

Review Article

Heritage Multimedia and Children Edutainment: Assessment and Recommendations

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Despite the rising commodification of heritage sites and practices, children engagement in their own cultures remains incredibly low, greatly endangering the future preservation of nations' unique nonrenewable resource. Considering children's very early engagement with cultural attitudes and identities, it is increasingly critical to develop a deeply rooted culture of responsibility and conservation from the earliest years, ensuring that children naturally feel invested in their surroundings. Unfortunately, heritage education remains largely undervalued, with most efforts relying on in-person experiences in formal cultural institutions. This paper thus aims to explore how heritage education can be redefined, using some of the most innovative virtual imaging and artificial reality technologies to at once expand access and engagement with one's own history. Though there have been introductory applications of this edutainment multimedia technology, it will require a multidisciplinary team to create heritage programming which is as entertaining as it is intellectually challenging for young children. With the rich resources of 3D imaging and interactive programming already at our disposal, we are well-equipped to do so, given a coordinated effort.

1. Introduction

Heritage is associated with the old and museums, history books, lectures. These were its relatives. But as countries construct their own national identities, and as those identities become marketed international brands, heritage has become a vivid lived-in experience. "*On our today's world, heritage is no longer just a memory or a cultural reference, or even a place or an object. Heritage is moving towards broader and wider scenarios, where it becomes often the driven forces for commerce, business, leisure and politics*" [1].

And yet, the youth population is as disengaged as they ever have been from the dust and bones of their birthplace and families. Archeological sites, traditional arts, and ancestral folklore are being relegated to the bin of history, only to be accessed when a parent or teacher forces the issue. But what is the source of this disengagement? How can it be rectified? And why does it matter?

Kailash states that "*there is a problem due to the lack of cultural heritage input in our curriculum both at school level and at the level of college and higher studies*" [2]. As the saying goes, children are like sponges; they absorb everything around them, developing a sense of self based on their environment.

If however their environment does not provide the needed stimulus or access, children naturally develop a disinterest in the matter, in this case knowledge of their own heritage.

One of the major challenges facing heritage education initiatives has been the slow mobilization of new theory into practice [3, Page 103], or rather its geographically limited use. Perhaps the most successful cases are found in European systems, where cultural-historical theory is becoming increasingly influential for informing early educational curricula. Schools are developing initiatives to connect pupils more closely to the world of culture and arts, through organized visits to places of artistic and cultural interest or direct partnerships with artists, musicians and creative directors. In addition, there are several examples of cultural heritage-related festivals, celebrations and competitions where pupils are encouraged to participate. The permanence of these efforts is evidenced by their institutionalization, with a variety of cultural bodies and networks giving roots to the movement [4].

European governments have also been active in creating the appropriate policy environment to promote cultural education. In 2005, the Council of Europe launched a Framework Convention on the value of cultural heritage for the society, which identified the need for European countries to preserve

cultural resources, promote cultural identity, respect diversity and encourage intercultural dialogue [5]. Article 13 of the framework acknowledged the important place of cultural heritage within arts education, and also recommended developing linkages between courses in different fields of study [5]. The European Commission also joined the effort, proposing in 2007 a European Agenda for Culture in a Globalizing World, which acknowledges the value of arts education in developing creativity [6]. Furthermore, the EU strategic framework for European cooperation in education and training over the next decade clearly emphasises the importance of transversal key competences, including cultural awareness and creativity.

In 2008 the Council published a “White paper on intercultural dialogue,” which offered an intercultural approach to managing cultural diversity. The paper identified educational organizations (including museums, heritage sites, kindergartens and schools) as having the potential to support intercultural exchange, learning and dialogue through arts and cultural activities [7]. In fact 2009 was the European year of creativity and innovation, which further recognized the connection between cultural awareness and creativity.

This attention is of course not maintained worldwide. Indeed, at the culmination of UNESCO’s five-year collaboration with its arts education partners in Lisbon, the organization highlighted the need to promote arts education in all societies, as detailed in *“The wow factor: global research compendium on the impact of the arts in education”* [8, 9]. The conference document asserts that providing arts education helps to prepare students for higher education, promote the expression of cultural diversity, and uphold the human right to cultural participation.

In the case of Arab countries, unfortunately significantly less attention has been given to heritage education, resulting from a variety of obstacles including lack of funding and governmental interest (There are many obstacles; Perhaps the largest is that Arab Ministries of Education are generally less interested in early children development programs, which parallels the public’s lack of awareness of its importance. Correspondingly there is lack of clear development strategies or policies in government, particularly towards any sort of nonmath or noscience curriculum. In countries where policy does exist, teachers are often ill-equipped to properly deliver more interactive lesson, thus dulling their effectiveness. In addition to the lack of appropriate school buildings and facilities, lack of qualified personnel such as teachers, supervisors, instructors and administrative committees in various fields, lack of teaching aids such as specialized books, publications, games and Toys, and lack of kindergarten curricula that is based on scientific and education basis [10, 11]). Even the limited number of organizations actively funding early education projects in the Middle East, the most notable of which is the Arab Gulf Programme for United Nations Development Organizations (AGFUND) remained unengaged in art education initiatives. (Based on its mission priority, since its establishment in 1980, AGFUND is still funding projects and programs aiming at supporting childhood development in less development countries, that adopted a comprehensive approach in focusing on major aspects which affects child

life and needs especially in the health and education sectors, institutional and capacity building sector, and special nature development programs and projects. AGFUND is implementing these projects in collaboration with Ministries of Education and the UNESCO in 11 different Arab countries [10]).

Given the decreasing engagement with traditional learning methods, and the world’s already overstretched educational systems, it becomes critical to explore independent alternatives to arts and cultural education [12]. In their vision for twenty-first century education, Shank and Kozma [13, Pages 253-254] predict a model where schools, homes, the workplace, libraries, museums, and social services integrate education into the fabric of the community, suggesting the need to expand our notions of where education can happen. Such a multisurface approach is perfectly complimented by the advances in multimedia and communication technologies. There is already a trend towards incorporating technological innovations within classes. The new “Classroom 2000” developments, for example, focus attention on the student’s experience, bringing students closer to the technology and letting them interact with and add to the captured content (For example, the Living Schoolbook in New York State is working with Video on Demand and demonstration projects for K-12 [14]. Useful publications for a cross-curricula approach of geography and the historic environment, math and science, produced by English Heritage Education Services [15]). Thus, for a field as interacting and expressive as art, one can easily imagine how technology, particularly advances in 2D & 3D animation, gaming and website design, could offer greater access and collaborative potential for children who may otherwise be disinterested.

