

Chapter 16

History and Cultural Heritage in Virtual Environments

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Abstract

Applying virtual reality and virtual-world technology to historical knowledge and to cultural heritage content is generally called virtual heritage, but it has so far eluded clear and useful definitions, and it has been even more difficult to evaluate. This chapter examines past case studies of virtual heritage; definitions and classifications of virtual environments and virtual worlds; the problem of convincing, educational, and appropriate realism; how interaction is best employed; the question of ownership; and issues in evaluation. Given the premise that virtual heritage has as its overall aim to educate and engage the general public (on the culture value of the original site, cultural artifacts, oral traditions, and artworks), the conclusion suggests six objectives to keep in mind when designing virtual worlds for history and heritage.

Keywords

history, heritage, games, evaluation methods, cultural heritage, HCI, multiuser interaction, virtual worlds, virtual reality, 3D interfaces

The potential of virtual reality technology applied to history and to cultural heritage appears to be rich and promising. Teaching history through digitally simulated “learning by doing” is an incredibly understudied research area and is of vital importance to a richer understanding of culture and place. However, many issues await to confront us: potential confusion between what is the past and what is history; the issue of realism when applied to the simulated portrayal of history and heritage; effective and meaningful interaction; how to maintain long-term usefulness; the ownership of cultural knowledge before, during, and after it is digitally transmitted across the world; and how we can evaluate the successes and failures of this field.

Background

Virtual heritage is considered by many to be a fusion of virtual reality technology with cultural heritage content (see Addison 2000; Addison, Refsland, and Stone 2006; Roussou 2002). Interestingly, the earliest examples of virtual heritage do not appear to be virtual reality per se, but 3D models available either as a museum exhibit, a web-based showcase of technology, or an academic test of augmented reality.

Although there have been earlier examples of digital archaeology (Reilly 1990; Sylaiou and Patias 2004), the Wikipedia lists Dudley Castle as the first example of virtual heritage in a museum, opened by Queen Elizabeth II in 1994 (Wikipedia 2013; Johnson 1996). The user could move either one of two circular buttons to navigate the laser disc-stored computer model “reconstruction” of the castle. The website describes this project as a “Virtual Tour” or as a “Virtual Reality Tour,” but there is no head-mounted display, nor a wall projection that changes in viewpoint when users change their position or gaze.

The University of Columbia’s Computer Graphics and User Interfaces Lab is credited with the first “mobile augmented reality” (Feiner et al. 1997); it developed augmented reality equipment for “exploring the urban environment” (i.e., heritage tours around their university). Walkers carrying the portable computer as backpack, and wearing a bulky head-tracked, optical see-through, head-worn display, would see a 3D virtual model of the main building of Bloomingdale Asylum, recreated at its original location, imposed over the real and existing campus. GPS tracked the user and updated the image as best it could; an interesting ghosting image resulted from the flickering and latency of the system. Later developments saw an augmented Pompeii developed by the MIRA Lab (Papagiannakis and Magnenat-Thalmann 2007), and Archeoguide (Dähne and Karigiannis 2002).

One of the first web-based examples of virtual heritage was both a model of a cultural heritage site and the showcase of new technology; the Virtual Reality Modeling Language

(VRML). With its offering of the second version (VRML 2.0) of this declared new 3D standard for web models, Silicon Graphics provided a VRML model of the ancient Aztec city of Tenochtitlán (Harman and Wernecke 1996). VRML was single-user only; browser software was typically buggy, and the models large and very slow.

Perhaps because of these limitations, the VRML model of the Mexican city was also slow and buggy, and there was no external landscape. The city depended on its aquatic surrounds (the original Aztec temple-city was actually a floating island in the middle of a giant lake); and Aztec culture was a vigorous fusion and distillation of earlier Mesoamerican cultures. Neither of these two important cultural and geographic aspects was communicated in the model.

Yet this was a breakthrough as an example of the latest technology offering a view of the past to those who could not travel to Mexico or visualize from drawings (the real Aztec site is now underneath the concrete of Mexico City). The potential of virtual heritage to reveal to the public through the Internet both the established science and reasoned conjectures of archaeologists and anthropologists was now upon us.

