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Review

Learning cultural heritage by serious games

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ABSTRACT

Immersive technologies such as virtual environments and augmented reality have a clear potential to support the experiencing of cultural heritage by the large public, complementing the current tools and practices based on tangible goods such as museums, exhibitions, books and visual content. Serious games – videogames designed for educational objectives – appear as a new tool to learn cultural content in an engaging way. In this paper, we will provide an extensive portrait of the current proposition of serious games in the cultural sector, highlighting the educational objectives of games in this domain and analysing the complex relations between genre, context of use, technological solutions and learning effectiveness. We finally identify and discuss the most significant challenges in the design and adoption of educational games in cultural heritage.

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1. Research aims

This paper aims at providing the state-of-the-art of serious games in the humanities and heritage field, highlighting the educational objectives of games in this domain and analysing the complex relations between genre, context of use, technological solutions and learning effectiveness.

2. Introduction

Virtual worlds have already been used in the cultural heritage field, allowing the broad public to appreciate remote (in space and time) cultural content with an immersive experience. This is the case of many virtual museum applications, which offer the opportunity of exploring in first person a remote site, manipulating fragile relics with no risk of damage, benefiting from additional

multimedia information and following cross-correlations within the content, appreciating virtual reconstruction of damaged remains, and much more.

Although they are helpful, these applications still lack a powerful mechanism to engage the large public into an active state of learning where spectators are motivated to create their own knowledge rather than to receive information passively. Conversely, such engagement is evident in computer games providing amusing and compelling experiences, which keep the player focused for long lasting sessions. For this reason, games with educational purposes – namely *Serious Games* (SGs) – are now becoming more and more popular.

The main feature of a SG is its objective of supporting the player to achieve learning targets through a fun experience. The fun aspect of a SG provides engagement and can be determined by several factors like storyboard, graphics, usability, collaboration/competition mechanisms and interaction devices. The learning aspect implements a pedagogical approach, by structuring the educational content and organizing its presentation [1].

Thus, the design process of a SG differs from the one of a common e-learning application as an intrinsic balance between learning and gaming should be found. Indeed, the learning content in a SG has a predominant role in the game-play, but the game interactions and mechanics should not simply be a funny layer added atop a digital learning tool.

In this paper, we discuss the current situation of SGs in the cultural heritage field, presenting numerous examples of available

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games, primarily structured according to their learning objectives. SGs vary a lot not only in terms of learning objectives, but also of genre (e.g. adventure, simulation) and of application context (e.g. virtual visit), which impact game design. In the following, these three aspects (learning objective, genre and context) will be discussed while providing an extensive portrait of the current offer of serious games in the cultural sector. Up to our knowledge, Falk Anderson et al. [2] represents the only one attempt to sketch a state-of-the-art of serious games for cultural heritage, mainly focussing on the technological aspects. Our goal is tackling the application perspective, while providing a wider showcase including more recent developments. Moreover, on the basis of the overview, we also propose and discuss some key considerations for effective SG design.

In Section 3, a survey of the domain is proposed, which classifies 51 SGs for Heritage according to their main learning objective. In Section 4, the game genres are discussed with respect to their potential to transmit effectively the learning content. In Section 5, the specific requirements of the application contexts are described along with insights about the common practices and/or suggested improvements. Section 6 identifies two main SG design aspects, the game environment and the interaction modalities, and discusses their effectiveness to maximize engagement and deliver a proper cultural heritage experience. Finally, Section 7 summarizes opportunities, challenges and barriers to the adoption of SGs in the cultural sector and suggests research trends to enhance effectiveness of SGs.

3. Serious game proposition in the cultural sector

Cultural content is very diverse: on the one side, there is the physical, or “tangible”, cultural heritage, such as historic sites and buildings, monuments, documents, works of art, machines, and other artefacts, which are considered worthy of preservation for the future. The natural environment is also an important factor of a society heritage. Natural heritage includes landscapes, flora and fauna, as well as geological, paleontological and morphological elements. Together with the architectonic and artistic legacy of a place, such elements are the target of cultural tourism, which is gaining increasing interest.

