# At the Computer's Edge
## The Value of Virtual Constructions to the Interpretation of Cultural Heritage

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**The title of this paper is an adaptation of Ian Hodder's notion that interpretation starts 'at the trowel's edge' (1997), as excavations should be active, reflexive and multivocal practices, during which interpretation takes place as an inextricable part of our research. The process of interpretation is a complicated issue. It has engrossed most practitioners, and is closely related to the conceptualisation of the past as reflecting contemporary social and cultural experiences through the scrutiny of cultural heritage remains. Archaeological remains are under appreciated, as they can be accessed only by specialised audiences, and any finds are presented by means of conventional illustrations and comprehensive list of artefacts. Even the most common recording method in archaeology, i.e. fieldnotes, and the subsequent site reports, have been criticised (Hodder 1989) for their distance and impersonality, as well as their attempt to demonstrate objectivity by establishing rigorous classifications and complex terminologies. For that reason, different forms of media have been used in the interpretive processes, not only in scientific research, but also for providing varied levels of engagement with the archaeological datasets by the public.**

The advent of computer applications in archaeology and cultural heritage over the last twenty years has transformed both the way we do archaeology and our understanding of fundamental words, such as artefact, heritage and interpretation (Cameron & Kenderdine 2007: 1-3). Although these technologies tried to overcome the issues discussed above, as they were rapidly evolving they created a trend, usually leading to the application of these tools for the sake of it, in order to demonstrate their powerful capabilities, and were not being driven by any scientific considerations (Gillings 2005, Goodrick & Earl 2004, Richards 1998: 341). Virtual constructions or alternative computer graphic simulation have been constantly used in various forms, such as virtual and augmented reality, for the interpretation of cultural heritage in museums and institutions, but they have also been employed to illustrate journals, and even externalise our reasoning in academic books. At this point it should be pointed out that the authors are opposed to the term 'virtual reconstruction', as it implies an attempt to revive the past, which can never be accurate, as it is an interpretation of past reality by 're-inscribing it into the face of the present' (Tilley 2000: 425-426). The argument that the term 'reconstruction' is misleading and should be abandoned is not new, as it was described by Taylor in 1972 and came to the forefront recently in Clark's paper 'The Fallacy of Reconstruction' (2010). However, it is the first time that a new term is suggested and used to describe the ambiguity of our work. The high visual stimulus that virtual constructions usually provide is a useful way to attract visitors to museums, archaeological sites or other heritage institutions. They also allow archaeological knowledge to be communicated and interpreted more effectively. In addition, online platforms have been used to make archaeological knowledge approachable to the public, by incorporating multimedia, simplified versions of field notes and self-explanatory images. On the other hand, novices in the field of digital methodologies are not aware of the potential of virtual constructions in investigating and interpreting archaeological data. This means that digitally constructed versions of the past can be effectively employed as a means of formal spatial analysis in the reasoning process of archaeological scientific research. It can be used to investigate multifaceted issues, which cannot be approached by any conventional means used in archaeology, such as architectural drawings and photography.

This paper examines how the interpretation of archaeological remains, and consequently cultural heritage, can be facilitated by the use of computer methodologies, and argues that these applications should be considered one of the most promising ways to approach incomplete, abstract and ambiguous archaeological evidence. They create unique perspectives and new theoretical visions, advancing the construction of disciplinary knowledge, while making the audience extract meaning from the information being visualised, and making difficult-to-understand or abstract concepts more comprehensible. In order to examine this potential we use as a case study a Minoan site in Greece.

### THE CASE STUDY

Zominthos is located on a plateau of mountain Psiloritis in Crete, 1.200 metres above sea level and is the only known mountaintop Minoan settlement so far. It was discovered in 1982 and the excavation which is still in progress has revea-