Heeter stated in 1999 that, *“We have only begun to realize the potential connectivity possible in a networked world. Parents, teachers, scientists, community leaders, friends, reporters—anyone can participate in a learning experience, particularly if it is online.”* Thus the rapidly expanding world of multimedia has enormous potential to engage children in their cultural heritage, providing them with a channel to actively engage in its development.

However, meanwhile animation lends itself perfectly to direct communication without barriers of language or cultural differences [16], actually, we still *“have a long way to go in designing intuitive interfaces and that is what will distinguish the educational applications of tomorrow”* [17]. We are still though at the early stages of using immersive edutainment multimedia (EM) to experience cultural heritage and virtual reality systems.

As the potential of this fusion continues to be discovered, it behooves us to think concretely and practically about its future applications, including its role in developing a genuine appreciation and understanding of heritage. The modern education system must adapt to the changing global conditions, allowing children to feel engaged in societies that are in constant flux. However, without the tools of “Edutainment Multimedia,” we cannot hope to create a generation confident or invested enough to carry our society safely into the 21st century.

To explore edutainment multimedia's role in cultural identity building, the following sections aim to define and clarify:

- (i) children's current perception of heritage in relation to informal and formal education and edutainment multimedia,
- (ii) current approaches in heritage education,
- (iii) initial considerations for edutainment multimedia's role in heritage education,
- (iv) interactive virtual reality and heritage education.

2. Cultural Heritage from a Child's Perspective

Very few researchers have examined children's understanding of culture, in part because it is difficult to design appropriate measures. Indeed most young children do not grasp the relationships between nations, national origin, and traditions, and do not have a concept of culture. Throughout childhood, they absorb prevailing views and draw conclusions that affect their perceptions and feelings about themselves, their heritage, and other individuals and groups. In essence, cultural patterns of interaction silently guide the developing child, in the same way that adults often do not recognize the source of their beliefs. But these patterns also become the basis for their definitions of self and personal identity, something that they are inherently a part of.

Developmental accomplishments and cultural heritage manifestation are bound together, and, as a consequence, specific behaviors come to be synonymous with specific phases of development itself. Beginning in the early years, attitudes and values can be shaped, while in later grades, development tends to be more action oriented, what children do with the ideas that they have. Thus, by the time children are five years old, they have already learned a great deal. They have reached "developmental competence" and "maturity," meaning that they have achieved the normative learning benchmarks of their community [18, Page 217]. These benchmarks coordinate biological growth and social learning, and under ordinary circumstances children's knowledge and skills match those required in the social and cultural settings in which they live. At ages 6–10 years, however, children shift from relying on visible racial cues and begin to understand cultural aspects of ethnicity such as language, food, ancestry and heritage [19, Page 226]. (However, children who are adopted internationally are at this risk of losing their ethnic heritage, and social workers in the field have a vital role to play in minimizing this risk. Childhood, then, is a critical time for intervention in the schooling of at-risk children if we expect to change outcomes [20, Page 1-2]).

If one is aiming to build a culture of appreciation towards culture and heritage, this education must therefore start at a very young age, such that it is incorporated into their understanding of self. In considering how that knowledge could best be imparted, it is necessary to reflect on children's relationship to learning, and how they process information. Indeed, from a young child's perspective, playing and learning are nearly indistinguishable [18, Pages 217-218]; [21, Pages 623–625], as children learn from all varieties of new stimuli.

Arts and cultural heritage education is a communication process, which is based on an intense engagement with artwork or cultural artifacts as well as cultural values and symbolic systems [12]. Thus, achieving heritage education requires sustained interactive access to these cultural objects [22], with the time for children to play through the new knowledge. Given this need for sustained engagement, the highly entertaining tools of games and virtual realities are particularly important, for they will allow the child to absorb far more than traditionally directed methods. Interesting is the Japanese perception for edutainment; it has considerable importance from the academic point of view. One example is the Institute for Research Edutainment which organizes forums dedicated to its application in schools. It is important to note that the Japanese edutainment is not focused exclusively on the intellectual; in fact, Nintendo has some of the best edutainment games/family as Wario Ware and Mario Party 3-4, which are focused on the playful side [23].

To summarize, teaching future generations, especially in the childhood stage, to be aware of our cultural heritage is in fact the best way to guarantee the endurance of cultural heritage traditions and heritage sites. Meanwhile, children's early experience with heritage can be also an important first step in their own enjoyment creative exploration. Now, perhaps more than ever, we are able to contemplate the past as creative tool for plotting our future [24, Pages 190-191]. Childhood personnel though need to be better prepared in cultural heritage issues to help children for whom school represents a major challenge.

3. Formal and Informal Heritage Education

According to Gruber and Glahn [22], the educational process of arts and cultural heritage education includes the following three components: the artwork or the cultural artifact to which we refer as the object, the recipient person who esteems this object (visitor), and the facilitator or mediator who communicates additional context information to the recipient. The mediator refers to social or technical systems that facilitate the communication to the recipient in terms of direct interaction, and can vary depending on the educational method in use.

The most recently discussed is a direct approach to cultural education, mediated by specific formal cultural institutions such as museums and libraries [4]. These methods are particularly appealing given the potential to redress inequality in terms of access to cultural resources.

With the aforementioned development of advanced multimedia, heritage education could also be media by technology itself. Unlike formal education which uses a cognitive approach to imparting information and skills to problem solving, edutainment multimedia relies on affective and sensory learning, based on experiential and participatory methodologies that help children reconnect awareness and caring in a concrete way.

The re-creation of historic environments for serious education and entertainment is of course not new [25, 26], although the methods for achieving the objectives have evolved considerably over time. Historically, story tellers

conjured up visions of events and places, before the days of widespread books and printing, providing their listeners with an impression of realities (often augmented realities) elsewhere in space and time. Alternatively, theatre, fine art, and cinema have added to the richness of the explicit visual experience of interpretations available to the viewer [27, Pages 23-24].

