MULTIMEDIA AND CULTURAL HERITAGE: A DISCUSSION FOR THE COMMUNITY INVOLVED IN CHILDREN'S EDUTAINMENT AND SERIOUS GAMES IN THE 21ST CENTURY

Naif A. Haddad

Department of Conservation Science, Queen Rania's Faculty of Tourism and Heritage, Hashemite University, Zarqa, Jordan.
naifh@hu.edu.jo

Abstract:

Unfortunately, heritage education and awareness remains largely undervalued, as most efforts rely on in-person experiences in formal cultural institutions. While there have been many virtual applications in the field of heritage edutainment with multimedia technology, there are still not enough to make the required and hoped-for change for the children of the digital natives' generation. However, with the rich resources in 3D imaging and interactive programming already at our disposal, we are well prepared to do so, given a coordinated effort. This paper deals with a key topic that has an importance at the international level: the education of children through the conceptual approach of "edutainment" and "serious games" and particularly focuses on the cultural heritage, considering its tangible and intangible aspects. The paper attempts to clarify, explore and investigate how heritage edutainment multimedia, which bring enjoyment, fun, play and discovery into children's daily lives, can make a significant contribution to their understanding, curiosity and appreciation of the cultural heritage. The paper also proposes some ideas and storylines for project development, especially for a methodological approach to serious games, which if appropriately planned, can be as entertaining as they are intellectually challenging to young children. Taking into consideration that there is a growing body of research on the effectiveness of online serious games as creative learning tools, this can only be achieved by the collaboration of a multidisciplinary pedagogical, technical and creative team, to encourage children and parents to look, explore and care for the wonders of our cultural heritage.

Key words: edutainment multimedia, childhood appreciation, serious games, communication technologies, interactive virtual reality, digital natives.

1. Introduction

21st century knowledge and learning activities need to reflect the experiences of 21st century heritage workers. Children through their participation and involvement with digital technology and gaming are becoming a critical sector in the future survival of their cultural heritage. The new generation, or "digital natives", have "a very different blend of cognitive skills than their predecessors" (Prensky, 2001b).

Oral heritage experiences are common to children everywhere. Heritage is not only a fascinating subject to learn, but also a vivid and real experience. However, without speaking about cultural heritage and "Edutainment Multimedia", we cannot hope to provide the kind of education and schooling needed to carry us safely into the 21st century (Haddad, 2012). Shank and Kosma (2002) in their vision for 21st century education predict a model where schools, homes, the workplace, libraries, museums, and social services integrate education into the fabric of the community. Heeter (1999) emphasized that, we have only begun to realize the potential connectivity possible in a networked world. However, cultural heritage resources are suffering. Unfortunately, heritage education and awareness remain largely undervalued, with most efforts relying on in-person experiences in formal cultural institutions.

On the other hand, the advances in multimedia and communication technologies continue to make the world a smaller place. Digital technology has changed our approach to cultural heritage appreciation, and promises to continue to open new horizons. However, due to digital technology, there is also an increasing gap between the traditional heritage experts (information users, such as curators, conservators, restorers and art historians) and technical experts (information providers) involved in heritage digital multimedia. Although cultural heritage research is increasingly aided by, and dependent on, digital multimedia, 3D heritage tools are still not popular among information users in this field.

New technologies are sometimes difficult to assimilate by the multidisciplinary community involved in the cultural heritage, while the practical aspects which interest information users most are the interface and ease of access to data (Haddad, 2013). Digital photogrammetry and 3D laser scanner technology is playing an important role in the field of culture heritage multimedia. However, the 3D laser scanner is still relatively expensive, needs highly skilled operators, and post-processing and editing are time-consuming if

---

meaningful results are to be obtained.

Gamification and learning design, however, represent a new, complex area of design development in games. In addition, the rapid advances being made in delivering 3D interactivity e-games over the internet let us infer rapid interaction with virtual historic monuments. Prensky (2001a) stated that "learning via digital games is one good way to reach digital natives in their native languages".

Furthermore, virtual reality (VR) software offers considerable promise as a platform for visualization and production, as it is possible to incorporate interactivity, real-time changes between scenes and sounds and a large variety of effects into multimedia products. This can play a major role in children's understanding, appreciation, and interpretation of the cultural heritage.

In order to reach children, however, we must utilize tools they are already familiar with, such as interactive e-games. The generation and reconstruction of historical and archaeological experiences, using computer animation techniques, can also be used to raise public awareness, while it is not always easy to visit historic sites. However, it is important to understand and define the challenges in gaming to fully develop interactive environments for pedagogical and entertainment purposes.

This paper deals with a key topic that has an importance at international level: the education of children through the conceptual approach of "edutainment" and "serious games" and particularly focuses on the cultural heritage, considering its tangible and intangible aspects.

According to Susi et al. (2007, p.2) edutainment refers to "any kind of education that also entertains even though it is usually associated with video games with an educational aim". A Google-search on "edutainment" renders about 4.5 million hits [2016-4-2] and a Google-search on "edutainment multimedia" renders about 357 000 hits [2016-4-2]. However, Van Eck (2006) and Susi et al. (2007, p. 2) considered that the edutainment software was a failure "since it resulted in what has been described as boring games and drill-and-kill learning".

On the other hand, the term serious game, which came into wide use with the emergence of the Serious Games Initiative, covers the same goals as edutainment, and has been described as the use of computer and video games for non-entertainment purposes, and as simulation approaches and/or technologies for primarily non-entertainment purposes (Susi et al., 2007, p.5).

Serious games are described as games aiming to accomplish something more than entertainment, and are considered more a movement than a defined area in itself (Susi et al., 2007, p. 3). Michael and Chen (2006, p. 21) defined serious games as "games that do not have entertainment, enjoyment or fun as their primary purpose", but that extend far beyond teaching facts and route memorization, and instead include all aspects of education, such as teaching, training and informing for all ages. They argued that the main issue is to make players learn something, and, if possible, have fun while doing so. In this respect, Anderson et al. (2009, p.1) stated that the field of serious heritage games concerns itself with recent advances in computer games, real-time computer graphics, virtual and augmented reality and artificial intelligence.

A Google-search on "serious games" renders about 15 million hits [2016-4-2] while in [2007-01-03] it gave about 1.1 million hits (Susi, 2007, p. 2). This means that there is a growing body of research on the effectiveness of online serious games as creative learning tools and interest in them is rapidly spreading.

Serious games have also been given other names, including "immersive learning simulations", game-based learning (GBL), digital game-based learning (DGBL), edugaming and gaming simulations. GBL is described as a branch of serious games that deals with applications that have defined learning outcomes (Miller, 2012).

According to Corti (2006, p.1) GBL (which means more or less the same as serious games) is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills. Furthermore, it has the possibility of improving training activities and initiatives. DGBL, as the latest development in e-learning, is directly linked to GBL, but is restricted to digital games.