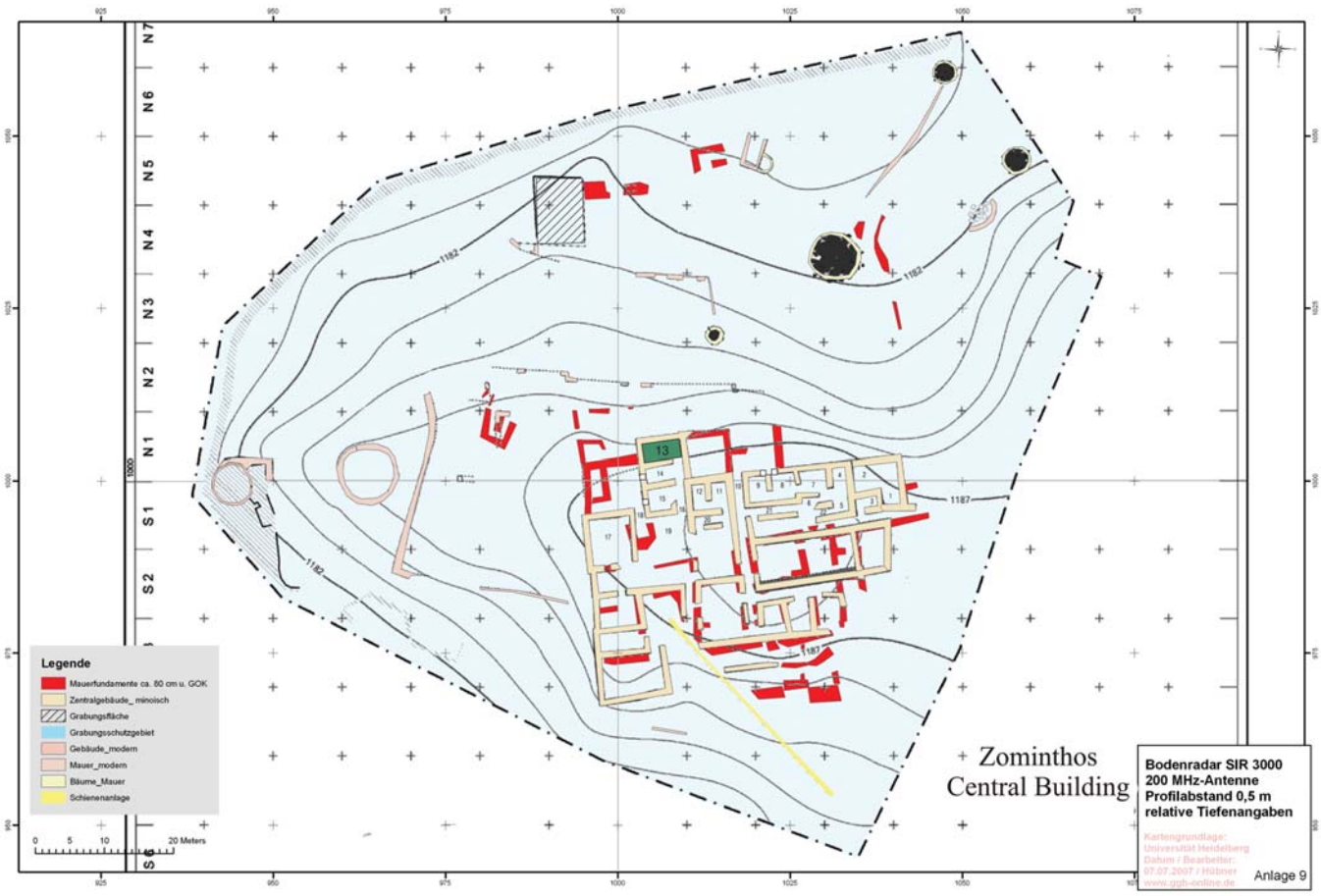


**Figure 1 - Plan of Zominthos Central Building. In red colour is the geomagnetic prospection indicating the existence of other structures near the 'ceramics workshop'.**

led a 1600m$^2$ Central Building, developed from the 17$^{th}$ century BC onward. More than 50 rooms have been attested at the ground floor, while the evidence suggests a second storey as well (fig. 1). The structures, which are well preserved still standing at a height of 2.20 metres, are built of large blocks of local limestone, while some of them are plastered and bear mural paintings (Sakellarakis & Panagiotopoulos 2006). The excavation is still at preliminary stages, and thus remains unpublished, while the site is not accessible to the public.

## THE 'CERAMICS WORKSHOP'

At the northwest annex of the so-called Central Building, Room 13, was revealed in 1989 and has been characterised as a ceramics workshop (fig. 3). It is a 15m$^2$ area with more than 250 vessels for everyday use, some bronze and stone tools, a basin in the middle of the room and a potter's wheel.