However, research in virtual reality (VR) and archaeology is a relatively young field which has shown considerable growth in recent years, as the development of new interactive technologies has inevitably impacted the more traditional sciences and arts. This is more evident in the case of novel interactive technologies which appeal to a broader public, as has always been the case with virtual reality [28]. Although early virtual heritage works have been criticized for their lack of visual realism [29, Page 22], nowadays advances in computer hardware and sophisticated 3D modeling packages allow creating compelling visualizations of static objects.

Of particular interest in the use of virtual reality displays and computer generated interactive experiences is the fact that they can allow visitors to feel like they are traveling through space and time [25, 27, 30]. The experience is thus immersive experience and interactive, generating a sense of “presence” which encourages collaborative activities amongst multiple remote users.

4. Methodological Considerations

Before engaging in an assessment of the potential role of edutainment multimedia in heritage education, it is important to understand the limited nature of this study. As discussed in the previous section, developing an interest in heritage requires a redefinition of the *recipient* and *mediator* guidelines, taking into consideration the radical changes opened by edutainment multimedia. This reevaluation, as attempted in this paper, requires an initial evaluation of the current conceptions of the terms, in order to understand the present state of cultural education. Based on these findings, one can begin to see the gaps in both content and methodology, leading to recommendations about how to make the experience the most valuable to children in the digital age. Only with this clarity can we imagine the most suitable space for technological interventions. This paper however does not have sufficient space for such a comprehensive review and thus is intended an introduction to the potential relationship between the two, as opposed to a thorough going methodological recommendation.

5. Multimedia in Heritage Education: Current Assets

In order to understand the potential role of multimedia in heritage education it is necessary to assess current efforts, including virtual modeling, electronic games, and TV programs.

5.1. Virtual Reality and Cultural Heritage. Many cultural heritage projects have developed virtual museums depending on their own concepts and policies [17, 23, 25, 31–35]. Although

innovative mobile technologies have been deployed in museums, there is still a lack of research on how novel ubiquitous computing can be developed and deployed to augment the museum educational experience for children [33]. An exception to this is the Virtual Site Museum’s authentic database, which together with advanced VR technology contributed positively to both research and experience in the classroom. The following selected cases thus give us an indication of potentiality of cultural heritage virtual reality projects, as well as drawing the limits of our achievements. As Plowman and Stephen [36, Page 160] note “New technologies may lead to new concepts of play and learning/especially as new ways are found of conceptualizing ICT so that the term does not simply denote standard computers.”

5.1.1. LIFEPLUS Project. The LIFEPLUS project proposes a new development for the innovative revival of life in ancient frescos paintings in ancient Pompeii and creation of narrative spaces. The revival is based on real scenes captured on live video sequences augmented with real-time autonomous groups of 3D virtual fauna and flora. The metaphor, which inspires the project approach, makes “transportation in fictional and historical spaces,” as depicted by frescos paintings as realistic, immersive and interactive as possible. Thus the visitor of the ancient site is presented with an immersive multisensory trip to the past. In the context of cultural heritage sites such as the ancient city of Pompeii, people would be able to observe and understand the behaviours and social patterns of living people from ancient Roman times, superimposed in the natural environment of the city [37, Pages 235–240].

For that purpose, LIFEPLUS aims to position itself between the extremes of real life and virtual reality, in the spectrum of “Mixed Reality” and especially augmented reality (AR), in which views of the real world are combined in some proportion with specific graphic enhancements or augmentations (Apart from virtual heritage, LIFEPLUS addresses the following emerging market needs [37, Page 237]. (a) Tourism and edutainment. Novel operational paradigms (immersive AR virtual life) for edutainment experiences are preconditions for economic viability for all types of future cultural and memory institutions, location-based entertainments and E-visitor attractions. (b) on set visualization and virtual studio: Film studios currently shoot films expecting to add in computer generated (CG) effects such as backgrounds, dinosaurs or CG characters later. Directors would benefit from the ability to see in real time or very soon afterwards an overlay of real and planned CG elements to decide whether the composition is acceptable). Although initially targeted at cultural heritage centers, the paradigm is by no means limited to such subjects, but encompasses all types of future Location-Based Entertainments, E-visitor attractions as well as on-set visualizations for the TV/movie industry [27, Pages 11–16].

5.1.2. Northwest Palace of Ashurnasirpal. The Palace of King Ashurnasirpal II (883–859 BC), located in northeastern Iraq, is a famous Assyrian world heritage archaeological site. Learning Sites, Inc. built the original digital model of the Palace of Ashurnasirpal (Learning Sites, 2003), as an authentic reconstruction of the archaeological site, with VRML

interaction, and animation. Easily disseminated by digital media such as CD, DVD, or internet, it runs on a PC platform with VRML viewers. This model of the palace was used as the basis for the Virtual Site Museum. From this base model, optimized 3D models were recreated for the real-time, high-end VR application described by [32]. Learning Sites built links in the model to access data (photos, drawings, and notes) that were used to create the VR model. The full-body immersion and interaction with the king have proved to be effective means to engage the students, providing an understanding of ancient society (Figure 1).

It offers user-oriented interfaces so that a user can navigate the palace and activate prepared information. The user-oriented device interfaces assisted the researchers to expand their knowledge in surroundings displaying integrated information. These human-factored applications will make the Virtual Site Museum a more reliable and productive VR experience for archaeological research and education. Students, however, with an instructor, were able to stop and observe the various iconographic representations of King Ashurnasirpal and his protective deities. They can stand outside the doorways and look into the various rooms of the palace or stop in the doorways and look around, or stand where the king or his courtiers or the representatives of foreign countries may have stood during the various ceremonies associated with the various palace audience halls [32].

Students in this way can learn different aspects of the ancient site. In the class setting in the virtual space at the supercomputer, they can experience the artifacts in their original contexts and at a nearly real scale.

They can access the supporting data first digitally and then, in the conventional classroom, discuss—or look up at home and in the library—data in the traditional publications. Students and scholars also invent projects in the palace over the web on Assyrian art and architecture [32].

5.1.3. *The Battle of the Ancient City of Syracuse.* This project represents a virtual recreation of the siege by the sea of the ancient city of Syracuse by the Romans in 212 BC. It allows the collaboration of two users. The pilot simulation battle combines the positive aspects of multiuser virtual environments, edutainment VR applications, and new human computer interaction (HCI) interfaces. The educational purpose of this multiplayer setup was the transmission of historical information and presentation of the battle through the great scientific inventions of Archimedes and information about its life. The whole experience is targeted towards users between 9–15 years of age, and uses established video game techniques and metaphors like 3D graphics, cinematic story line, high action based interaction and dramatic closure. The actual educational information passed gives students the opportunity to learn about the ancient city of Syracuse, its prominent position in the ancient world and the historical context of the conflict between Rome and Carthage. Some details about Archimedes and his position in the global intellect are also explained [17].