According to Prensky (2001b, p. 6), the DGBL form of entertainment has shaped the new generation with preferences and abilities and offers an enormous potential for learning to both children and adults. However, while some distinctions may exist between these, we shall use the term *serious game* for any kind of online game for learning. In the cultural heritage, several projects and many initiatives have already been explored and implemented in the form of serious games (c.f. Anderson et al., 2009; Kontogianni and Georgopoulos, 2015).

The following section attempts to determine the source of children's disengagement in cultural heritage issues, how this situation can be rectified and why it is important. We also address how we can develop methods to promote appreciation, awareness of cultural heritage issues among children.

2. What is the source of children's disengagement from the cultural heritage? Why does it matter and how can it be rectified?

The question is: how can we give children the knowledge and skills to make informed decisions about their cultural heritage? Child development research has provided an increasingly comprehensive knowledge base to explain how young children acquire skills and knowledge and has defined the environmental supports needed to stimulate and sustain development (Bowman, 1994).

Developmental accomplishments and the cultural heritage are bound together, and as a consequence specific behaviours come to be synonymous with development itself. In the 6–10 year-old range, however, children shift from relying on visible racial cues and begin to understand some cultural aspects of ethnicity, such as language, food, ancestry and heritage (Ramsey, 2008).

Children become what they experience. It has long been recognized that teaching children about cultural heritage and archaeology is essential to preserving history (Stone and Molyneaux, 1994; Smardz and Smith, 2000). Now the notion of young children stepping out of the classroom to experience history, art and culture heritage as a living and breathing phenomena in their local environment has become alien to school life. Education has been institutionalized by the creation of organizations and networks to promote arts and cultural education (ACESE, 2009). In recent years, however, there has been a growing emphasis on the need to involve children in heritage issues. Explorations of archaeology, in fact, have great potential for encouraging children's analytical skills and inspiring in them a curiosity and appreciation for cultural heritage issues (Haddad, 2014).

On the other hand, even though there is a plethora of digital tools, instruments and applications that are available in the cultural heritage domain, little attention is paid by governments, ministries and agencies towards educational policies for children. However, recent research and studies have highlighted the pressure for curriculum development in the arts in the 21st century, to include the study of new media (including film, photography and digital arts) and to enable pupils to use information and communication technologies (ICT) as part of the creative process (Haddad, 2012).

In fact, 2D and 3D animations, e-games, web site games, outreach materials and the Muppets hold children's attention. Children's enjoyment and interest in participating in cultural heritage practices can be fostered. This is a basic issue in creating future generations that respect and want to preserve their cultural heritage (Haddad et al., 2012).

According to Prensky (2001b) research on Sesame Street reveals that children do not actually watch television continuously, but in bursts, and strategically distribute their attention between playing with toys and viewing. More analytically, Prensky (2001b, p. 4-5) explains that "They tune in just enough to get the gist and be sure it makes sense. In one key experiment, half the children were shown the program in a room filled with toys. As expected, the group with toys was distracted and watched the show only about 47 percent of the time, as opposed to 87 percent in the group without toys. But when the children were tested on how much of the show they remembered and understood, the scores were exactly the same".

Children spend a considerable portion of their time playing e-games. From the children's own perspective, during their early years, play and learning are not always separate in practice (Einarsdottir et al., 2009; Samuelsson and Carlsson, 2008). This is one of their major forms of recreation because it is available in their mobiles, and can be done indoors or outdoors.

As Plowman and Stephen (2003, p. 160) noted, new technologies may lead to new concepts of playing and learning, especially as new ways are found of conceptualizing ICT, so that the term does not simply denote standard computers. They actually need to be instructed in lessons about the cultural heritage, archaeology and conservation.

By assessing cultural heritage themes with multimedia tools addressing heritage, archaeology and preservation, one can figure out how to promote better awareness and preservation of the cultural heritage among the young. From a quick review of the literature of heritage curricula, television shows, and e-games all over the world, we can see that these materials exist mostly in schools and museums.

However, there are currently a limited number of good e-games for young children that target specific heritage developmental and edutainment needs. Although many serious games make use of heritage buildings, they do not directly discuss how to promote awareness of preserving them. Most of the commercial games do not talk about the sites themselves, but use them as settings to show heroes and villains fighting each other (usually with a lot of blood). Internet games are basically based on vandalism, war destruction and disasters.

While these games teach children fighting tactics, they do not directly address the issues of understanding and appreciating aspects of the cultural heritage.

It is possible to find multimedia tools that directly encourage students to become archaeologists, but without specifying how to learn preservation techniques. For instance, the US National Parks Service (NPS) has a children's archaeology website, that explains how to become an archaeologist and how to start your own dig (NPS, 2016).

The Archaeological Institute of America publishes a magazine for kids, called *Dig*, to promote youth interest in the field. The magazine targets children aged nine to fourteen (Dig, 2013). There are, however, many such other interactive archaeology games online for kids, such as the British Broadcasting Corporation's (BBC) "Dig Deeper," which deals with cultural heritage history (BBC, 2014).The Public Broadcasting Service (PBS) also has a game called "Be an Archaeologist" in which children have to fit together the pieces of a pot from a dig/archaeological excavtion site (PBS, 2000).

In the internet we have only begun to understand the potential role of e-games. There are many useful web-based learning games (see Cobb, 2016) such as "Hidden Objects: Gardens of Time" (RockYou, 2014) in which the child has to try to find hidden objects, or build his own garden. RockYou (2014) and the *Detective Game*, designed for solving some sort of mystery that makes them explore the site like an archaeologist. In the famous Sesame Street, which has been aired for over 40 years, there are precedents for archaeology on the show. It has been dedicated to addressing children's critical development needs, loved by children, respected by educators and trusted by parents (Haddad, 2012). Sesame Street has also included brief discussions of archaeology, and many episodes incorporating holidays in various cultures. One episode explains archaeology as a profession and several feature *Indiana Jones* parodies. For example "The Golden Cabbage of Snuffertiti" and "Ernie and Bert explore an Egyptian Pyramid".
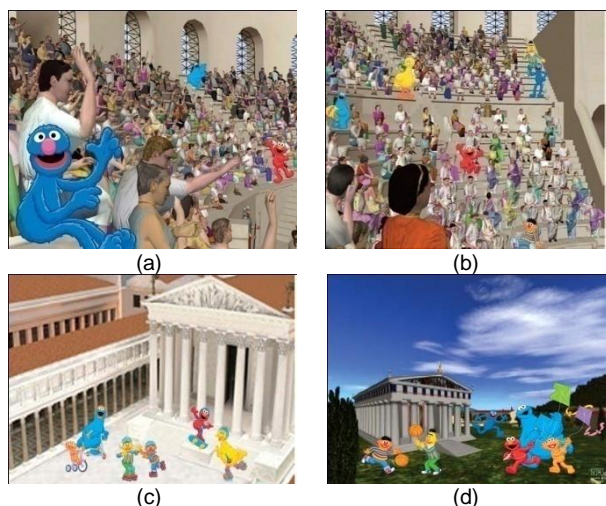
Figure 1: a) and b) Examples of shoots of a virtual Roman audience reacting to a theatre play on stage after inserting Muppets, see Table 1, N° 6. c) Shoot of ancient Rome in Interactive Virtual Reality Project after inserting Muppets, see Table 1, N° 4. d) Shoot from ancient Greek temple after inserting Muppets, see Table 1, N° 7 (After Haddad, 2014, p. 7, fig. 3c, 4 a, b, p.8, fig. 5 a)

There are also episodes featuring holidays and visits to American and international cultural sites. In one episode, Big Bird, a large yellow bird Muppet, sings "Merry Christmas" or "Feliz Navidad" in Spanish, highlighting aspects of Hispanic American culture such as "Christmas Eve on Sesame Street". In one TV special, Big Bird visits China, "Big Bird in China," introducing children to archaeological sites such as the Great Wall. In another episode, "Big Bird in Japan", he visits Japan, showing children the famous temples of Kyoto and the skyscrapers of Tokyo.