According to the evidence, ceramics were placed on two benches running along the northern and southern walls (fig. 2), and on wooden shelves along the walls. It is usually complicated to identify ceramics workshops, as they are not architecturally unique, and the artefacts unearthed could be part of a household or of another unit of the settlement. However, in this case all the objects unearthed, strongly suggest that Room 13 was a ceramics workshop. Although Room 13 has provided a range of features, there are two peculiar characteristics: i) Even though the walls are preserved to a significant height, no window was revealed, as it is the case in the adjacent Rooms 14 and 15 as well in Rooms 8 and 9 at the façade of the building. Thus, an illumination study was defined to reveal the extent to which an apparently weakly lit space could be used as a working area, ii) the existence of a basin in the interior is an extraordinary find. In this pa-

**Figure 2 - Close-up view of pottery positioned on a bench, along the north wall of the 'ceramics workshop'.**

**Figure 3 - Virtual construction of the 'ceramics workshop'. Aerial view.**

per we will examine only the first, as the second has been presented elsewhere (Papadopoulos & Sakellarakis in press). According to ethnographic comparators from regions of Crete and mainland Greece with a strong tradition in pottery making, potters' workshops should be illuminated by sufficient sunlight to facilitate the production of ceramics. Ceramics workshops used to have at least one large window and a door, which remained open during the production of pots. During this research it became apparent that every single working space should have enough light to assist people's work. When natural light is not adequate, flame illumination can be used to increase the lighting levels. However, the kind of light that is produced from flame sources, such as a candle or an oil lamp, is a combination of light and shadows, which hinders the work as clear visual contact and absolute control of the product created is needed. The level of preservation of the walls in Room 13 is exceptional for such a structure, leaving no room for hypotheses about the preservation of any openings in them. However, loopholes (small openings) may be hypothesised to have existed at the upper courses of the walls, which are not intact, facilitating the illumination and ventilation of the interior. For this reason, several structural models were produced in order to provide a reliable illumination study regarding the impact that this unusual absence of windows may have. Small windows were constructed at the east and west walls of the room, according to these found in Rooms 7 and 8, and 14, 15, accordingly. Also, oblong windows were created at the north wall and various alternatives were examined with the partition wall that divides rooms 13 and 14 (fig. 5).

The absence of windows was initially explained by the excavator, based on the fact that clay is a fragile material and as a consequence, a ceramics workshop should not be over lit or having constant air circulation, since clay can easily become dry and useless. He also supported this idea by thinking that the windows existing at the adjacent rooms may have provided sufficient light to aid potter's work. Although this idea was impossible to be physically tested since the structures are not fully preserved, the virtual constructions produced provided the chance for further analysis. The existence of an opening at the roof cannot be supported, as the evidence suggests that there was a second storey as well (fig. 4).

The results of the lighting study undertaken indicate that no light could enter in the room through neighbouring openings as the values obtained do not exceed 40-50 Lux in spring and summer months. With windows in the north, east and west walls constructed there is increased illumination ranging from 0-70 lux (fig. 6).

However, none of them seem to have facilitated the diffusion of light to a sufficient extent to consider these alternatives a solution to the problematic aspects of the dataset. Also, flame illumination was tested (fig. 7), although this was discouraged from the very beginning, since modern potters argued

**Figure 4 - Alternative structural models of the 'ceramics workshop'. From top left clockwise: no windows, window at the north side, window at the east side, window at the west side, window at the partition wall, lower partition wall, one window at each side, two windows at the north side.**

**Figure 5 - Virtual construction of an opening at the roof of the 'ceramics workshop'.**

that the existence of flames in a dark room produce irregular shadows which confuse the makers about the actual form and shape of the vessels produced.

Through this illumination study, which would have been impractical through other means, it was proven that the light coming from adjacent openings or any hypothetical constructions of windows cannot be considered sufficient to consider this area as a working space. The initial interpretation has to be re-evaluated based on the archaeological finds, ethnographic correlates and the results of the lighting analysis (Papadopoulos & Sakellarakis in press). The latter may suggest that Room 13 was used for storing and drying the vessels that were produced somewhere else in the Central Building and most probably outside this room, where a kiln and more than 100 vessels were found.