The audience has the opportunity to experience the information just communicated by Archimedes (his inventions and the usage of war machines and siege ships during

the Syracuse siege by the Romans) (Figure 2), as part of a multiplayer game. Two participants compete against each other, controlling the siege machines and ships. After the end of the game sessions, which are considered the climax and most entertaining moments of the application, the ending sequence is presented which again communicates historical information about the actual outcome of the battle and the fate of Archimedes. The project evaluation took place at the facilities of the Foundation of Hellenic World, while the external component and software for the optical motion tracking systems used in project were developed by the researchers of the Center for Research and Technology Hellas/Informatics and Telematics Institute (ITI) within the project “e-interface” [17].

5.1.4. *Ancient Rome in Interactive Virtual Reality Project.* The work is a reconstruction of ancient Rome in interactive virtual reality, and involves the development of a fully interactive model of ancient Rome that includes both its architecture and the machinery systems (Figure 3). The visitor to the virtual site will be able to wander through a full-scale city and enter most of its large public monuments, in addition to a few residences. The body of source material is directly accessible via the interactive model.

The educational objective is to provide university and secondary school students, and also the public at large, with a vivid illustration of ancient Rome and an example of the ancient urban reality that is not available through traditional archaeological means. For example, a program exhibited is the journey through the ancient city; the audience can choose the path through the city just as in a real tour [26]. They may also “knock” on doors to enter buildings, or fly up high to view the city from above—all this with the use of simple devices such as a joystick (The work produced by the project can be accessed via the website (<http://www.unicaen.fr/rome>), and via a stereoscopic display at the University of Caen). During an interactive visit, the visitor can use the emperor “*Marcus*” who provides a scale and who walks and runs like a real human, though is subject to the laws of gravity. We can also see the virtual environment with Marcus’ eyes [38, Pages 174–178].

5.1.5. *Shared Miletus.* The archaeological site of Miletus is no longer accessible, as its ruins have sunk into a swamp near the Turkish coast. Thus, the main goal of this project was to give visitors a full-body immersion remotely using high-speed telecommunication. The international Grid (iGrid) was used for networking, and real-time interactions were accomplished in the CAVE with C_ and VR libraries, such as Performer (SGI, 2000), CAVELib, CAVERNsoft, and Ygdrasil [32].

5.1.6. *ERATO Project.* ERATO is a research project (2003–2006) entitled “Identification, Evaluation and Revival of the Acoustical Heritage of Ancient Theatres and Odeas,” that was implemented within the Fifth Framework INCO-MED Programme of the European Commission, under the thematic title “Preserving and Using Cultural Heritage.” Actually, the ancient theatre in its many aspects has attracted

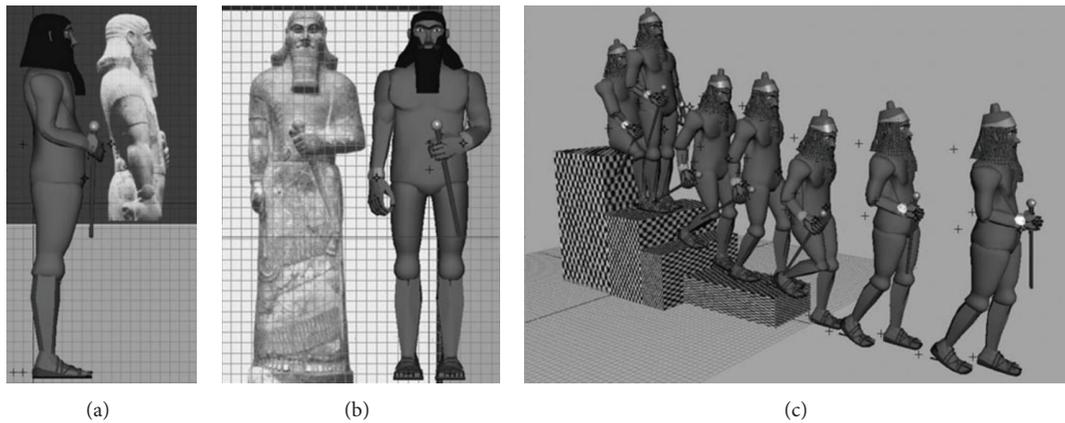


FIGURE 1: Body proportion (a), skeleton-skin model (b), and animation sequence (based upon an image of an ancient statue in the British Museum, [32, Figure 5, Page 252]).



FIGURE 2: Screenshot from the battle simulation. Roman siege ships are attacking the wall. Defensive weapons are already mounted on the wall (a). The animated avatar of Archimedes talking about the siege of Syracuse (b) [17].

a great deal of interest in the recent years. Theatres and Odeia served as a cultural centre and stood as a huge multi-functional, social, religious, and political meeting space [39, Page 265-266]. The project was designed to identify virtual restoration and the revival of the acoustical and architectural heritage. One of the objectives of this work was recreation of 3D models of selected archaeological open-air and roofed theatres of the Hellenistic and Roman period, and a creation of the real-time crowd engine in order to animate a virtual audience according to historical sources and surveys. This was generated using a collection of tools, including custom ones developed specifically for this task, in addition to standard 3D modeling applications [40], Figure 4. In order to more intuitively answer the question of what ancient Roman theatres sounded like, auralised sound examples of various theatres can be heard on <http://historyoftheancientworld.com/2011/03/how-did-the-ancient-roman-theatres-sound/>. An interactive real-time scenario of a virtual audience was created in the ancient Roman Odeon of Aphrodisias. The audience not only reacted to their favorite actors, but they also responded to the play as well: approving, disapproving, laughing out loud, crying, hailing a character, or discussing with a neighbor. This virtual reality approach provides users

with details as small as appearances of the Romans (such as clothes, shoes, hairstyles and bodies) and their distribution by social classes.