Although these projects and programs teach children to understand and appreciate some aspects of the cultural heritage and historical sites, they do not directly address issues of awareness and other problems that our cultural heritage is facing, such as the need for protection, preservation and conservation.

Sesame Street also uses archaeological sites for settings to teach lessons or tell stories, but does not discuss the important role of the archaeologist in the excavation of sites, or even in conservation tasks. Therefore, Sesame Street should feature segments showing children and or the Muppets not only learning about the profession of archaeology, but should also present and explain why it is important to learn basic information on the subject. They could also be given some practical tips.

In fact, by using characters that children already know and learn from, they can offer infinite possibilities as a platform for young children to explore heritage and archaeological themes with the Muppet characters that already entertain and educate them (Fig. 1).

The creation, however, of cultural heritage applications for outreach material in relation to cultural heritage digital edutainment e-games, even virtual reality (VR) systems is a learning process full of challenges. Children's TV programs should also design and produce either monographic heritage websites or serious games, dealing with a more efficient use and management of the cultural heritage.

Heritage and archaeological themes and objects could be used more efficiently to teach children some of the principles of other social and physical sciences. Therefore, there is a need:

To address critical topics and to identify the most effective promotion messages and sellable features of cultural heritage resources.

To include more themes with the Muppets not only concerning archaeology but also for cultural heritage conservation and preservation issues, explaining why it is important.

To suggest new ways of promoting cultural heritage appreciation in order to increase empathy among young children in the future using the different multimedia resources, for example, Sesame Street outreach material with some modifications could be used as the basis for serious games.

To seek for new and more creative and attractive content to teach children more about the cultural heritage, archaeology and conservation issues, by arranging regular workshops for both pedagogical and gamestorming specialists.

Virtual heritage and archaeology now play a significant role in exploring issues that involve the creation of immersive cultural heritage projects that enhance our perspective and understanding of the environments in which our ancestors lived and worked.

Therefore, well-designed, age–appropriate, and culturally sensitive educational activities with or without serious games during the early childhood years, must be provided to facilitate positive interaction with the greater environment, and foster learning of an array of social, emotional and basic cognitive skills (Haddad et al., 2012). According to Froschauer et al. (2012), games have the power to create this kind of long-time knowledge by connecting the learning content with meaningful actions. Rob Fahey, former editor of Games Industry.biz argued in a recent online piece that "it is inevitable: soon we will all be gamers" (Cobb, 2015).

However, in order to increase children's interest in these issues, it is essential to use the potentiality of digital multimedia tools. VR hardware and software can play a major role for the creation of a number of educational and cultural heritage programs targeted at the widest possible audience on many levels (Gaitatzes et al., 2000).

By mobilizing multimedia as a tool to expose children to the values and achievements of the cultural heritage, appropriate serious games and activities also can help children to gain positive social skills. This is a requisite to appreciate the diverse world cultures in which they live. For this, appropriate heritage games can play a considerable role in:

Engaging children in observing the wonders of our cultural heritage world, which can lead to valuable and significant lessons for families, friends and educators that can help in life to explore, learn and foster appreciation of heritage and preservation issues.

Teaching children about cultural heritage and that their heritage can help them to promote a sense of appreciation and development of a national identity and

a sense of national and personal pride, with acceptance of other people and cultures.

Finally, from a general review of projects in the field of ancient cultural heritage and archaeology, the virtual heritage branch is used to create virtual environments built as reconstructions of historic sites, but with only a few examples of fully interactive projects published on the Internet.

Table 1 summarizes some of the most important and characteristic cultural heritage projects that have played a major role in children's heritage multimedia. These examples dealing with virtual museums and VR environments can fit children's interest. For example, the Virtual Museum Transnational Network (2011) attempted to bridge technological domains, archival, social and cognitive sciences to advance the state-of-the-art of digital preservation for virtual museums and future persistence.

Table 1: Summary of the main conducted VR heritage projects

N	Project name	Project Summary
1	Lifeplus project	Revival of life in frescos from ancient Pompeii and creation of narrative spaces. which explores the potential of augmented reality (AR) so that users can experience a high degree of realistic inter-active immersion
2	Northwest Palace of Ashurnasirpal	Digital model of the Palace with VRML interaction, and animation.
3	The Battle of the Ancient City of Syracuse	"E-interface" project with multi-player game represents a virtual recreation of the siege by the sea.
4	Ancient Rome in Interactive Virtual Reality Project	A fully interactive model of ancient Rome includes both its architecture and the machinery systems.
5	Shared Miletus.	A full-body immersion remotely using high speed telecommunication.
6	ERATO Project	Designed to identify virtual restoration and the revival of the acoustical and architectural heritage.
7	Foundation of the Hellenic World (FHW)	Created many Edutainment VR for the life and values of the Hellenic world (Olympic History and Games).
8	Virtual Museum Translational Network	EU FP7-funded Network of Excellence that aims to provide the heritage sector with the tools and support to develop Virtual Museums that are educational, enjoyable, long-lasting and easy to maintain
9	CAHRISMA Project	Created Hybrid architectural heritage, visual and acoustical heritage aspects
10	Acropolis Restoration Service (YSMA) Project	Advanced "physical modelling" of the Parthenon, with educational "games" based on those models
11	Metamuseum	Focused on the functions of the public museum for easy communication
12	The Enigma of the Sphinx Project	The user interacts with a game-like interactive "friendliness" and sense of presence virtual reality application.
13	Jerusalem Temple Mount	An interactive simulation , real-time immersive fly-through visualization
14	Virtual Notre Dame	A non immersive, PC based network application using the internet.
15	"Giotto's colours" in the Upper Basilica of St. Francis of Assisi	Characters are animated and represented while performing the action painted by the artist. Visitors can interact within the virtual space and mix with the characters without the support of traditional interfaces
16	The Roma Nova project	A "serious game" taking place in a replica of the ancient city of Rome.
17	The online learning game ThIATRO	Immerses the player into an exhibition and helps students learn about art history. ThIATRO exclusively deals with 2D artworks (paintings). For future work, it will be interesting to integrate 3D artworks (like sculptures or architecture) in the game and thus fully exploit the possibilities of the 3D virtual environment.
18	The Thermopylae project	Investigation on the fusion of techniques used in videogames, virtual reality and the entertainment industry for telling the story of a historic event in an educational and attractive way. The project combines 3D computer generated imagery (CGI) and interactive games by dividing the experience in two parts.
19	The Rome Reborn Serious Game project	The main aim of this educational project is to produce a high resolution version of a detailed three-dimensional model of Ancient Rome. The virtual characters teach the player about different aspects of life. There is a 'mashup' application with 'Google Earth'.
20	Virtual Egyptian Temple	The aim of the game is to explore the model and gather enough information to answer the questions asked by the pedagogical agent (priest).
21	The Parthenon Project	The project goals were to create a virtual version of the Parthenon and its separate sculptural elements so that they could be reunited in a virtual representation.
22	Ancient Pompeii project	The main goal of this project was to simulate a crowd of virtual Romans exhibiting realistic behaviour in a reconstructed district of Pompeii.