## DIGITAL MUSEUMS & INTERACTIVITY FOR THE PUBLIC

Are we only concerned about the interpretation of archaeological sites focusing solely on archaeologists, historians and individuals with a professional interest in discovering more about the past, consequently keeping all these data locked in our scientific closets waiting for the 'experts' interpretation? Alternatively, do we really look forward to sharing this knowledge with the public? And, if so, which is the proper way to exhibit and interpret excavation and research data? No matter what our intentions are about an archaeological site, there are practical difficulties that heritage managers have to deal with. For instance, bureaucratic impediments and lack of sufficient funding have delayed the construction of a museum and the site's preparation to open for the public. However, an archaeological site of such importance, as well as its architectural finds and artefacts, cannot remain inaccessible, even if research is in preliminary stages. On the other hand, how many people have the chance to visit all the sites that they are interested in, for how many times in their life and for how long? Moreover, how can all the artefacts be arranged and exhibited, and in ways that can provide an overall impression of the site and its past reality? For all these reasons that emerge during a site's management process, the 'Digital Museum' and 'Zominthos' Interactive Dig' have been created so as to enable public access to a closed site and to expand the ever-changing, multifarious and mutual process of interpretation. By critically examining the debate, and the concerns about digital heritage and its presumed elimination of the real, we will use these two case studies to show the advantages of a well organised and scientifically supervised digital project. These include bringing the public closer to heritage, and allowing every individual to vividly take part in the process of heritage interpretation in an unprecedented and everlasting way.

Digital or virtual heritage museums, and in general new technologies, have received widespread averse publicity, and

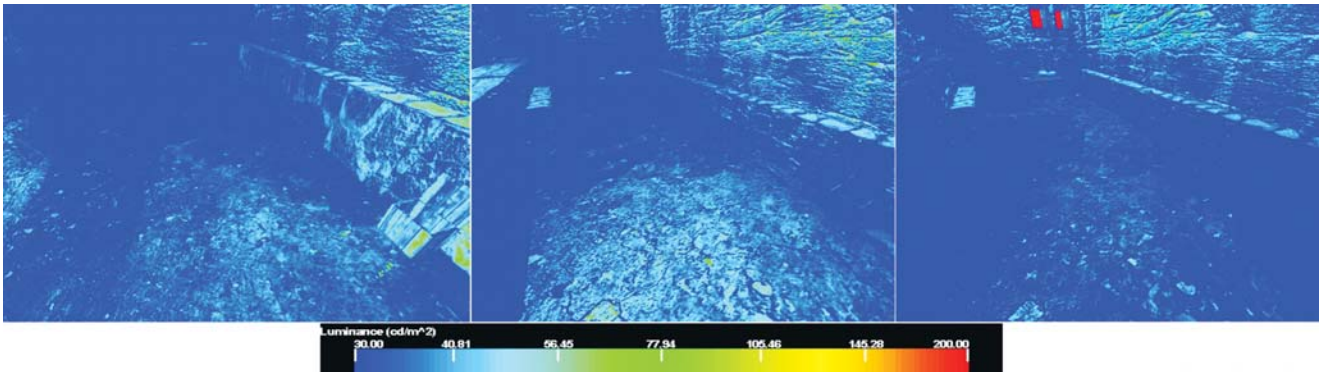


**Figure 6 - Lighting analysis of the 'ceramics workshop' (clockwise): window at the north side, window at the east side, window at the west side. The tested date is 21-06-2009 12pm.**

have been criticised for their lack of flexibility in interpretation and a limited sense of place (Tringham et al. 2005). Also poorly supervised digital projects, mainly undertaken by non-specialists in heritage, only provide an illusionistic and artificial idea and sense of the past (Frischer et al. 2000). Even though there is shortage of literature and surveys focusing on different methods of interpreting and communicating cultural significance to the public, there is a strong theoretical argument in opposition to the above position, which defends the potential and power of these technologies.

Viewers nowadays possess an active role throughout the process of interpretation and often rethink the role of the producer, author or expert (Mason 2005). In addition, heritage sites and museums that present knowledge in a linear time no longer hold the same glorious and authoritarian position that they had in the past. Linear communication has been abandoned and new 'transactional models', in which information is devised, discussed and interpreted in a circular process have vividly engaged visitors with this process (Hooper-Greenhill 1994:15). Thus, part of these 'transactional models' can be enriched, or even solely consist of, digital material created directly in the digital realm. For example, a digital museum without the physical existence of a bricks-and mortar museum could also efficiently engage the public with the process of interpretation and active engagement, in a way that 'conventional' museums cannot, since the public can have access to this resource at any time all over the world thanks to the internet-based interfaces.