5.1.7. ATHENA Project. *Theatres Enhancement for New Actualities.* In a similar vein, the ATHENA project is also with ancient theatres, which is now being implemented within Euromed Heritage IV, European Commission. The project aims to create a general strategy for dealing with tangible and intangible heritage aspects, developing a methodology for recognizing ancient theatres as part of a cultural cluster while promoting a wider consciousness in local populations (especially in young generations) about cultural clusters. It also strives to improve the overall level of knowledge concerning the sites, in addition to increasing the sites general relevance and popularity [41].

5.1.8. Foundation of the Hellenic World (FHW). The FHW, based in Greece, is a nonprofit cultural heritage institution working to preserve and disseminate Hellenic culture, historical memory and tradition. Through the creative use of state-of-the-art multimedia and technology, they have taken considerable steps in “edutainment VR.” The organization’s aim is to promote the understanding of the past and to

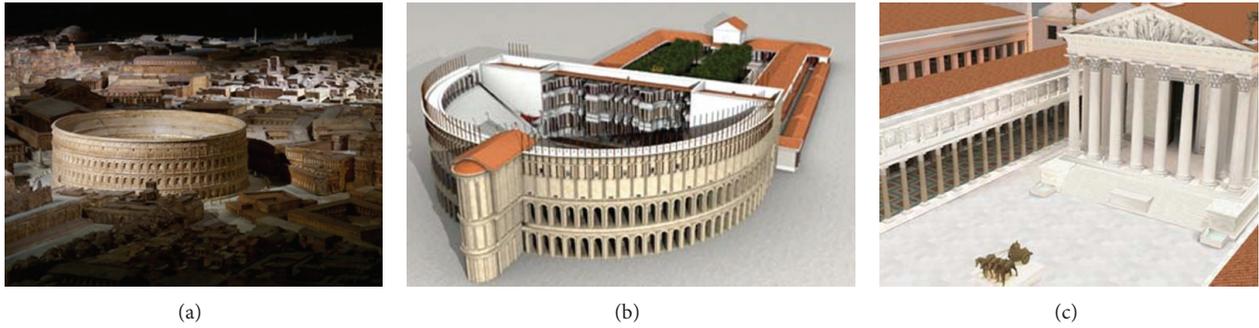


FIGURE 3: 3D models of Rome; the Theatre of Pompey and pumps and the Forum of Augustus (<http://www.unicaen.fr/rome>). The virtual model makes it possible to visualize the hugeness of the complex and achieve a better understanding of the mechanical systems used in theatres in antiquity.

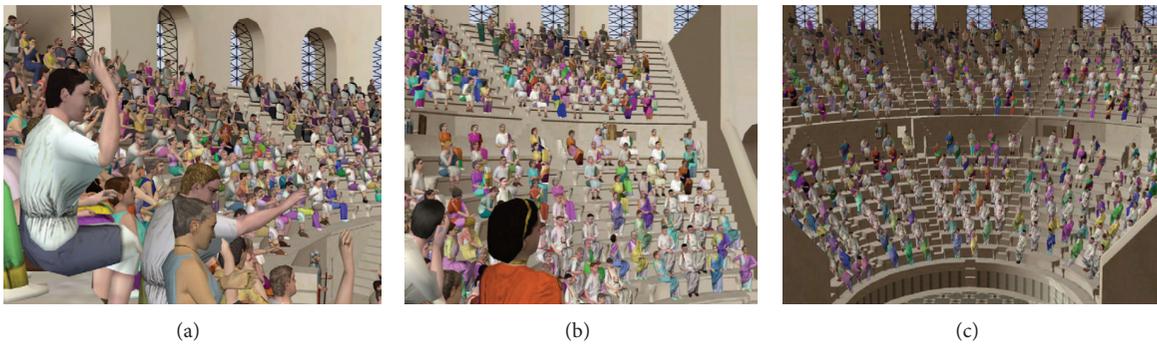


FIGURE 4: Shoots of virtual Roman audience reacting to the theatre play on stage [40].

synthetically, and comprehensively present the history, life and values of the Hellenic world in its broader geographical evolution (Figure 5) [28]. The Foundation itself has created a forum for archaeologists, historians, scientists, and artists to visualize their ideas and utilize the highest level of technology and resources for research and education within the context of Hellenic cultural heritage. The Foundation’s public presence enhances its communication with the wide public, something that constitutes one of its fundamental objectives.

However, institutions of informal education, such as museums, research, and cultural centres, as in the case of (FHW), are now in a better position to make use of such advanced systems and investigate their educational potential while effectively shaping how they deliver public entertainment and education.

Many cultural heritage VR projects present the virtual reality systems, interaction devices and software used at the Foundation of the Hellenic World (FHW) (<http://www.fhw.gr/fhw/index.php?lg=2&state=pages&id=80>).

A particularly interesting project was designed for the Olympic History and Games in virtual reality productions for the Olympic Games in 2004 in Athens. Instead of focusing on only one production, several productions were created as a complementary series, finally concluding in a full-scale interactive representation of ancient Olympia and its Games. Significant effort has been made to recreate the feeling of the games and help the user/spectator to interact with the edutainment activity. This is clear from the creative approach

to interactive edutainment of the project, which is built on the famous Greek sculptor “Feidias” workshop. It is a highly interactive virtual experience that takes place at the construction site of the 15-meter-tall golden ivory statue of Zeus, Figure 6.

The visitors enter the two-story-high workshop and come in sight of an accurate reconstruction of an unfinished version of the famous statue of Zeus and walk among the sculptor’s tools, scaffolding, benches, materials, and moulds used to construct it. The visitors take the role of the sculptor’s assistants and actively help finish the creation of the huge statue, by using virtual tools to apply the necessary materials onto the statue. Interaction is achieved using the navigation wand of the VR system, onto which the various virtual tools are attached [25].

5.1.9. CAHRISMA Project. The work done in the context of the CAHRISMA project aimed to create Hybrid architectural heritage, where not only visual, but also acoustical aspects of the heritage are reconstructed. It integrates a virtual crowd simulation into a real-time photo realistic simulation of complex heritage edifices, where a crowd of virtual humans are able to move and interact within a virtual environment. The user can interact with the crowd, for example, by voice recognition. Another possible extension is the zoom feature which allows users to increase the number of visualized virtual humans [27, Pages 22–24]; [37, Pages 235–240].

