# Application of Game-Based Learning in Cultural Heritage

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## Abstract

Although the end of Moore's law has been predicted for many years, the capacity to store information in information and communication technology is still progressing in ways we could not imagine. Hence, the museum environments are also benefiting from improvements in data collection, storage and processing as well as allowing the great body of information within cultural heritage domain to be applied through interesting processes in the museums, one of which is game-based learning. Although, concept of employing games in the learning process is known for a long-time research teams in game-based learning and in the CH field in general often lack unified approach with results that are extended globally and team effort contributing to a larger systematically organized body of knowledge. In this paper we identify advantages and disadvantages of game-based learning application in the museums. By doing this we attempt to tackle promotion of cultural heritage, raise awareness of its importance and motivate users to visit cultural institutions such as museums more often.

## 1 Introduction

Digitization era is transforming large number of museums and their exhibitions with promotion and attracting visitors [RCR19] in mind. Combining virtual content with a real exhibit or animating users to indeed visit the hybrid museum are the challenges ahead. Cultural heritage applications consisting of stories, interactive virtual environments and 3D models, are ways to engage the visitor by providing additional details of the exhibition. Users can suffer from information overload having to choose activities "a priori" and often from a large number of choices. On the other hand, game designers in cultural heritage domain have to take into account end user's perspective in interpreting digital heritage [RDA17]. Digital age learners (DAL), according to [Pre04], have cognitive style changes manifested through several factors indicating they view technology as integral part of their life. Authors in [PHK15] find that when designing serious games for learning the combination of cognitive, motivational, affective and sociocultural perspective is needed for successful game design. Great diversification exists amongst procedures used by researcher for examination of effectiveness of game-based learning systems [HKS14, OVR15].

The most simple and obvious yet most powerful reason to bring serious games into museums is to motivate and engage the visitors of the museums in learning new material through amusing and informative activities. Visual versus text presentation of the new content is well researched subject with visual education being more powerful as well as allowing learners to accomplish learning goals in shorter time. Since globalization has adverse effect on cultural diversity both tangible and intangible cultural heritage are subject to various safeguarding conventions, with latter being UNESCO's priority in recent years. European union funds research related to deployment and maintenance of virtual museums with the aim of creating environment that can serve as digital heritage as well as being informative and interesting venture such as MU.S.EU.M [INN08] and i-MARECULTURE.

Game-based learning and in generally, serious games, attempt to bring cultural heritage closer to a younger user population through interesting, interactive and educational content. By exposing DALs to cultural heritage through familiar medium we are attempting at its preservation in terms that are acceptable to younger generations. Hence, we contemplate that survival of cultural heritage relies on, amongst other factors, the very same technology that affected globalization and initiated a loss of cultural individualism through group identity creation. We do not argue that technology will replace the human interaction, although that might be the case in extreme circumstances, but rather it can assist with transfer of knowledge to younger generations in cultural heritage domain. Hence, authors in [MCB14] base their research of serious games for preservation of intangible cultural heritage through employing three categories: (i) cultural awareness, (ii) historical reconstruction, and (iii) heritage awareness as shown in Figure 1, and they assess available serious games in those domains as well as their educational objectives.
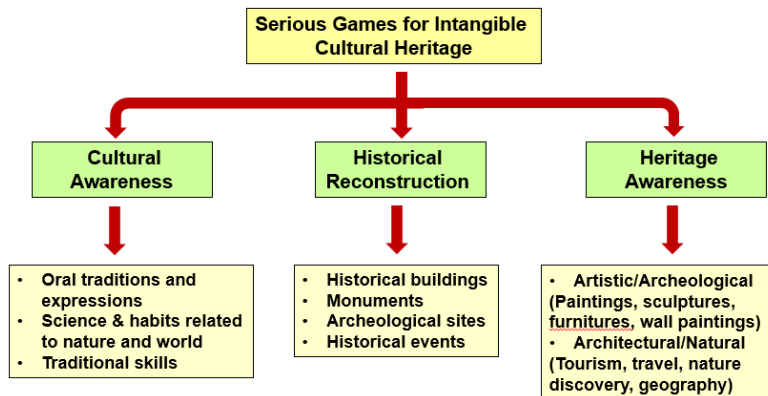


Figure 1: Categorization of serious games' domains.

Vision of using technology in combination with actions contained in entertainment games has created field of serious game industry. Considering that both entertainment and serious games are becoming more powerful and appealing to consumers one major difference between two industries is that serious games extended entertainment field ideas being used and applied it to non-entertainment fields. We have examples of ancient cultures exploration [MCB14] and contemporary cultures exploration prior to travelling in country's architectural or natural environment by means of serious games.