In addition, we should always bear in mind that heritage is knowledge, cultural product and a political resource. The nature of this knowledge is always negotiated, set as it is within specific social and intellectual circumstances (Livingstone 1992). Although this knowledge should be open to the public through any means and under all circumstances, we should be aware of its reliability, and the link of the creator to the primary sources and the field of heritage. What would be the importance of just conserving the past, without communicating its significance and also addressing intangible aspects of heritage? Uzzell (1994) provides a theoretical framework for a discursive approach to interpretation based on an intellectual focus, while presenting different perspectives and interpretations of the past and relating it to the present. Through this approach it becomes apparent that we cannot impose one explanation on an object or aspect of heritage and expect a consistent and premade response from the viewers, as each individual has his/her own perception, based on his/her background and levels of pre-understanding. Unfortunately, though, this approach is not popular at heritage sites. However, the use of digital technologies supports and enhances this theory. Therefore, modern methodological tools could be a panacea for the limitations and constraints that exist in physical heritage sites. Karp (2004: 48) supports this point of view, as he strongly defends the importance, necessity and equality of the existence of digital museums, even when a physical museum does not exist. However, in order to make these alternative digital spaces of equal importance to the physical museums, professional curatorial standards need to be established, and designers and authors of websites and interfaces need to be trained and have an appropriate scientific background.

## THE DIGITAL MUSEUM OF THE 'CERAMICS WORKSHOP'

The digital museum of the ceramics workshop was constructed in the summer of 2010, in an attempt to work on different display combinations for the museum that will be erected at some point in the future (fig. 8). By using simple 3d modelling software, we built a one room preliminary model for the finds unearthed in the 'ceramics workshop'. However, as the finds

**Figure 7 - Virtual construction of the 'ceramics workshop' under flame light. Left: lamp burning wax, Right: Three lamps burning wax and olive oil.**

**Figure 8 - General views of the 'ceramics workshop' Digital Museum.**

are not accessible to the public, apart from a few pictures available at Zominthos Interactive Dig, and the excavation's official website (www.zominthos.org), we decided to produce still images and panoramas for the public, also adding images from the excavation of the workshop, thus integrating to some extent the finds with their context.

## INTERACTIVE DIG: THE ZOMINTHOS PROJECT

In 2009, Zominthos entered to the *Interactive Digs* of Archaeology Magazine, US, as the only Greek excavation featured in that section. The visitors of the website can navigate through the Zominthos Project, read extensive field notes dating from 2005, which are accompanied by numerous self-explanatory images, as well as learn about the special finds of the site. They can also watch a video tour, narrated by the director of the excavation, and finally meet the team that works in the excavation, and get a grasp of their everyday lives during the working season.

During the last two years, field notes were updated on a weekly basis, with details about the process and the progress of the excavation. The records are accompanied by numerous photos with descriptive captions. However, the most important feature is that the visitors can post their comments, discuss things with members of the team, give their own opinion and ideas about some finds and learn by inquiring. It is characteristic that in these years of operation the webpage has received more than 100 messages, ranging from positive comments about the work done, to serious questions and observations about the archaeology of the site. Especially at specific sections, such as the 'special finds' part, people seem to be fascinated by the intriguing objects, trying to understand and give their own interpretations via a fruitful open discussion with other participants as well as archaeologists from the team. These are only a few of the interpretations given for kymbe, a peculiar ceramic vessel: '*Could this be a funnel or scoop for large storage jars?', 'Looks like a breadpan I once owned', 'Could it be to wash things like clothes?'*. Similar comments have been received regarding the fieldnotes, where people closely experience the everyday pace and difficulties of such large-scale excavation: *'Thank you so much for keeping this interactive'*. Of interest is also the 'video tour of Zominthos' section, in which Prof. Sakellarakis presents his discoveries. The comments received prove that although most of the people have little knowledge of archaeology, and have never experienced a real dig, this video has a great impact on the way that the past is perceived (fig. 9).

