritage as a complex bound of practices, addressing objects/sites included in the second group of digital heritage assets (i.e., digital representations). The course is designed to enhance hands-on, creative and innovative learning experiences, providing space for non-formal and informal education within it.

Some activities were designed to improve students' technological literacy, including advanced use of software for the generation of three-dimensional models. From the beginning, 'we understand that the goal of achieving high digital

literacy for students who enter the university with a humanistic curriculum -enhancing their ability to appreciate, embody and take advantage of what Digital Humanities offers them- is complex, to say the least" (Author 2021)

Other activities were related to the appropriation, communication, socialization and activation of digital heritage, which led us one year later to start a collaboration with a museum -the MNAT- and an initiative of the Catalan Cultural Heritage Agency -the Giravolt project- what proved to be stable and fruitful. This collaboration was central to engaging learners in the process, reducing the gap between formal education and professional life, and allowing us to achieve the main training goals of the course:

- Go through the whole process for developing three-dimensional digital representations of archaeological and cultural heritage objects and sites; in other words, to walk the path from photogrammetric and laser scan data acquisition, to the resulting model.
- Design (and test) strategies for the dissemination of the achieved models.
- Produce a critical, practice-based discourse on heritage preservation by three-dimensional digital means.

Learning-Practicing Environment

The Art History and Archaeology studies at URV are located on the Campus Catalunya in Tarragona, a city well-known for its archaeological Roman remains. The outstanding Roman circus, theatre and amphitheater, the villages Dels Munts and Centelles and the Early-Christian Necropolis advocated for Tarragona to be declared a World-Heritage site, a recognition that was finally obtained in 2000 (for more information about the Roman footprint in ancient Tarraco, see Patrimoni Cultural Gencat).

It was challenging to find a more suitable case-study to drive the training program than the old Tarraco Roman remains that surround us. They combined the acknowledgement of their valuable cultural (archaeological) condition with the need to improve the development and communication of their 3D digital representation. In this sense, it was an adequate case to afford students the opportunity to learn techniques of three-dimensional digitization while simultaneously testing potential activation strategies and tactics for those digital objects.

Working in the classroom

The training program is designed to overcome the dichotomy between theory and practice, introducing a strategy close to the methodology of learn-by-doing, in order to:

- improve the didactic impacts on students using practical experiences linked with rigorous theoretical concepts;

- share the learning experience with students with different level of initial knowledge (professionals, surveyors, Bachelor and Master of Science students, PhD students);
- stimulate the multidisciplinary approach required in the documentation of archaeological heritage using team works for data acquisition and processing. (Balletti et al. 2023)

The classroom is understood as a space where an initial contextualization and challenges of 3D techniques for the digitization of cultural heritage takes place, focusing specifically on those that will be implemented in the fieldwork: photogrammetry and scanning with a leader to capture data, and different software to process it, for instance, Reality Capture.

The classroom is also the place where the early conceptual, ethical, and technological questions arise. This early stage in the training pursues the introduction of those 'rigorous' - and also debatable- theoretical and methodological concepts that will accompany students in their fieldwork. It is expected that trainees anchor them in their practice -through adjusting, translating, and transforming movements.

Considering the importance of the learning process above the exclusive evaluation of results, one of the main tasks requested of students is to carry a diary of their research. This pushes trainees to acknowledge their experience, giving it value. Part of its content can be punctually transfer to a digital space, like social networks (e.g., Instagram). It is possible to access some of these digital narratives through the IG account @[left blank for peer-review]

The classroom aims to be a reference place to go and come back: a safe room to babble and debate the results of putting digitization of archaeological remains and their preservation into practice. Many of the topics discussed in this ambient are finally reflected in students' diaries and deliverable dossiers.

Fieldwork at the *Necròpolis Paleocristiana*

The Early Christian Necropolis in Tarragona was discovered in 1923 during the construction of a tobacco factory. Today, it is recognized as one best-preserved late Roman (3rd-5th centuries AD) cemeteries in the Roman Empire, containing more than 2,000 documented burials (Museu Nacional Arqueològic de Tarragona (MNAT) n.d.)

Among the various ancient archaeological sites in Tarragona managed by MNAT, the Necropolis proves to be the most accessible and appropriate place to work.

Firstly, students arrive to our course having previously worked with the epigraphic inscriptions at the *Necròpolis Paleocristiana*, in the subject Sources for the History of Art and Archeology. This allows us to focus directly on accomplishing our 3D digitization goals, avoiding an extended and necessary task of historical contextualization of the remains. Secondly, the size of the epigraphs is suitable for

accomplishing the tasks of digitization by the photogrammetry technique in more or less a couple of hours. Finally, far away from the great number of visitors of the circus and the amphitheatre, the *Necròpolis Paleocristiana* is a relatively quiet place. Students can work as much time as they need around the pieces, neither being surrounded by people nor dealing with unwanted interruptions (see Figures 1 and 2).



Figure 1. A student taking photos at the *Necròpolis Paleocristiana*. Course 2021-2022. Source: authors.



Figure 2. A student comparing the 3D printed model of an epigraphy with the actual piece. In the background, other students can be seen working with their cases. Course 2022-2023. Source: authors.

Complementary hands-on research and workshops

The classroom sessions and the fieldwork conducted at the Early Christian Necropolis are complemented by two different approaches. In the first place, students are invited to choose a historically or culturally relevant building to continue improving the photogrammetric procedure, experimenting with the scale factor.