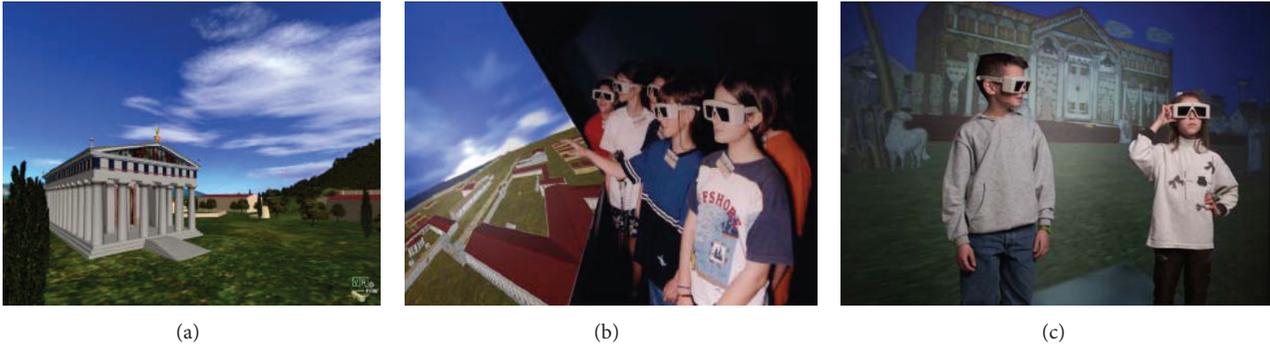


FIGURE 5: Young visitors immersed in the virtual learning environment of the Hellenic cultural heritage through immersive virtual archaeology [28].

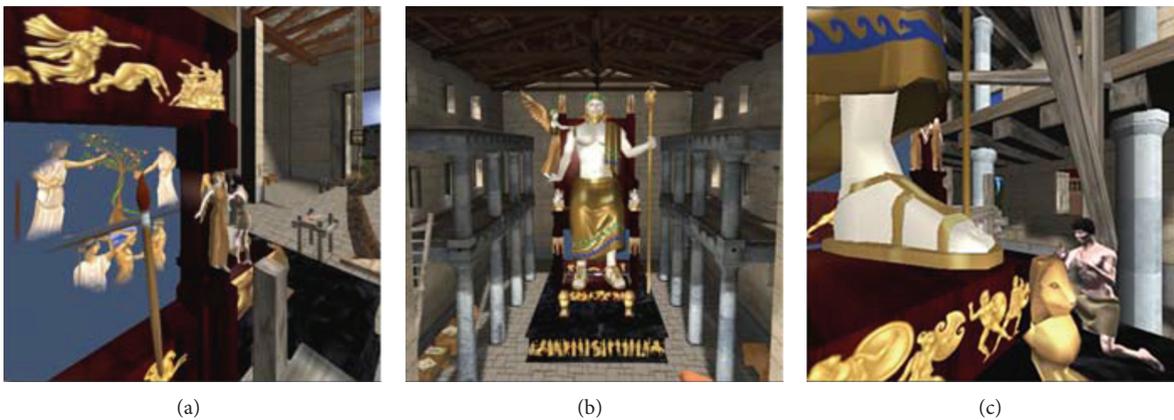


FIGURE 6: *Feidias* Workshop; A creative approach to interactive edutainment [25].

5.1.10. Acropolis Restoration Service (YSMA) Project. This pilot project, inspired by existing educational programmes developed by the Department of Information and Education of the Acropolis Restoration Service (YSMA), explores further possibilities of advanced “physical modeling” of the most celebrated monuments of Western civilization—the Acropolis rock and the Parthenon temple [42, Pages 19–23]. Its aim is to present archaeological science as a contemporary educational instrument that facilitates an exciting and appealing form of historical inquiry for younger audiences. Another important advantage is making essential historical knowledge available and attractive to foreign students. The first stage of the project produced digital and physical models in variety of scales; the second stage focused on creating new educational “games” based on those models. The project is a collaborative work between YSMA and Victoria University of Wellington, New Zealand [43].

5.1.11. Metamuseum. The purpose of the project was to enable experts and visitors to communicate easily. The system provided knowledge exploration, using related information about and among the actual artifacts from several museums [44]. The project used a series of nonimmersive wall-screens at individual viewing stations in the museum. Each viewing station had a terminal with access to the data base. A specialist

could input new data via the project’s network. A visitor could use a PDA as a site guide. The Metamuseum focused more on the functions of the public museum [45].

5.1.12. The Enigma of the Sphinx Project. The user interacts with a game-like interactive “friendliness” and sense of presence virtual reality application. The interface consists of a large projection screen as the main display, a “magic wand”, a stereo sound system and the user’s voice for “casting spells” [46, Pages 106–108].

5.1.13. Jerusalem Temple Mount. The Jerusalem Temple Mount was created as an interactive simulation of the Herodian Mount for the Jerusalem Archaeological Park. The architectural design of the Temple Mount was created in solid modeling and the people in the simulation were authentically dressed static 2D figures from still photos provided courtesy of Archives and Collections, Universal Studios. The simulation is a real-time immersive fly-through visualization on an SGI Onyx2 IR3 [31].

5.1.14. Virtual Notre Dame. Virtual Notre Dame is a reconstruction of the Gothic Notre Dame Cathedral. This work is a nonimmersive, PC based network application using the internet. The realistic architecture rendered by Epic Unreal engine is normally used in creating video games [47].

5.2. *Children TV Series/Programs: The Case of Sesame Workshop.* After surveying the potential uses for multimedia in heritage education, it is interesting to apply some of these concepts to an existing and successful edutainment initiative. Perhaps the most well-known of these efforts is the internationally recognized Sesame Workshop, a nonprofit organization established over four decades ago in more than 150 countries, including many Arab states [48, Pages 103–105]. With the help of a cast of cheerful Muppet characters, the show has been dedicated to addressing children's critical development needs in terms of education, health, and social development. Sesame Workshop methodology has two complementary aspects, the television series and the educational outreach initiative and training.

The conceptual approach of “edutainment” in Sesame Workshop is a response to traditional education systems and represents an attempt to find the new channels to introduce more interactive learning styles. The Sesame Workshop adaptations have successfully integrated multiple cultural educational topics into a single program, or series of programs, thus addressing multiple cultural awareness topics. There are also few explanations of archaeology (what an archaeologist does) and several feature Indiana Jones parodies, in addition to Muppets visiting such historical sites such as the Great Wall in China, Figure 7, and the famous ancient Temples of Kyoto.