Interestingly, every year the Virtual Museum Transnational Network organizes a Virtual Heritage Schools Program that includes one international school and five national schools (Virtual Museum Transnational Network, 2011). However, the list presented in Table 1 can be definitely extended with more examples from all over the world.

3. Discussion and recommendations

As mentioned above, this paper aims at improving the awareness of institutions, curators and producers about the importance of such a digital multimedia technology, which is needed in order to let children have a more active role in the enjoyment and appreciation of the cultural heritage and prepare them to adopt future actions of preservation and protection.

Digital technology is revolutionizing the ways in which we are communicating with each other and perceiving the environment around us. Currently, there is a great variety of ways in exhibiting and disseminating cultural heritage assets all around the word.

Gamification and learning in children's environments are closely related and serious games are a rapidly growing industry. There are well-known examples of serious games (e.g. Reach for the Sun, DragonBox, Twelve a Dozen). Serious games allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc., but they are also claimed to have positive impacts on the players' development of a number of different skills (Susi, 2007, p. 1).Thus, they provide a great opportunity for children to understand the cultural heritage. Institutions of informal education, such as museums, research and cultural centres, 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. Curators can exploit the digital counterparts to design exhibitions and disseminate cultural knowledge to a wide public. Creative industries and small medium enterprises can build new services promoting cultural heritage worldwide.

The conceptual approach to children's edutainment can take advantage of the powerful digital multimedia, mobile and gaming industry to inspire young children to learn more about the cultural heritage, antiquities and conservation issues. Prensky (2001b, p.5) considered that learning games were only 50% educational, but if we could get kids to play them for six hours over a weekend, we would effectively add a day a week to their schooling! Six hours is far less than a digital native would typically spend over a weekend watching TV and playing videogames.

However, for digital children, the typical traditional approach of introducing the local arts and crafts that have existed in their environment (e.g., pottery, mosaic, sand-bottles, glass-work etc.), is not sufficient to understand and share with them the dangers facing our cultural heritage. Children's game experiences are the most important part of their daily life, whether there are playing a casual game on their mobile phone and computer or playing by themselves.

The potentiality for the growth of the serious games industry is promising. By keeping the entertainment feature of the game experience, learning designers can make an important contribution to the design teams. This can be achieved by organizing games that focus on changing, in a predefined way, the beliefs, skills, and/or behaviours of those who play the game (Derryberry, 2007, p. 4).

One of the solid examples and innovative projects is the "Giotto's colours" in the Upper Basilica of St. Francis of Assisi. This example is the model needed for creating a virtual environment as seen from the scene "The Rule Confirmation", fresco painted by Giotto. The scene has been represented in 3D, starting from an accurate study of Giotto's space, characters, proportions and the models have been mapped using the original painting. Two VR installations were created: in the first it is possible to virtually enter into the fresco. The primary objective of this experiment was to involve the observer in the scene painted by Giotto and to enable the visitor to feel and understand the message that Giotto was communicating (Pietroni and Antinucci, 2010).

The innovative Roma Nova project (Petridis, 2016) aimed at teaching history to young audiences by means of an engaging experience in which the player is immersed in a crowd of virtual Romans in a dialogic interaction. There are 12 engaging dialogues and a hypertext database of more than 100 learning objects to learn about citizenship and life in ancient Rome (Petridis, 2016). However, the online playful approach learning game ThIATRO not only increases the motivation to learn, but also raises the interest in art history and cultural heritage in general. Its evaluation showed that ThIATRO changes its players' aesthetic responses, allowing them to perceive art on a deeper level (Froschauer et al., 2012, p. 290).

A very useful serious game example is the multiple language on-line game "Stop Disasters!", a disaster simulation game from the UN/ISDR (International Strategy for Disaster Reduction), which aims at teaching children how to build safer villages and cities against disasters. Interestingly enough, children can learn how the location and the construction materials of houses can make a difference when disasters strike and how early warning systems, evacuation plans and education can save lives (ISDR, 2012)).

This game's technological concept and approach has the potential, as a useful and well structured case, to be transformed and used for the creation of analogous cultural heritage games.

In fact, there is a need to involve new trends in ICT technology to present the achievements of our cultural heritage legacy, and how this legacy knowledge was obtained from different areas. The thousands of 3D documents and 3D models from accurate photogrammetric and 3D laser scanning/LiDAR approaches might be used as tools for preservation and conservation at a professional level. They could also be used as the initial raw material for children's heritage edutainment themes to create 3D heritage edutainment serious games and related learning activities.

Another application is to use the 3D models, reconstructions and archives to serve as virtual tours for tourism. In order to make the final result more realistic

and close to reality, the realistic 3D textured models produced by different photogrammetric methods might be useful tools for the creation of serious game applications (Kontogianni and Georgopoulos, 2015, p. 249).

In this field, several actors need to be involved; it should be directed by a multidisciplinary team of both learning and game design expertise, archaeologists, art historians, architects, heritage experts, cultural resource management (CRM) specialists', professional conservationists, photogrammetrists, VR/AR reality and ancient technology surveyors, art educators, artists, art directors, IT experts and local arts foundations (Haddad, 2012, 2014).

Heritage multimedia and serious games, if we make the appropriated plans, can encourage children, parents, even educators to look for, explore and care for the wonders of our cultural heritage. Serious games, however, are a perfect multimedia tool to introduce young children to different aspects and themes of cultural heritage, archaeology and also conservation issues. Interactive tours and games (Thomas et al., 2000) can be a good tool to help children understand many cultural heritage issues and the possibility of creating an interactive tour on a website can teach children to be sensitive and positive to the significance of our cultural heritage (Haddad, 2012; Papagiannakis et al., 2005; Ben-Ari, 2001). Serious games represent a high-quality model of children's edutainment multimedia and serve as the pilot for additional information that can help to foster understanding and respect for the cultural heritage.