There were also computer-based virtual heritage projects in the early 1990s. Learning Sites has described its work on the Egyptian site of Buhen (Learning Sites 2011; Sanders 2008). Later that decade the Federation of American Scientists (2011) released its educational “Discover Babylon” project, a free downloadable project, but difficult to run on modern computers. Also in America, the historian Roy Rosenweig distributed interactive CDs on American history, which led to the formation in 1994 of the Centre for New Media and History at George Mason University (now the Roy Rosenwald Center for History and New Media).

Defining Virtual Heritage

Fast-forwarding to the second decade of the twenty-first century, we find virtual heritage projects are still scattered and liable to disappear. While social media has exploded, the technological projects on which many virtual models of cultural heritage sites are based are still single-user, limited in interaction, and often confuse the visitor with either a minimum of navigation cues or far too much overlapping of textual and spatial information (Tost and Economou 2007). Game engines are increasingly used to create digital environments (Anderson et al. 2010), but their genre-related affordances are seldom used, a point I wish to expand on later in this chapter. There are also interesting installation-based virtual heritage sites such as iCinema, the Panoscope of Laval University Quebec, the web-based and downloadable Virtual Museum of the Via Flaminia, and huge planetarium displays such as at the Foundation of the Hellenic World, in Athens, the curved wall of the Earth Theatre at the Carnegie Mellon Museum of Natural History, or the large VR theater at the University of California, Los Angeles. Yet virtual heritage projects dependent on the traditional examples of virtual reality technology, head-mounted displays and CAVEs, are few and far between.

And this is perplexing, for head Mounted Displays (HMDs) and CAVEs (Cave Automatic Virtual Environments) are arguably integral to the conventional definition of virtual reality as requiring spatial presence and head tracking (and if I am right, there are several such examples in this book). For example, Bryson (1996) defined virtual reality in an article in *Communications of the ACM*.

Virtual reality is the use of computers and human-computer interfaces to create the effect of a three-dimensional world containing interactive objects with a strong sense of three-dimensional presence.

He also stressed the importance of using HMDs or CAVEs, for VR apparently requires “a head-tracked, usually stereoscopic, display that presents the virtual world from the user’s current head position, including the visual cues required so the virtual scene is

perceived as independent of the user, that is, has ‘object constancy,’ while the user moves about.”

I have three issues with the above definition in regards to virtual heritage. Famous examples of virtual heritage tend to be desktop-based or fixed wall installations, and do not change according to the “user’s current head position.” There are many such examples of game engines and desktop-based digital worlds that can be labeled as “virtual heritage.” For example, the *Forbidden City: Beyond Space & Time* (IBM’s modification of the Torque game engine to showcase The Forbidden City of China); the *Discover Babylon* free and downloadable PC game; *Ancient Rome 3D* runs in Google Earth (see also the Rome Reborn project); the Building Virtual Rome case studies; downloadable Unreal Tournament ancient history models;¹ Google Warehouse models; or *Playing the Past*, the commercial serious learning game for children about the Black Plague that ravaged Europe.

Second, there appears to be an ocular-centric bias to early notions of virtual reality, (nonsighted people surely perceive a form of reality), and even augmented reality experts are now moving away from a visual-only definition of virtual reality and mixed reality (Azuma 2004; May 2004), but there are specific implications of this traditional definition of virtual reality when employed in the services of cultural heritage.

Third, virtual heritage is concerned with culture, which is not directly a question of “spatial presence.” For example, UNESCO (2003) definitions of cultural heritage have widened in recent years to include the notion of intangible cultural heritage, the “practices, representations, expressions, as well as the knowledge and skills, that communities, groups and, in some cases, individuals recognize as part of their cultural heritage.” This new and more inclusive viewpoint necessitates that virtual heritage considers the nonmaterial and even the nonscientific.

In line with this more generous interpretation of virtual heritage, Stone and Ojika (2000) published a definition of virtual heritage that offers a point of difference to scientific virtual reality environments:

[Virtual heritage is] the use of computer-based interactive technologies to record, preserve, or recreate artefacts, sites and actors of historic, artistic, religious, of cultural significance and to deliver the results openly to a global audience in such a way as to provide formative educational experiences through electronic manipulations of time and space.

Unfortunately, virtual heritage projects may not appear to be computer-based, and some authors have even argued that noncomputer displays such as nineteenth-century cycloramas are a form or at least a forerunner of virtual heritage (Jacobson 2008). Sometimes the knowledge is not appropriate for consumption by global audiences, and the issue of recreation, reconstruction, or simulation is a vexing one. For despite its name, does a virtual heritage model really preserve? These considerations lead me to suggest an alternative definition: virtual heritage is the attempt to convey not just the appearance but also the meaning and significance of cultural artifacts and the associated social agency that designed and used them, through the use of interactive and immersive digital media.