The virtualization of buildings brings to the discussion table not only a host of new technological challenges but also several divergent questions, mostly related to rights to perform and disseminate 3D digital representations. This includes questioning the status of these new digital objects—whether they are documentation or new heritage objects in their own right—and the role of the heritage virtualization initiatives in facilitating the visibility of unknown or overlooked heritage. This view is expressed in the following extract from a group of students' diaries:

Through this work, we have been able to check to what extent it is still necessary visualize our heritage today. The epigraphic pieces exhibited at the MNAT have undergone a process of cataloguing and digitization (...) but the case of the Library of Reus [an old slaughterhouse] is different. Even though it is registered as an industrial Modernist building, no activity to make it known was conducted. Not even people of Reus give it the right importance, and precisely because of that reason, it is quite urgent to conceive a [digital] heritage project for this standard building of the modernist city of the Baix Camp (Fieldwork notes, Group 1, course 2021-2022)

The second complementary action is the *Bessons Digitals – Jornades de tecnologies 3D per a explorar el patrimoni cultural* [Digital Twins Meeting - 3D Technologies to Explore Cultural Heritage]¹, co-organized by MNAT, Giravolt and the Universitat Rovira i Virgili. The first edition took place in April 2023, aiming to give students the opportunity to experiment with 3D techniques different from the ones they were working with. Additionally, this action enables us to open up a discussion on digital heritage to a broader audience, including our academic and professional colleagues, and the surrounding communities.

The meeting was structured into two blocks: on the one hand, a round-table that inaugurated the activity, focusing on specific cases of 3D digitization; and on the other, two workshops (designed for undergraduate and postgraduate students of the URV) in which they experimented with laser scanning (see Figure 3) and additive manufacturing (3D printing).

The second edition of *Bessons Digitals* is scheduled for March 2024, and we will probably introduce workshops on drone scanning and immersive journeys.

¹ More information at: <https://www.mnat.cat/bessons-digitals-jornades-de-tecnologies-3d-per-a-explorar-el-patrimoni-cultural/>



Figure 3. Luis González, responsible for three-dimensional planimetry at the Architectural Heritage Service of the Generalitat de Catalunya, teaching Laser Scanning techniques and the methodology to digitize large scenarios.

Results and outcomes

After three years of delivering this undergraduate course in collaboration with our partners, we are able to list some of the main recurring outcomes:

- 1) The learn-by-doing approach helps students in Humanities overcome a generalized discomfort in front of technologies. Technological training not only enhances students' digital competences and literacy but also points to a desirable blur in disciplinary barriers.
- 2) Theoretical concepts connected with the digitization of heritage are not imposed; on the contrary, they emerge in practice. This allows students to engage in a more closed and critical relationship with them. The following example illustrates the above:

Photogrammetry provides many advantages, but **we cannot ignore the difficulties that we have to face** (...) we have come to the conclusion that photogrammetry requires the availability of computer equipment with a powerful graphics card that allows the management and processing of hundreds of images. Precarious computing resources constrain success in these types of projects. **Therefore, it is important to reflect on whether or not the digitization and dissemination of the 3D models are enough to produce a 'democratization' in accessing heritage** (...) [we] would like to highlight that photogrammetry is not a neutral technique but rather generates gaps and shows a series of lacks that are not obvious *a priori*. (Deliverable dossier, Group 3, course 2021-2022)

Issues such as democratization have prompted us to reflect on commonly accepted 'mantras'. Among them is the

uncritical assumption that crossing certain economic gaps is sufficient to its improvement (see: Magnani, M. et al., 2020).

As technological developments and literature on the topic (e.g., Shults 2017; Luther et al. 2023; Sierra, Albert, Gabriel de Prado 2017) continuously remind us that virtualization techniques are increasingly transforming into more democratic tools, it is worth noting, as the students did, that the 'democratic' issue needs to be nuanced by other variables.

3) The collaborative approach between a museum, a governmental institution, and a university allows students to perform the research tasks in a real professional environment, knocking down the undesirable walls that still separate academic and professional knowledge. This results in a higher participative engagement of trainees.

Conclusions and Future Directions

A hands-on learning-by-doing methodology results in the achievement of our course goals. Additionally, the close and continuous collaboration among the University and other stakeholders validates our own assessment. The production of the three-dimensional models is fed with a variety of conceptual and heterogeneous practical inputs. This showed to be helpful for students to situate their research and develop a critical approach to their practice.

Dichotomies related to technoscience vs. humanities knowledge; academic vs. professional spheres; or, even, practice and theorization processes are questioned and, in some moments, overcome.

At the same time, new inquiries arise, deeply connected with the opportunities and challenges in preserving heritage in a current hybrid analog-digital world and the geopolitical variables involved in the survival or, on the contrary, the disappearance of certain items.

Our future plan is to continue adjusting our training course in order to be able to implement other virtualization techniques like guided VR/AR/MR to integrate documentation/storytelling within the models, following previous work of members of our partner Giravolt, such as the Ullastret 3D and VR project, which invites visitors to relive a 2,200-year-old Iberian archaeological site (Sierra, Albert, Gabriel de Prado 2017)

It is also in our agenda to investigate the correlation between digital objects and their physical counterpart, moving from three-dimensional representation to the concept of digital twin, anchored in Conservation 4.0 (Gasparetto and Baratin 2021) and Heritage 4.0 (Luther et al. 2023) discussions.

This course trains students to perform 3D representations of cultural/archaeological heritage and, at the same time, goes far beyond them, diving into the unsettling waters of memory and materiality in digital culture.

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