There is thus a need for the generation of virtual scenes and mixed reality methods (such as CH plug-ins) that enrich the captured 2D/3D data with additional knowledge and virtual objects. Taking into consideration that a number of technologies are on the horizon that will provide an even more immersive environment than is possible today, such as Haptic computing, which adds the sense of touch to the simulated or virtual environment (Derryberry, 2007, p.13), so if we address and define a wide range of educational objectives, these serious games are a dynamic tool to present critical learning opportunities for young children, and can serve as a positive model of how heritage multimedia can be used to foster educational cultural heritage, archaeology and conservation aims. This approach can also have a fundamental impact on society because it allows users to develop a sense of national and personal pride and the acceptance of other peoples and cultures.

However, we need to ask, does this have an impact on the transfer of new skills from the serious game environment to the real world? Serious games should be designed with appropriate educational content from multidisciplinary and creative teams to infuse their full role as places of cultural and artistic creation, shared enjoyment and emotional needs. This can assist in producing new ideas for heritage edutainment multimedia, with the aim of establishing the necessary children and family awareness and care for the significant and unique heritage legacy.

However, arts and cultural heritage education is a communication process and is based not only on the joyful and intense engagement with artwork or cultural artefacts, but also with cultural values and symbolic systems (Haddad, 2012). "Kid's don't like to practice. Games capture their attention and make it happen. And of course they must be practicing the right things, so design is important" (Prensky, 2001b, p. 6). Developing an interest in heritage, however, requires a redefinition of the *recipient* and *mediator* guidelines, taking into consideration the radical changes opened by edutainment multimedia. In addition, an analysis of constructivism in Computer Science education (CSE) leads to the following conclusions: (a) *models* must be explicitly taught; (b) *models* must be taught before abstractions; and (c) the seductive reality of the computer must not be allowed to supplant construction of *models* (Ben -Ari, 2001).

To reach the digital native generation through the application of technology to heritage, to become a viable historical recreation tool, a common project lexicon, and support and to promote access to and reuse of digital cultural heritage resources, we should consider and seriously deal with the following issues:

- For successfully developing and deploying serious gaming capabilities to real-life strategic business decision-making, there is a need to bring cultural content to new audiences in novel ways. We have to face a combination of technological, economic and creative challenges. 3D models should be used in more effective and creative ways to improve interpretation in museums, and virtual museums, children TV productions, serious games, as well as in the classroom. To address the gap between ICT approaches in cultural heritage knowledge assets and the social impact over them, and 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 achieving heritage education. This requires sustained interactive access to these cultural objects (Addison, 2000), with the time for children to play through the new knowledge.

- To make better strategy decisions for defining the essential components of games for learning and change, we should emphasize the wonder and imagination of socio-cultural scope, rather than focusing only on the 3D model detail. With and for children we should develop cultural heritage awareness material; by using a spirit of enquiry, wonder and imagination that is stimulated and sustained, where cultural heritage and archaeology should be used as tool not only to exercise skills in making children think, but also how the past can be related to daily life. For this we must include a plan in learning designs for learning transference from the game back to the greater learning plan or to the workplace (Derryberry, 2007),

- As many large business companies already use some sort of gamification or serious games in Europe, there is a need to design standards for gaming design principles and protocols for the edutainment multimedia programs and campaigns to help young people and children retrace their lost cultural heritage, to deepen their appreciation of cultural assets. 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 such as Wario Ware and Mario Party 3-4, which are focused on the playful side (Roussou and Efraimoglou, 1999). There is a need, though, for defining guidelines for the role of the digital multimedia in children's cultural heritage edutainment enhancement.

Given the need for defining guidelines about the role of multimedia in children's cultural heritage enhancement for sustained engagement, the highly entertaining digital tools of serious games and virtual realities are particularly important; they will allow the child to absorb far more than the traditionally directed methods (Haddad, 2014). However, to clarify in more detail what kind of improvements are needed in advanced storytelling techniques or in the interaction to meet children's needs, there is still a lack of conducted evaluations and monitoring studies from specialists in multimedia edutainment about the effects and results of the existing children's multimedia cultural heritage material. These still lack research on how novel ubiquitous computing can be developed and deployed for serious heritage games, and augment the museum educational experience for children by using and redefining social structure with games. The final aim is the introduction of a visualization interface that allows the creation of personalized services to different types of users, including children, citizens, curators, researchers and creative industries.

In order to promote an interest in caring for the cultural heritage environment, these guidelines should consider the following issues:

- Review and evaluation of different cases of curricula to investigate what is being taught to children about cultural heritage and how it is being approached. There is an urgent need to investigate through group research what children absorb and their prevailing views and then draw conclusions that may affect their perceptions and feelings about themselves, their history and heritage and other individuals and groups in addition to evaluating what aspects are being taught in the National Curricula for the early years, and suggest what should be included to make it more valuable to children. This will assist in deciding how and where to introduce and present cultural heritage elements to children according to their age (4-7, 7-10 and 10- 12).

- To fulfil the mission of preparing children to become successful 21st century learners and citizens, and in order to create new creative industry heritage market opportunities, there is a need for establishing collaborations among researchers, educators, game developers, policy makers and publishers to further the use of games to help the education sector.

- There is a need for assessment of online cultural heritage learning; traditional and cultural heritage serious games, cultural heritage virtual reality, TV programs, outreach material, and community cultural heritage educational and entertainment programs. However, learning designers and game designers must collaborate to supply a good number of engaging and effective learning creative experience edutainment games and to seek for a simple classification for scripting systems used in serious games for entertainment and serious purposes.

- A partnership between cultural heritage institutions, researchers and digital games companies for collecting, serving and archiving all over the world 3D documents, digital models from 3D laser scanning and/or photogrammetry of World Heritage sites, monuments, sculptures and artefacts, with the purpose of using them in edutainment multimedia. These documents could be sold to virtual gaming companies, TV and film industry producers for use in TV documentaries and children's programs. However, new interoperable metadata formats that permit easy repository, archiving and harvesting of both tangible and intangible cultural heritage assets should be taken into consideration. The multidisciplinary team should ask and answer the following questions:

- How do we set group goals, and how do we expose children to different styles of the various cultural heritage forms as a form of personal expression? And how do we encourage them to identify, explore, discuss and appreciate different forms of heritage, heritage instruments and tools? What makes a game effective from a learning perspective? What elements lead to learning and what elements detract from learning?

- How can we help and encourage children to develop and create their own visual cultural arts and serious games, especially with the aid of computers through the existing website material (e.g., drawing, painting, collage, sculpture, construction), and to develop such concepts as "I am a HERITAGE artist," "I am a HERITAGE scientist", and "I am a HERITAGE Conservator"?

- How can we help and encourage children to know, observe and participate in cultural heritage events, festivals with friends and peers in schools, home, and social gatherings?

4. Suggested methodology, storylines for serious games project development and their potential content

As mentioned, in order to expand public and children's use of the developed 3D digital achievements, reaching the 21st century's digital native children requires a re-imagination of the conventional educational technological pedagogy, accounting for their changing interactions with the world around them. In working to truly preserve heritage sites, projects must address the youngest cultural citizens, developing in them a deeply ingrained appreciation of heritage. Institutions and pioneer companies, which are today exponentially more powerful and sophisticated than before, should seek to develop interactive heritage games for children operating on both web and mobile phone platforms.