Sesame Street's success lies in their skillful weaving of characters and story lines with the delivery of cultural information. Coming in the form of relatable stories, the knowledge is thus a lot more accessible and memorable for children, making them more likely to talk about it or reenact it. Sesame Street has taken advantage of some of the latest technological advancements, with interactive e-games, extremely active social media channels, and mobile applications contributing to a complete educational experience. They have though been conservative in their application of the most cutting edge technology, and have yet to embrace the sort of Augmented Reality Technology that can bring different world to life within Sesame Street.

With the Muppets likeability, and the content-rich material that they provide, there remains significant potential to introduce heritage material using more virtual technologies. For example, the EU funded IST projects [6] are beginning to experiment with animation in an interactive experience, providing a way to truly draw children into different historical worlds within Sesame [49]. Actually, the rapid development of workstations makes it feasible to animate them in real time, which is required for VR Interactive Television, and video games applications. As the combination of artificial life with VR cannot exist without the growing development of computer animation techniques and corresponds to its most advanced concepts and techniques, and as several other works have been dealing with virtual humans in virtual heritage reconstructions, Sesame Street using the Muppet characters could start to invest more in these records projects, as was done by the UNESCO World Heritage Centre and the Archaeology Institute of America's curricula for teachers. Mixing such aesthetic ambiances with mobile virtual life augmentations in realtime, with the addition of compelling story lines and loveable characters, can develop the narrative

patterns into an exciting new edutainment medium [50, Pages 183-184]. Sesame thus would be the perfect platform to begin incorporating more multimedia oriented approaches to heritage education, providing a physically and intellectually accessible channel for cultural exploration.

6. Discussion and Recommendations

The above reported case studies in this review help redress the lack of systematic design research into mainstream computing's ability to enhance informal learning. In general, recent advanced virtual museums can be classified by evaluating their capabilities of interactivity, immersion, and real-time interfaces. From a content perspective, while many museums and media organizations have designed multimedia curriculums for children dealing with cultural heritage, most of these sites and curriculums do not directly discuss the issue of preservation of culture, instead indirectly promoting an interest in the site itself (For instance, the British Museum offers a website for kids about the ancient Greek Olympic Games [51]. The Metropolitan Museum in New York holds lectures and storytelling sessions for kids about medieval history [52]. The Public Broadcasting Service (PBS), a nonprofit television and media organization in the USA, has also used the medium of television to teach children about heritage and supplement elementary school history curriculums. For American teachers has created “The Greeks,” a multimedia site with videos, activities, and other information about all aspects of ancient Greek culture and history [53]. The site offers students interactive tours of ruins, such as the Parthenon, as they are now and images of how they might have looked when ancient Greeks were using them [54]).

General review of the range of projects in the field of Old World archaeology described as virtual heritage, shows numerous examples of virtual environments build as reconstructions of historic sites but sterile and devoid of population. However, beyond tools, we need a standard user-interface that can both run the exact heritage models being made by scholars in increasing numbers and be enhanced by the new tools, which might be added as plug-ins. This might be a high-quality but inexpensive proprietary games engine [55].

However, virtual gaming and TV film industry have shown ways to embrace imagined environments. Indeed an increasing number of fine digital materials are being produced for researchers and educators who want to incorporate heritage and archaeology into multidisciplinary studies. Up to the present, there have been few examples in the field of fully interactive, real-time models that have been published to the Internet. Generally, scholars have only been able to publish articles about their modeling projects with, at most, several color 2D illustrations. This presentation greatly hinders the overall effect of the project, and prevents greater interest and funding from being drawn. 3D models should be used in more effective and creative ways to improve interpretation in museums, and virtual museums, children TV productions, E-games, as well as in the classroom.

On the other hand, the above presented programs and projects illustrate the potentials and scenarios to promote



FIGURE 7: Sesame Street Muppet characters and some heritage TV segments.

cultural heritage and archaeology appreciation among children, as an essential step to the preservation of heritage in the future. We can also reflect on how EM can incorporate play and discovery into childhood heritage evolution, in a way that is fun and developmentally appropriate for young children.

For example, passing through the 3D models created by ERATO project (the 3D visual models of theatres and the animation of the actors and audience included in the virtual reconstructions, modelled in 3D for a visual VR, musical instruments from the Hellenistic and Roman times, and Audible sound demonstrations of virtual performances with high degree of acoustical realism integrated with the visual restorations to form the virtual realizations of performances), and from other similar projects as ATHENA: *Ancient Theatres Enhancement for New Actualities*, they can support many digital children games and activities. But unfortunately, there is no coordination nor thought to further benefit from these many projects.

6.1. The Need for Multidisciplinary Team and Approach. The kind of change which could be accomplished is not clear cut, and it will require a multidisciplinary team to handle the various facets of the change. This multidisciplinary team can assist in producing new ideas for activities and games in EM, with the aim of establishing the required children and family awareness.

On all levels, heritage education requires the expertise of archaeologists, historical architects, educators, creative and art directors, scriptwriters, artists, painters, outreach initiatives, information and communication technologies (ICT) persons, TV, cinema and theatre persons, CRM specialists professional, conservators and cultural heritage institutions.

Methods to teach concepts and make students fully understand novel technologies and put them in practice are always challenging tasks. Reinforcement learning (RL) is one of the methodologies of machine learning and cognitive sciences. All RL methodologies require a balance between the research for new strategies and the use of already acquired knowledge [56, Pages 179-180]. Given the central place of constructivist learning theory and its influence on pedagogy, computer science and heritage persons and educators should pull through the theory, perform research, and analyze their educational proposals in terms of constructivism. Software

and language designers can be guided by constructivist principles, though the individuality of the construction by learners implies that no system will ever be universally easy-to-learn, and educators must learn how to teach these extant artifacts [57, Pages 49–53].