Issues and Objectives

In a publication cowritten with the archeologist Laia Tost (Tost and Champion 2011), I proposed six objectives to improve research into and development of virtual heritage environments. First, we should meticulously and comprehensively capture objects and processes of scientific, social, or spiritual value. Second, we should present this information as accurately, authentically, and engagingly as possible. Third, we should distribute the project in a sensitive, safe, and durable manner to as wide and long-term an audience as possible. Fourth, we should provide an effective and inspirational learning environment

appropriate to the content and to the audience. Fifth, we should allow the possibility to participate in its construction. Finally, we should attempt to carefully evaluate the project's effectiveness with regards to the above aims in order to improve both the project in particular and virtual heritage in general.

The Capture and Display of Data

There is an important link between the capture of data and the display of data. First, increasing computational power, increasing ability to record and project a digital version of reality, is irrelevant if the data to be simulated existed in the past. It may even be dangerous, implying by its certainty a concrete reality (Eiteljorg 1998), which we are in fact only extrapolating from unreliable sources, our imagination, or the memory of others.

In popular usage there seems to be a conflation between the word "virtual" meaning to have the effect of the "real" without actually having material or form and as a synonym for the word "digital." Further, "appears to be real" could mean "An object looks like something that really exists," or "I can believe that it exists." Designers can use this conflation to persuade the viewer that high-resolution images imply a high degree of archaeological certainty when this is not the case (Eiteljorg 1998). An emphasis on visual representation and realism is thus not always of primary interest to archaeologists (Kensek, Dodd, and Cipolla 2002), social scientists such as Gillings and Goodrick (1996) and Anderson (2004), or to virtual heritage specialists such as Roussou and Drettakis (2005).

Authenticity and Realism

The term "virtual" implies an object that is indistinguishable from an object that physically exists, apart from its lack of physicality, or ability to affect the physical world. The comparatively recent depiction of virtual reality in popular culture, films, television, and science fiction novels emphasizes the notion of the virtual as digital simulacra, a complete and indistinguishable mirroring of physical reality created and maintained by vast data and

computational power. Such a popular concept is dangerous in the area of virtual heritage for a multitude of reasons.

A representation of current reality may induce the untrained eye of the general public to believe that the original inhabitants perceived as we do. Such an inducement may diminish the understood cultural significance of the original site. According to some archaeological theorists (Renfrew 1994), an attempt at realism may conflict with interpretation.

The issue is also a problem for the designer; many designers aim for levels of detail that are never noticed, or perhaps even considered important, by general members of the public. The user requirement for a degree of realism may also vary between say, an archaeologist and a member of the general public. “Heritage always has been about people, but the challenge today is to make it relevant to a much wider section of people, and that emphasis will not necessarily be on the conservation of concrete objects” (Howard 2003, 50, 157). So while mythology and the use or implied inhabitation may not be scientifically accurate, it can afford more of a sense of place to members of the general public.

As Shackley (2001, 27) has noted, public expectation and the journey may be as important as the visit itself. If content designers view virtual heritage environments as stand-alone recreations of objects, visitors may be short-changed in terms of the learning experience. They will not have the background contextual knowledge of the archaeologist; nor can they be relied on to possess a well-trained deductive logic or a scientifically honed ability to create and test hypotheses.

Long-Term Usage, Technology, Content, and Research Data

There has been an explosion in virtual heritage conferences this century. In the last year alone, there have been calls for digital cultural heritage or virtual heritage papers by Virtual Systems and Multimedia (VSMM), ACM Virtual Reality Software and Technology (VRST), VAST (International Symposium on Virtual Reality, Archaeology and Cultural Heritage),

DIME (Digital Interactive Media Entertainment and Arts Conference), Archäologie & Computer, Games Learning Society, and more singular events, such as “High-Tech Heritage: How Are Digital Technologies Changing Our Views of the Past?” New Heritage Forum, and the Serious Games Summit, just to name a few. Museums and the Web and iCHIM (International Cultural Heritage Informatics Meetings) have published related work, and there is also the Digital Humanities series of conferences.