It should be emphasized that edutainment heritage games scenarios/storylines do not necessarily have to be directly concerned with heritage subject matter, but they must deal and respect with what can be termed as the 3Cs (Content, Concept and Creativity).

Game-based learning such as new research in pedagogy is advancing rapidly. "Games, by their nature, combine content and experience, providing a context in which content is put into action" (Cobb, 2015). In fact

children can learn to mind, care and save the world cultural heritage by playing games. According to Prensky (2001b, p. 5-6), "The trick, though, is to make the learning games compelling enough to actually be used in their place. They must be real games, not just drill with eye-candy, combined creatively with real content". However, human aspects must have equal weight with the technical aspects in the subjects represented through all stages of the game vision and in the game design process.

The following are just some methodological guidelines that are suggested together with examples of story lines specifically conceived for children. The integration of ICT technology (such as photogrammetry, laser scanning, 3D reconstruction, computer vision and virtual reality) and educational programs, TV and serious game industries is recommended to promote initiatives outside schools in social and family contexts.

However, for transmitting to future digital native generations the means by which we can interact with cultural heritage and to address such issues, we recommend three main phases; the theoretical phase, the practical phase and the productive phase.

The first, theoretical phase, is to develop a general framework, under a socio-cultural scope for identifying the "learning" elements in serious games, in order to define what cultural heritage is and when, how and where it was used by tracing the related evolution of culture over the early years of human existence and how these were evolved in time and how the integration and co-existence of different cultures and civilizations can stimulate a level of humanism and technological process.

All the reasons for the development and adoption of cultural heritage resources, either social and cultural or economical and functional, should be examined. To do so, many questions should be addressed, including what the ancients cultures knew, when and how they knew it; what machines and tools they used and for what purposes? Also, how do cultural heritage resources help society advance and how can we apply these principles to our world and to the future?

Secondly, the practical phase is to focus on specific and interesting examples, using archaeological and textual evidence such as experimentation and analysis of how the ancient cultures built these amazing things! In addition to investigating the available means of production identification of the final topics/ themes to be derived, after group discussion in special workshops with museums, institutions and public.

Discussion points should include the heritage item's original purpose; whether they survived up till now; if lost, discuss why it went out of use and whether it would be useful to reinstate its use today; its impact on society and if modern society is affected by it and what we can learn from it today.

It is also linked to exploiting the recent ICT tools to reuse and interpret cultural heritage, given the importance of social aspects of gaming to learning experiences and pedagogical practice. By incorporating some aspects of social networking and other Web 2.0+ technologies into serious game designs, we can enhance learner-adoption by today's workforce. According to Derryberry (2007, p.

15), "developing and deploying serious game using industry-standard tools, such as those offered by Adobe, will promote sweeping adoption by users".

Finally, the productive phase is to create 2D and 3D animation models in order to exhibit and demonstrate the cultural heritage to the public in a fun immersive way through serious games, also to preserve accumulated knowledge in a user-friendly way, engagement in games, and engaging storylines that foster learning. This phase requires the selection of specific cultural themes in order to create 2D and 3D animation models showing the results of the previous phases. These should be used to exhibit and demonstrate to children and the public models and 3D animation of these systems in serious games, museums and on the web.

There is an urgent need to organize more games, learning, and society conferences to bring together academics, designers and educators to discuss how serious game technologies can enhance learning, cultural heritage education and conservation, such as the glsconference.org, where the main aim was "to prevent the issues of learning and the social role of games from getting lost in the cause of industry-building" (Susi, 2007, Appendix A).

Thus, in endeavouring to secure the cultural legacy, we should create stunningly accurate models with captivating creative storylines and loveable characters, creating a basket of tools that are as educational as they are entertaining. According to Prensky (2001a), serious games should be fun first and then should encourage learning. The solid experience of Sesame Street and research shows that fun is the key form of entertainment to engage kids and players in a game. However, besides fun, there are several other elements that add to the kids and players' engagement.

When game design focuses on learning outcomes, then, while preserving playfulness, serious learning is possible (Derryberry, 2007, p. 5). "There is a great deal of evidence that children's learning games that are well designed do produce learning, and lots of it — by and while engaging kids" (Prensky, 2001b, p. 3). As a result, dissemination of the cultural heritage to the public and especially to children will be efficiently performed.

On the other hand, there is a need to understand the principles behind ingenuity and cultural heritage in order to better understand digital technology and apply these principles to our world in the future. Below we give a concise vision of some suggestions for project development, as well as their potential content.

Firstly, in designing these programs, the community involved in children heritage edutainment multimedia must first establish pupil's educational deficits and curiosities. A special research team should investigate the current curricular assets, the teacher's favoured teaching method and the student's knowledge of the heritage. Simultaneously, we have to explore the entertainment value and informational e-content of the most popular adventure and education through serious games, drawing up a scheme of the market and its most successful products.

Secondly, based on these findings, a creative team should go through some rounds of development, fitted around sessions of programming products and

consumer testing for each serious game. This process will ensure that each program delivered is rich in educational content but also commercially viable for a broad international market (a feature missing amongst most 'educational' games).

Initial projects in edutainment can lead to preliminarily design of the games, spanning children's different interests and levels of development. Each game can be built with designated learning outcomes in mind, which can cover the 4-7 age brackets and the 8-13 age brackets. Collectively they can introduce children to digestible bites of world history, anthropology, and architecture, ancient technology, conservation and preservation, exciting future generations about some of the world's greatest cultural treasures.

For example, beginning with 4 to 7 year-old children, *Treasure Map* can introduce concepts of shape, color, and number, while allowing children to explore the fundamental elements of architecture, archaeology and ancient technology. As burgeoning archaeologists, young players have to uncover different artefacts and ancient architectural building details throughout several of the most well preserved heritage sites. Using either a marked map or following the voice of a friendly mythological, or historical character children can be guided through the historical structures and buildings, even archaeological excavations, and asked to find items by their colour, shape, and number.

They can wander freely throughout each 'level,' moving on to the next only after they have taken pictures of all of the pieces for their personal museums. Children can also boost their literacy skills such as in the interactive *Temple in the Clouds*, an animated storybook which winds through one of the ancient world's incredible monuments. The story follows a young baker's daughter as she makes her deliveries, in which she learns about the city's history and its many colourful characters. Each page has a text which lights up as the main character narrates the tale, and children can either follow this or read themselves. The book's illustrations are customizable, and children can move the characters around the scene to 'draw' their own image of the story, creating a personalized tour of the structure. They can then either record the movements and play them back, or watch the pre-recorded scene. They can also provide rewarding aesthetic and learning experiences that would otherwise be difficult to obtain.