Such approach should include raising licensing standards for also childhood programs providing more family resource and support services and stimulating better collaboration between schools and the other heritage services. For that, community heritage education programs are needed. This while establishing cooperative relationships with heritage specialists, archaeological parks, and heritage centres, and homes is equally important. The concept of programs and campaigns is that, participants can use several tools to map and plot their heritage in combination with multimedia (field survey, drawing, 3D models, photography, script writing, interviews, video, digital illustration, animation, and theatre), then they can continue to interpret and promote it through demonstration, performance, exhibitions and creative documentation, websites games and writing. A collaborative approach between those different players at policy-making level and schools is a must, to support some projects or where specific networks or bodies are set up to promote children cultural heritage education programs and games. In the meantime there is a need to:

- (i) conduct training and specialized workshops that can assist in changing the mindset of educators and teachers and to collaborate with new partners, to develop new resources and to implement new approaches in teaching “outside” the pencil and paper classroom. Online learning, e-commerce, public relations, and museum/collection sites would all benefit from integrating e-collaboration in different ways;
- (ii) plan and develop a pedagogical approach for both the formal and informal cultural heritage education programs for students outside of school, with alternatives methodologies in EM to enhance child interaction with cultural heritage and life in the community and environment;
- (iii) design EM programs and campaigns, to help children’s retrace the lost of their cultural heritage, to deepen their appreciation of cultural assets in their locality and to encourage them to take responsibility

for the conservation and sustainability of their culture. For example, heritage specialist and educators can develop some concepts like “I am a heritage artist,” “I am a heritage scientist.” These programs and campaigns should be implemented with collaboration of archaeologists, CRM specialists’ professional conservators, arts educators, artists, Creative and art directors, community and local societies and cultural heritage institutions. Some suggested topics and themes are: (1) cultural mapping: archaeological sites and architectural heritage. (2) folklore and lifestyle of rural and urban areas. (3) cultural heritage visual, oral, and aural performing and fine arts. (4) scriptural heritage (treatises on architecture, archaeology, aesthetics). (5) pre- and post-independence heritage philosopher and thinkers. (6) mode of transmission.

As a first step, the specialized technician and nontechnical users involved in heritage documentation and interpretation should discuss issues of interactivity in multimedia visualization production system, which can now more easily be achieved by the modern digital photographic and laser scanning technology, and can play a major role in the interpretation of the cultural heritage. However, it should be recognized and accepted that cultural heritage documentation is not only needed for proper conservation, but also foremost to raise public and especially children awareness.

Such investments are effectively useful and vastly improve the diffusion of heritage knowledge. For that, the thousands of documents of 3D models conducted around the world of 3D laser scanning, photogrammetry can be used as the first material in EM to create and design 3D animation for digital heritage children’s edutainment games and activities. However, these games should be designed with the appropriate educational content from multidisciplinary and creative teams together with the childhood and heritage specialists.

As a recommendation, there is a need to design a project based on this critical issue of this section of this study. However, inhabited virtual heritage applications require careful balancing of computational resources between the visualization of environment and the visualization of people. There is also a need to design a special web site in which scholars can circulate and share their models and tool plug-ins. This can also facilitates the generation of historical and archaeological experiences using the techniques of computer animation, while reducing the need to reconstruct the historic sites.

These international examples of the fusion of EM with cultural heritage could be applied in the Arabic world, which is rich with world cultural heritage sites but transversely has lack of heritage awareness programs. These tools also exercise critical and creative thinking skills, where the past can be related to daily life. Explorations of archaeology also have great potential for encouraging children’s investigative skills and inspiring in them a curiosity and appreciation for the our nonrenewable cultural heritage.

7. Summary and Concluding Remarks

Unlike formal education which uses a cognitive approach to impart information, EM projects facilitate affective and

sensory learning, using experiential and participatory methodologies that can help children reconnect in a concrete and creative way to their cultural heritage. Potentially a virtual reality-based heritage experience gives the child the opportunity to feel he is present at significant places and times in the past, using a variety of senses to experience what it would have felt like to be there. Heritage EM, if we make the appropriated plans, can encourage children, parents, even educators to look for, explore and care for the wonders of our cultured heritage.

Virtual Site Museum’s authentic database together with advanced VR technology contributed positively to both research and experience in the classroom and museums. However, For the application of technology to heritage to become a viable historical recreation tool, a combination of technological, economic and creative challenges must be overcome. The 3D models should be used in more creative and effective way to improve interpretation in museums, virtual museums, children TV productions, E-games, as well as in the classroom.

Specialized technicians and nontechnical involved in heritage should discuss the issues of “Heritage interactivity multimedia visualization production system,” which can play a major role in the interpretation of the cultural heritage for children. The thousands of 3D model documents of 3D models like of the 3D laser scanning and photogrammetry should be used not only as tools for preservation and conservation, but also as the initial material in children heritage EM, to create 3D heritage edutainment games and activities, as directed by the multidisciplinary team of archaeologists, historian architects, CRM specialists’, professional conservationists, arts educators, artists, creative & art directors, IT experts, and local arts foundations. In the meantime, there is a need to:

- (i) design more EM projects and campaigns to help young people and children’s retrace the lost of their cultural heritage, to deepen their appreciation of cultural assets in their locality and to encourage them to take social responsibility for the sustainability of their cultural assets and to participate in mapping and documenting their history and cultural assets. These initiatives should rely on local community partnerships, while objects in museum should be used as a resource base for teachers and educators, especially in the Middle East today;
- (ii) establish and develop partnerships between cultural heritage institutions, researchers and digital games companies for archiving 3D documents of 3D digital models of laser scanning and photogrammetry of the world heritage sites, monuments, sculptures and artifacts, with the purpose of using them in EM. They can even share these documents with virtual gaming companies and TV and film industry producers to use them in documentaries, films, and television series;
- (iii) develop an EM pedagogical approach for nonformal heritage education programs. There is a need for alternative EM approaches and methodologies to enhance child interaction with heritage and life in the community and environment. In the meantime, it is

necessary to conduct specialized training workshops to orient educators towards more multidisciplinary collaborations, helping to develop new resources and implement new approaches to arts education;

- (iv) develop a national and regional heritage EM supreme children council to take over planning to coordinate between all children related sectors such as ministries of cultural heritage and education, and civil socio-cultural associations. There is a need to craft a short, medium and long range plan to implement and monitor the national EM strategy, taking into consideration the comprehensive dimension in developing childhood sector and linking it to the national development plans. Promote collaborative approach between the different players at policy-making level as well as in EM and schools to improve heritage education—especially in the middle East countries—to support some projects or where specific networks or bodies are set up to promote heritage education programs.

Conflict of Interests

The author declares that there is no conflict of interests regarding the publication of this paper.

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