So an outside observer may believe that such academic interest, coupled with recent advances in virtual reality (VR), specifically in virtual environment technology and evaluation, would prepare one for designing a successful virtual heritage environment. Ironically (for a heritage-related field), these papers are not always archived, freely accessible to the public, and seldom if ever contain direct links to the projects being discussed. As virtual heritage projects are often one-off projects, criticism may not help improve them.

However, we can hold out hope for recent developments in Digital Humanities such as DHCommons and the Open Library of Humanities, as well as the planned cohosting and collaboration of many of these conferences. A fully archived, publicly accessible archive, with links between projects, tools, methods, and publications, would be a great step forward for the field.

Effectiveness and Educational Value Requires Interaction

History is not a blueprint but an intersubjectively inscribed mass of interpretations, actions, intentions, and beliefs. Yet most digital simulations lack change, or interaction, or the ability to store interaction history. For example, many virtual heritage sites have brilliantly detailed temples, but no people, and no tasks to solve.

Conversely, for activity-based virtual environments, (such as games), user-based tasks are required. Participants are really visitors rather than actors or role-players; they do not

learn more about themselves or the world through activity; they solve puzzles and complete tasks but do not reflect or learn more about the uniqueness of the world or themselves.

It could be counterargued that computer games featuring history and heritage can be used and interacted with in a meaningful way by teachers and students (which is the argument of McCall 2011). While I mostly agree, it also depends on the interrelation of teacher and student, and does not fully immerse the student in the *there* of virtual heritage environments. For example, Gaver and colleagues (2004: 888) write that the difference between ludic systems and typical computer systems is the following: “If a system can easily be used to achieve practical tasks, this will distract from the possibilities it offers for more playful engagement.” This is a continual issue with learning environments in general.

Hein (1991) also argues that interactivity in exhibits creates more engagement by allowing users to apply the tool directly to their own life. Yet activity per se is not cultural; the visitors are not individually recognized and remembered. Allowing multiple participants to enter a virtual environment together may increase the chance of social presence, and Lave and Wenger (1991) agree; for them learning is transmitted, discovered, or “experienced in interaction with others.” Unfortunately, the presence of others may actually impede or distort our understanding of different cultures.

We also seem to have inside our heads an inclination to situate through rituals and through habits of going about our daily lives. Tilley notes (1999, 29): “Rituals not only say something, they do something.” Hodder attempts to show how hermeneutics (the study of interpretation, originally of historic texts) could be used in archaeology, and he explains that “ritual regulates the relationship between people and environment” (1986, 23) and artifacts indicate the shared intentions of their creators (25). Place-making is not the capturing of an evocative image of a mysterious temple, but it is more the triggering of *placeholders*, symbols that aid and define our daily activities. A place can also carry cultural indications of

inhabitation driven by a cultural perspective similar to or different from our own. So a virtual heritage environment should allow us to see through the eyes of the original inhabitants, or at least feel that this place once belonged to someone else.

Yet how does one design for a cultural ritual taking place in a particular cultural place in virtual heritage environments? Digital environments typically lack an in-world social authority or audience to ensure rituals are practiced correctly; participants are not fully physiologically immersed in the digital space; they lack the means to fully teach ritualistic practice; they also lack reasons and incentives to develop and refine rituals through long-term practice.

In 2007 Bharat Dave and I proposed a new categorization of virtual environments in response to an ACADIA 2001 paper by Kalay and Marx (2001) that described eight types of virtual places, but these notions were descriptive rather than prescriptive. In the Champion and Dave (2007) paper, virtual environments are instead classified by overall design goal. The first is visualization-based, the second is activity-based, and the third covers “inscriptive” (hermeneutic) environments.

The first type of virtual environment is visual (sometimes with sound). You can walk around, zoom in and out of objects (say buildings), and that is about it. Your orientation and view can be manipulated, but the environment is not really interactive, as it does not affect your actions, and you cannot modify it. A three-dimensional fly-through of a building is one example. The advantage and disadvantage is that the environment is really a finished product; the inhabitants do not affect it, and so the model manages to be definitive, immutable, and appears consistent in appearance, which, however, is at odds with objects that change over time through fashion, fate, or neglect.

As Meister (1998) writes in his discussion of temples, in order to understand the value of a building to the culture that builds and maintains it, we need to understand how people

interact with it. For early virtual heritage projects (see, for example, the case studies in Barceló, Forte, and Sanders 2000), static computer models may prove suitable for education purposes when an archaeologist or local expert is a guide; yet the information and the discursive content becomes entrenched when viewed by a solitary audience.