In the case of the 8-13 age group, for example, they can be treated to the task-based building serious game "*Stone's Without Borders*", as experienced from the perspective of world famous builders and architects (Amenhotep, Daedalus, Nimrod, Iktinos and Kallikrates, Vitruvius, Apollodorus of Damascus, Anthemius and Isidore ,Sinan, Brunelleschi, Michelangelo, Palladio, Christopher Wren, Antoni Gaudí, etc.) and the wise owl *Athena*. The young architect will be summoned through time to build some of history's most magnificent masterpieces.

Each mission will introduce players to different historical periods and civilizations, while acquainting them with their common architectural, artistic elements, building techniques and methods. Some very demanding historical and mythological characters and a number of unexpected natural and anthropogenic disasters (even the occasional invasion) will keep the young builders, architects and conservators on their toes, and test their critical thinking and problem solving skills and creativity. Thankfully, the trusty *Athena* is always ready with fun facts and figures, allowing players to complete their projects on time while learning about the period's daily life. When it is time for the royal opening, players will be evaluated on their structure's design and budget, and awarded gold coins accordingly. With enough expertise and money, the young architects, artists and conservators can begin to design and create their own monuments and structures and join the ranks of the Imperial greats.

Another suggested idea is entering the dark world of smuggling and tomb raiding, children of 8-13 for example can solve the mysteries of missing artefacts in the "*Friends of Monuments*". The burgeoning secret agents must track the vandals' movements through modern day heritage sites, following various clues which introduce them to the structure's architecture, historical uses, and how it should be restored and preserved. Each detail will bring them closer to finding the answers to the crime, while developing their critical thinking and skills of deductive reasoning. Their adventures will also put them in contact with a host of loveable characters, including some infamous tourists and their blustering central command officer. Players are awarded small treasures as a reward for their services, which they can collect or trade with their friends.

4. Conclusions

This paper describes the existing state-of-the art initiatives in Europe and the USA and comments on the main results achieved by TV programs, serious games and Muppet animations. It examines why and how children should understand the significance of the cultural heritage according to the achievements of our digital age and its need for protection and preserving.

The gaming phenomenon has grown in recent years due to the development of 3D environments. Heritage video and e-games and edutainment multimedia offer a radical solution that can make a significant contribution to children's understanding, appreciation and care for the cultural heritage. It is the main medium they are familiar with and really enjoy. We can and must do more in this area, including measures that allow producers to reduce the cost of serious games.

However, it should be emphasized that serious edutainment game scenarios/storylines do not necessarily have to be directly concerned with strongly heritage subject matter, but they must deal and respect what can be termed as the 3Cs (Content, Concept and Creativity). What is needed is that virtual heritage applications should put more emphasis on the theoretical approach to educational goals and create an engaging storyline, besides the technological aspects such as graphics, hardware or interface.

Nowadays advances in computer hardware and sophisticated 3D modelling packages allow users to create compelling visualizations of static objects. Photometric stereo can exploit light reflection properties for 3D modelling. However, research in VR and archaeology has shown considerable growth in recent years. New forms of cultural experiences and services,

(new CH plug-ins) enriched with virtual surrogates through the use of advanced mixed and AR-enabled technologies and allow the re-use of technological assets in real application environments.

The rapid development of workstations makes it feasible to animate them in real time, as required for VR, interactive TV and video game applications. Taking into consideration the social features of both engagement and learning, 3D models should be used more effectively to improve interpretation in real museums, virtual museums, serious games, children's TV productions, as well as in the classroom.

In fact, we are only at the beginning of the rapid evolution of serious heritage games technology. A growing number of projects are currently based on AR integrated platforms, exploring a variety of applications in different domains of the cultural heritage. The thousands of documents of 3D laser scanning and photogrammetry models from around the world should be used as raw material in edutainment multimedia to create and design 3D animation for serious digital heritage games and activities. The already digitalized cultural heritage content can be used to create educational scenarios that should be properly categorized, indexed, edited and rated for further use and thus create a large-scale database of historical and cultural content,.

However, learning designers are key in heritage gamification; games as a learning methodology in our virtual world should be designed with the appropriate educational content from multidisciplinary and creative teams together by educational and heritage specialists. Therefore, to bring creative serious games ideas into action as a mission to learn, learning designers, game designers and gamestorming teams must collaborate to provide a good number of engaging and effective learning games. In addition, we must seek for a simple classification for the scripting systems used in serious games for entertainment and serious purposes.

A certain degree of collaboration between the different players at the policy-making level and schools is a must. However, institutional support is also needed to control any alternative that might emerge in the content and creativity of these games.

There is now a need to plan and develop a creative pedagogical approach for non-formal cultural heritage edutainment programs for students outside schools, with alternative methodologies in edutainment multimedia, in which the end users can virtually utilize the tools in a close-to-reality environment, to increase the digital native generation's interest in their culture and history.

This would encourage children to care for the future of their cultural heritage. The two main components of heritage multimedia "education and entertainment"—which have profound implications for learning and are almost totally ignored by many educators —should therefore be re-discussed, re-assessed, developed and totally integrated together.

Acknowledgments

References

Addison, A. C. (2000). Emerging trends in virtual heritage. *IEEE Multimedia*, *7*(2), 22–25. http://doi.org/10.1109/93.848421

Anderson, E. F., Mcloughlin, L., Liarokapis, F., Peters, C., Petridis, P., & De Freitas, S. (2009). Serious games in cultural heritage In M. Ashley & F. Liarokapis (Eds.), *10th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST*. http://www.coventry.ac.uk/ec/~eikea/docs/vast2009.pdf

Arts and cultural education at school in Europe (ACESE). (2009). European Commission, published by the Education, Audiovisual and Culture Executive Agency (EACEA P9 Eurydice), Available: http://eacea.ec.europa.eu/education/eurydice/documents/thematic reports/113EN.pdf

Ben-Ari, M. (2001). Constructivism in Computer Science Education. *Journal of Computers in Mathematics and Science Teaching*, *20*(1), 45-73.

Bowman, B. T. (1994). *Cultural Diversity and Academic Achievemen.* NCREL's Urban Education Program as part of its Urban Education Monograph Series. Retrieved September 22, 2015, from http://www.ncrel.org/sdrs/areas/issues/educatrs/leadrshp/le0bow.htm#author

BBC (2014). Archaeology and History in Depth, Dig Deeper Quiz. British Broadcasting Corporation. Retrieved September 12, 2015, from http://www.bbc.co.uk/history/archaeology/excavations_techniques/launch_gms_dig_deeper.shtml

Cobb, J. (2015). Play for Change. Retrieved from http://www.we-magazine.net/volume-01/play-for-change/#.Vv-CkPl97IUCOBB Jeff

Cobb, J. (2016). Mission to learn, Learning Games – 26+ to Change the World. Retrieved September 12, 2015, from http://www.missiontolearn.com/learning-games-for-change/

Corti, K. (2006). Games-based Learning; a serious business application. PIXE Learning Limited. Retrieved from www.pixelearning.com/docs/games_basedlearning_pixelearning.pdf

Christopoulos, D., Mavridis, P., Andreadis, A., & Karigiannis, J. N. (2011). Using Virtual Environments to tell the Story: "The battle of Thermopylae". *Games and Virtual Worlds for Serious Applications (VS-GAMES),* 2011 Third International Conference. http://doi.org/10.1109/VS-GAMES.2011.18

DIG: the archaeology magazine for kids. (2013). Retrieved from: http://www.digonsite.com/

Derryberry, A., (2007). Serious games: online games for learning, https://www.adobe.com/resources/elearning/pdfs/serious_games_wp.pdf

Einarsdottir, J, Dockett, S. & Perry, B. (2009). Making meaning: children's perspectives expressed through drawings. *Early Child Development and Care*, *179*(2), 217–232.