Although, in technical terms, this is a static website, the way that the information is presented and discussed reflects the principles of archaeological practice that Hodder has argued: reflexivity, multivocality and active interpretive process. People have the chance to make their own thoughts, and not just passively receive disseminated knowledge, by contributing to the interpretation of the site via the open discussion. Each one of us, intentionally or not, becomes embodied into the archaeological experience through interactive ways of understanding and interpreting the past. This framework should be considered the basis to lead the public to a critical understanding, discursive interpretation and deep engagement reflecting contemporary social and cultural values, debates and aspirations.

Virtual and augmented reality technologies, on the other hand, provide immersive environments which have been claimed to be important elements of public education and interpretation activities. However, several unresolved issues, such as their cost, but also conceptual limitations and accessibility, usually make these approaches an expensive toy rather than an educational tool (Economou & Pujol Tost 2008). The various methodological tools that interactive data repositories are based on, are far more user friendly and accessible to a greater audience, regardless of their age, resources and computer literacy. The evaluation of such attempts point to the fact that digital interactivity can be provided not only via sophisticated and usually expensive interfaces, but via more conventional digital media and narratives, which become complicit mediators of heritage knowledge, ensuring its sustainability in the coming years.

## CONCLUDING REMARKS

Although the phrase 'dissemination of archaeological or heritage knowledge' has been extensively used in various contexts, the authors argue that this concept does not really exist. Dissemination reflects a passive process of receiving knowledge, and to a great extent underestimates the public's perceptual and interpretive abilities. We believe that archaeological knowledge is an interpretation on its own, and as such should be faced by practitioners in our field. The way we present the past is a translation of the excavated data (Hodder 1991: 15), which in turn are an interpretation of past attitudes and structures. In addition, what the audience perceives is an interpretation of our own understandings, as they elaborate the archaeological data in their own way.

Through our case study, it became apparent that the process of three-dimensional modelling comprises an interpretation, and it is not only the final product that should be considered as such. In addition, when these methodological tools are used for the benefit of archaeological research, interpreta-


**Figure 9 - Video tour of the site in the 'Interactive Digs' of Archaeology Magazine, US.**

tion passes to another level, as various hypotheses and convoluted research questions can be effectively tested through experimental opportunities that are not given by conventional means of recording.

On the other hand, digital museums and interactive interfaces provide an ideal way to engage or encourage participants to learn more about specific aspects of their cultural heritage, especially when archaeological sites are remote, unpublished and closed to the public. These simple, but simultaneously interactive tools, not only keep visitors informed about the past, but with their participation they can mould and freely express their ideas, communicate with others, and finally reach their own conclusions.

Interpretation should be a multivocal and reflexive process, involving not only experts in the field, but also the public, who can offer valuable insights into our constructed pasts. Even if advanced technologies are not employed, the fact that the audience has access to the primary source of information, provides an immersive experience. The audience can not only read the evidence, or an image conveying information, but also construct their own images and narratives through rich interpretation (Earl in press), by giving sense to the past and exploring different dimensions. However, the interpretive process is not only influenced by the use of these methodological tools; it is now well established that archaeologists are not passive receivers of information, and consequently objective scientific observers, since archaeology does not comprise passive objectified entities (Adams 1991).

**SOMMARIO**

*L'apporto delle applicazioni virtuali nell'interpretazione del passato. Le tecnologie digitali applicate ai beni culturali hanno cambiato in larga misura il nostro modo di comprendere il passato e il modo di fare ricerca. Utilizzando con cura queste metodologie e sfruttando il loro potenziale nel caso studio di Creta Minoica, mostreremo che il processo interpretativo può essere rafforzato, non solo nella presente ricerca, ma anche nella presentazione del passato al pubblico fornendo un approccio di multivocalità, un'esperienza di totale immersione e un riflesso nelle unità analitiche e nel background dell'osservatore.*

**METAKEYS**

*Digital Heritage, Virtual Constructions, Illumination Analysis, Digital Museums*

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Technological developments, and their consequent impact on heritage interpretation, should be considered as the means to articulate heritage to the public in a way that paper, photography, ink and traditional approaches cannot. Since the demand for a new age is no longer latent, our goal is to find the golden mean, by neither exaggerating technologies' contribution to justify the efforts we spend in creating them, nor to be over sceptical about the potential of the range of these powerful tools. Digital heritage represents a necessary revolutionary avenue that cannot be kept apart from the methodological evolution of cultural heritage studies.

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