Game designers may also be led to believe that games using historical characters, events, or settings are readily adaptable and immediately appropriate to virtual heritage, but there are fundamental conceptual issues still to be addressed. For example, to what extent is the past more or less important or retrievable than history, and how is it attainable through interaction (as otherwise there is little point to using virtual environments)? One answer may be adopting virtual reality to represent the past or online digital worlds to represent the future, but it is still too easy to be taken in by the lure of technology and forget to concentrate on enhancing the user experience. For example, many have made the case for using game engines for virtual heritage projects (Stone 2005; Lucey-Roper 2006; Bottino and Martina 2010).

Much easier to upgrade, install, and replace, the most popular form of virtual environment is now arguably the computer game (Smith 2008). Current game consoles and desktop computers rival supercomputers of just a decade ago in power and performance. Games have context (user-based tasks), navigation reminders, inventories, records of interaction history (i.e., damage to surroundings), social agency, and levels of personalization. Games are a familiar medium to users (Petty, n.d.; Cuenca López and Martín Cáceres 2010), and, when in game mode, abstraction can be just as engaging to users as a sense of realism.

Games also form part of cultural learning and how to follow social rules, or learn about physical rules of the world, without risking personal injury (Schank 1990; Miller 1991; Petty, n.d.). We socially learn (by stories, and commands), we learn by observation

(observing cause and effect, emulation and by imitation), and we learn by play (puzzles toys and games).

There are indisputably certain pedagogical techniques that virtual heritage environments can learn from game design. Yet, despite the rich detailing of environments, agents, and artifacts, three-dimensional adventure games do not have a rich sense of cultural immersion. While not true for all games, the typical goal in adventure games is for collecting artifacts for the vanquishing of others, social interaction is limited to violence, time spent on reflection is punished, and we do not develop any feeling for the perspectives of the local inhabitants as their actions are typically “fight or flight.”

Without a huge amount of time spent in a virtual environment, it is also doubtful that our cultural and social view of the environment will change very much. To learn another language, we can attend class, but to think in another language and to be accepted by others without thinking we have to immerse ourselves in the actual context over a long period of time, long enough to learn from trial and error. So there are significant design challenges for virtual heritage environments; to portray accurate yet believable content; to provide appropriate yet meaningful interaction; and to link both content and interaction leading to significant and useful knowledge in an abridged time period.

Participation Requires Ownership

Sardar (1996) has attacked cyberspace directly, and virtual heritage indirectly, as a form of “museumization”:

Cyberspace is particularly geared toward the erasure of all non-Western histories. Once a culture has been “stored” and “preserved” in digital forms, opened up to anybody who wants to explore it from the comfort of their armchair, then it becomes more real than the real thing. Who needs the arcane and esoteric real thing anyway? In the postmodern world where things have

systematically become monuments, nature has been transformed into “reserve,” and knowledge is giving way to information and data, it is only a matter of time before other people and their cultures become “models,” so many zeros and ones in cyberspace, exotic examples for scholars, voyeurs and other interested parties to load on their machines and look at. Cyberspace is a giant step forward towards museumization of the world: for anything remotely different from Western culture will exist only in digital form.

The above paragraph is no doubt well intentioned, but it may persuade the reader that non-Western cultures are not interested in virtual heritage when that is clearly not the case. Perhaps the most pressing danger about the above paragraph is that it gives no clear alternative to digital environments; nor does it provide convincing proof that Western culture and only Western culture is strictly museum-fixated (and museum here seems to be used in the narrowest of senses). For example, archaeology itself is not a Western profession; there are historical accounts of two Babylonian kings who were archaeologists, Nebuchadnezzar II and Nabonidus (Spears 1996; Johnston 2010). Apart from the above attack on the West (and an overly strong conflation between tourism as convenience and digital media as mindless edutainment), the issue of ownership of virtual heritage equipment, data, and the overall intellectual property is indeed a perplexing problem that has not yet been fully resolved (Skeates 2000).