Gaitatzes, A., Christopoulos, D., Voulgari, A., & Roussou, M. (2000). Hellenic cultural heritage through immersive virtual archaeology. In Proc. *6th International Conference on Virtual Systems and Multimedia*, Ogaki, Japan (pp. 57-64).

Froschauer, J., Arends, M., Goldfarb, D., & Merkl, D. (2012). A serious heritage game for art history: Design and evaluation of ThIATRO. In *18th International Conference on Virtual Systems and Multimedia (VSMM),* (pp. 283-290). IEEE.

Haddad, N. A. (2012). Educational Multimedia Entertainment (EME) and Childhood Heritage Awareness. In Proceedings of the *First International Conference on Best Practices in World Heritage*: Archaeology (pp. 873-891). Menorca, Spain.

Haddad, N. A. (2013). From Hand Survey to 3D Laser Scanning: A Discussion for the Non-Technical Experts and Users of Heritage Documentation. *Conservation and management of archaeological sites*, *15*(2), 213–226. http://doi.org/10.1179/1350503313Z.00000000056

Haddad, N. A., Haddad, K. A. & Sloane, P. (2012). "The Hikayat Simsim" Multimedia Edutainment project in Jordan and its Role in Early Childhood Cultural Heritage knowledge. In Proceedings of the *First International Conference on Best Practices in World Heritage*: Archaeology (pp. 892-908). Menorca, Spain.

Haddad, N. A. (2014). Heritage Multimedia and Children Edutainment: Assessment and Recommendations. *Advances in Multimedia*, 2014, Article ID 579182, 13 pages. http://dx.doi.org/10.1155/2014/579182

RockYou (2014). Hidden Objects: Gardens of Time. Retrieved January 15, 2016, from https://itunes.apple.com/us/app/hidden-objects-gardens-time/id473326170?mt=8

Heeter, C. (1999). Technology Enhanced Learning white paper for the Internet 2 Sociotechnical Summit, Michigan State University Department of Telecommunication.

International Strategy For Disaster Reduction (ISDR). (2012). Stop Disasters Game. Retrieved from http://www.stopdisastersgame.org/en/playgame.html

Kontogianni, G., & Georgopoulos, A. (2015). Exploiting textured 3D models for developing serious games. *The International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences,* 40-5/W7, 249-255. http://dx.doi.org/10.5194/isprsarchives-XL-5-W7-249-2015

Michael, A. & Chen, S. (2006). Serious games: Games that educate, train and inform. Boston: Thomson Course Technology.

Miller, A., K. (2012). An Introduction to Games Based Learning. Kinect Education. Retrieved January 15, 2012, from http://www.kinecteducation.com/blog/tag/games-based-learning

National Parks Service (NPS). (2016). Archeology Program: Archaeology for Kids. Retrieved January 15, 2016, http://www.nps.gov/archeology/public/kids/index.htm

Papagiannakis, G., Schertenleib, S., O'Kennedy, B., Arevalo-Poizat, M., Magnenat-Thalmann, N., Stoddart, A., & Thalmann, D. (2005). Mixing Virtual and Real scenes in the site of ancient Pompeii. *Computer Animation and Virtual Worlds*, *16*(1), 11-24.

Petridis, P. (2016). The Roma Nova project. Serious Games Institute. Retrieved January 15, 2016, from http://www.seriousgamesinstitute.co.uk/applied-research/Roma-Nova.aspx

Pietroni, E., & Antinucci, F. (2010). The approval of the Franciscan rule: virtual experience among the characters of Giotto's Work. In *Proceedings of the 11th International conference on Virtual Reality, Archaeology and Cultural Heritage* (pp. 171-178). Eurographics Association.

Plowman, L., & Stephen, C. (2003). A 'benign addition'? Research on ICT and pre-school children. *Journal of Computer Assisted Learning*, *19*(2), 149–164. http://dx.doi.org/10.1046/j.0266-4909.2003.00016.x

Prensky, M. (2001a). Digital natives, digital immigrants, Part II: Do They Really Think Differently? Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf

Prensky, M. (2001b). Digital natives, digital immigrants Part I. On the Horizon, 9(5), 1–6. http://dx.doi.org/10.1108/10748120110424816

Public Broadcasting Service (PBS), (2000). NOVA Online: Search for Lost Cave People, Be an Archaeologist. Available: http://www.pbs.org/wgbh/nova/laventa/archaeologist.html

Ramsey, P. G. (2008). Children's Responses to Differences. *NHSA Dialog*,11(4), 225–237. http://dx.doi.org/10.1080/15240750802432607

Roussou, M., & Efraimoglou, D. (1999). High-end interactive media in the museum. In *International Conference on Computer Graphics and Interactive Techniques: ACM SIGGRAPH 99 Conference abstracts and applications* (Vol. 8, No. 13, pp. 59-62).

Samuelsson, I. P., & Carlsson, M. A. (2008). The Playing Learning Child: Towards a pedagogy of early childhood", *Scandinavian Journal of Educational Research*, *52*(6), 623–641. http://dx.doi.org/10.1080/00313830802497265

Shank, P., & Kozma, R. (2002). Learning chemistry through the use of a representation-based knowledge building environment. *Journal of Computers in Mathematics and Science Teaching*, *21*(3), 253–279.

Smardz, K., & Smith, S. J. (2000). *The Archaeology Education Handbook: Sharing the Past with Kids*, Walnut Creek, CA: Altamira Press.

Stone, P. G., & Molyneaux, B. (1994). *The Presented Past: Heritage, Museums, and Education*, London: Routledge.

Susi, T., Johannesson, M., & Backlund, P. (2007). Serious games: An overview. Technical Report HS- IKI -TR-07-001, pp. 1-24, University of Skövde, Sweden. Retrieved February 12, 2016, from http://www.scangame.dk/downloads/HS-IKI-TR-07-001_PER.pdf

Thomas, B. Close, B. Donoghue, J., Squires, J., De Bondi, P., Morris, M., & Piekarski, W. (2000). ARQuake: An Outdoor/Indoor Augmented Reality First Person Application. In *4th Int'l Symposium on Wearable Computers* (pp. 139–146). Atlanta, GA, USA. . http://dx.doi.org/10.1109/ISWC.2000.888480

Van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE review, 4*(2), 16–30.

Virtual Museum Transnational Network (2011). V-MusT.net: an introduction. Retrieved from http://www.v-must.net/library/documents/v-mustnet-introduction#sthash.RyXBNAyL.dpuf