Nevertheless, there are many further factors which deeply characterize a culture and have a non-physical nature, namely the “intangible cultural heritage”. These aspects include social values and traditions, customs and practices, philosophical values and religious beliefs, artistic expression, language and folklore. Intangible heritage is particularly difficult to preserve, and we believe SGs have the potential to maintain and communicate effectively, especially this immaterial legacy. Based on these considerations, we structured our analysis along a taxonomy featuring the following categories:

- cultural awareness;
- historical reconstruction;
- heritage awareness:
 - artistic/archaeological heritage,
 - architectural/natural heritage.

In the following, we describe each category along with brief descriptions of SGs tackling the corresponding educational objectives.

3.1. Cultural awareness

Cultural awareness is particularly focused on immaterial heritage, including the language, customs, traditions, spiritual beliefs,

folklore and rules of behaviour in a society, without forgetting the influence of past events on that society. In these regards, SGs have the potential to recreate accurately non only a physical setting but rather: provide a holistic experience including sounds (spoken language, traditional music) and aesthetic elements; bring to life folkloristic and religious events; give the opportunity to practice in first person behavioural codes and habits through in-game tasks; and much more.

A significant representative of games for cultural awareness is *Icura* [3]. Playing the game and exploring the 3D realistic environment with soft traditional music played in the background, the player learns about Japanese culture and etiquette, which can raise cultural interest and support a real pre-trip planning. Similarly, *Discover Babylon*⁶, *Roma Nova*⁷ and *Remembering 7th Street*⁸, aim at raising awareness about ancient Mesopotamia’s contribution to modern culture, ancient Rome and West Oakland in the time period post-World-War-II. *Africa Trail*⁹ and *Real Lives 2010*¹⁰ simulate a 12,000 mile travel by bicycle through Africa or a different life in any country of the world (e.g. a peasant farmer in Bangladesh, or a computer operator in Poland), respectively. Recently, Huang and Huang [4] presented *Papakwaqa*, a serious game about the Atayal minority in Taiwan, particularly focussed on intangible cultural assets like tribal beliefs, customs, and ceremonies.

Some projects are supported by museums and include *Yong’s China Quest Adventure*¹¹ and *The China Game*¹² about Chinese traditions and *Fascinating Egyptian Mummies*¹³ about the spiritual beliefs of the ancient Egyptians. Finally, *The Great Bible Race*¹⁴ deals with the religious roots of the Western civilization; *The Mosaica* project [5] developed a Jewish heritage game; *Les Fromages de France*¹⁵ advertises the variety of French cheeses and their geographical provenance.

3.2. Historical reconstruction

Games in this category have history as the primary educational goal and focus on the faithful *reconstruction of a specific historical period, event or process* which happened in the past; notions of archaeology, art, sociology and politics are also involved. Especially when dealing with the reconstruction of a specific process, it is usually important to involve the player actively in this event (like in a role-play game) to understand and learn the causes and the development of the event itself. For many events of the past, like historical battles, there is no physical remain but rather ancient textual descriptions only. In those cases especially, the recreation of the environment can give a concrete help to deliver knowledge of the past to the public in a more accessible way. When physical remains are available, they are usually reconstructed digitally in the environment to enrich the experience adding historically correct details.

As expected, many games in this category are set in a 3D environment. Very interesting examples of this kind are *The Battle of Thermopylae* [6] aiming to deliver the historical context and importance of the battle, the warfare of the opponents, their cultural differences and the strategic choices, and *The Siege of Syracuse* [7]

⁶ <http://www.fas.org/babylon/>.

⁷ <http://www.seriousgamesinstitute.co.uk/research.aspx?item=171§ion=14>.

⁸ <http://7thstreet.org/>.

⁹ <http://www.mobygames.com/game/africa-trail>.

¹⁰ <http://www.educationalsimulations.com/products.html>.

¹¹ <http://www.mylearning.org/yongs-china-quest-adventure-game-level-1/>.

¹² <http://asiasociety.org/node/20787>.

¹³ <http://www.mcq.org/momies/index.html>.

¹⁴ <http://greatbibleace.com/>.

¹⁵ http://www.jeux-geographiques.com/jeux-geographiques-Les-fromages-de-France-_pageid80.html.

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