Evaluation

Do we have concrete examples of meaningful interaction in virtual heritage environments? According to the few existing user studies, so far this is area is still too undeveloped (Mosaker 2001; Roussou 2005; Tost and Economou 2007; Rodriguez-Echavarria et al. 2007). While even archaeologists and technical experts have warned against an overemphasis on technical achievements, we still lack solid test cases that attempt to both build and test virtual

history projects for the end user (who perhaps should not just be involved at the end of the project).

The ethnographic techniques used by researchers may be effective in recording activity, but they do not directly indicate the potential mental transformations of perspective that result from being subjectively immersed in a different type of cultural environment. How can users learn via interaction the meanings and values of others—do we need to interact as the original inhabitants did? How can we find out how they interacted and, through the limited and constraining nature of current technology, ensure interaction is meaningful, educational, and enjoyable? How do we know when meaningful learning is reached?

Insko (2003) argues that because of the many definitions of presence, one should try to evaluate it with as many measures as possible. Insko adds that a good metatest of questionnaires is to see if they distinguish between virtual presence and real presence. In other words, for many of the presence researchers, evaluation of virtual presence is based on an approximation toward real-world presence.

Interesting as this may be, real-world tests will not necessarily be of help in assessing heritage reconstructions, unless the virtual experience is supposed to tally as accurately as possible with a given and accessible real-world experience of that culture. This is a problem if the real culture being simulated no longer exists in one place or at the current time, or if the cultural knowledge is fragmented or only circulated among experts and not the general public.

In a widely cited paper, Lessiter and colleagues (2001) list four criteria they believe determine presence and immersion in virtual environments. The four criteria are physical space, engagement, naturalism or realism, and negative feelings (such as phobia, motion sickness etc.). We could add the concept of cultural presence, the sense that a cultural viewpoint *inhabited* the site.

This leads us to the thorny issue of how to evaluate such a concept. We could use questionnaires; we could test the ability of participants to extrapolate general cultural rules or other information and apply them to other heritage sites; we could test whether participants could detect other players or nonplaying characters that appeared to belong to or not belong to the resident culture. We could also test for engagement using questionnaires, by recording physiological data, or by testing the memory recall of the participants. A further option is to give users tasks to complete, and record their performance. However such testing only records their technical proficiency, and not necessarily their cultural understanding.

Conclusion

The above chapter has listed six major issues. I have argued that the way data is captured does not always convey the processes, decisions, and values inherent in the act itself. And how this information is to be presented raises issues of what is authentic and also how to convey the accuracy or assumptions without losing or misleading the public. We also need to improve the accessibility of these projects to the general public. This means we need to consider the ways in which different audiences learn. If possible we should invite the audience to debate, participate, and contribute to the ongoing project in order both to educate the public and to maintain the project and to ensure both its usefulness and its longevity. However, how we evaluate these projects raises a myriad of interesting challenges.

Archaeological and architectural digital simulations have traditionally been concerned with exact replication of facts rather than with understanding, for the latter raises the annoying dilemma of how to present scientific uncertainty. For a computer model almost invariably implies certitude and replication of the “facts.” Until recently, accurate digital simulations of historically uncertain or controversial findings have been left unquestioned. Yet there are educational and scientific dangers in many current computer simulations that

are based on *apparent* mimetic certainty and not on the cultural agency that informs understanding.

To clarify these issues, I suggested a simple classification of virtual heritage environments. The first type of environment surrounds and orientates us (spatial presence), the second functions (allows us to do things), and the third identifies and embodies us or allows us to interpret the cultural perspective of others (is hermeneutic). Ideally, the third type of environment allows us to recognize, understand, and become (transform our worldview), but it is hard to see how it can work in practice, especially if informed guides are not available.

There is also the option of classifying by game mechanics, by platform, by content, or by audience. Unfortunately, the range of data, potential audience, and supporting technology is dynamic, vast, and highly content-specific. I have also briefly mentioned issues in the use of game engines and game genres; engagement versus learning and interaction versus historical accuracy are key concerns.

For various reasons, evaluation of the learning inside virtual heritage environments has been relatively context-free, not designed for user understanding of other cultures. Technology can overwhelm the content, especially when the knowledge driving the virtual simulation is incomplete, complex, or contradictory; and the continual need for research funding can actually impede research rather than develop it.

If virtual heritage has as its aim to educate and engage the general public on the culture of the original site, cultural artifacts, oral traditions, and artworks, then the field needs to advance not only in technological advances but also in philosophical and creative ways, especially in regards to the issues of realism, interaction, evaluation, and ownership.

Note

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