Game-based learning and diverse applications in the museum environment are gaining visibility within research community and their cumulative attempts are on the rise. The challenge of this paper is to systematically present strengths and shortcomings of game-based learning in general as well as in the examples already implemented in the museums.

## 2 Game based learning strengths

Safe practice, experimental learning and interaction are foundation of game-based learning. Considering positive effects of games on learning it is only natural to implement game-based learning into the cultural heritage domain [DM98, BNT14, PH18]. Furthermore, museums are becoming attractive again and visitors find learning amusing as well [PS16].

The development, implementation and evaluation of cultural heritage serious games is comprehensively researched within the cultural heritage community [LOS13, MCB14, Sch14, Kid15, PS16] and as such presents a large body of knowledge that can serve for analysis purposes of pros and cons in the museum application of

game-based learning. We identified (i) motivation and engagement, (ii) teamwork, (iii) instant feedback, and (iv) creativity enhancement as important positive aspects of game-based learning in the cultural heritage domain. We explored each of these aspects through available examples in the literature.

Motivation and engagement during the learning process of desired content is given if the game is simple in nature while more complex games need to be designed with discrete steps in mind keeping user's motivation in mind until the major goal is reached [Edu]. Multi-modality has been used in serious games design as an approach that integrates more aspects or multiple points of view in exploring certain content. For example, there are museums that offer visitors possibility of creating their own experience personalized exhibit using cross-platform gaming technologies [KKM16]. In addition, there are such museums as Acropolis museum that offers one virtual tour in which visitors can "navigate, teleport to points of interest, interact, learn and manipulate the exhibit" [SKG17]. Certain interactive gamified apps use NFC (near field communication) technology in order to motivate users through collection badges in a longer process and in such way assuring the visitor becomes truly engaged [AKK18].

Teamwork could be enhanced using serious games. They could emphasize teamwork in various application fields some of which are education, health, military, and management. For example, companies are often spread out in different locations and in order to act as one company in an unified manner there has to be sense of belonging to the same team. Hence, they resource to team building skills using serious games platform in order to develop on problem-solving as well as communication skill amongst team members [BKN16]. In addition, any multi-player game designed in cultural heritage content, allowing simultaneous play of few or more players creates a good foundation for teamwork [KPS05].

Progress assessment is the important part in serious game design, and it is usually integrated. Feedback system should be designed keeping in mind the effects it has on player's engagement in the game. Hence, interruptions should be well paced and overall minimized. Positive and negative feedback is used in the progress assessment tools. For example, if the success is achieved the player receives positive feedback while in case of failure negative feedback is provided in prompt manner. This way player can learn from the experience and use this knowledge as a corrective measure. Hence, feedback system can provide a player leads on how to improve weaknesses. Most feedback systems use points, badges and leader-boards for rewarding motivating players [HKS14]. The instant feedback across cultural heritage game samples explored for the purpose of this research is visible and appreciated as users lose interest quite quickly for a variety of reasons, which we will explore later.

Another important aspect of serious game design is creativity enhancement. Museums used blended learning techniques employing experts from various fields, such as arts, multimedia, education and computer science, in order to provide visitors with superb experience that will enhance their creativity. Innovative and original game is the one that user will consider successful as well. The difficult part in game design is to produce creative ideas in methodological manner and guide the player through the supportive structure [DMP16]. There is a strong correlation between the number of ideas produced by employing creative enhancement techniques, such as brainstorming or negative brainstorming, and number of ideas that develop further [KP07]. In order to guide a player towards a success we need clear goal at all times, path that can be executed leading to the accomplishment and guaranteed entertainment appeal in the process.

# 3 Game based learning shortcomings

Precursors of serious games are educational games which are unfortunately not recognized widely as a tool that can assist in learning process. Formal educational system of low- and middle- income countries are especially unconvinced that learning by gaming could be beneficial. Conversely, authors in [PQB10] give priorities on how to integrate technology in childhood education in a "developmentally appropriate manner" rather than solely researching the impact of technology and its effects on education. Application of serious games in museums is on the rise but still relatively new concept. They require game mechanics, aesthetics, educational results, and museology features all implemented in one [PS16]. One of the android applications offered in the Wolfsoniana Museum (www.wolfsoniana.it/en/index) allows visitors to scan NFC tags and Quick Response Code (QR Code) markers to gain more information about the exhibit [CMV13]. Visitors are offered to play a game at the end of the tour based on acquired knowledge during the visit. Even though there is an increased number of studies researching positive learning outcomes of serious games applied to cultural heritage domain it is still unclear of learning effects and evaluation mechanisms.

Virtual museum for the Stoa of Attalos in Athens has two separate parts: virtual museum of the exhibits of the Stoa of Attalos and specialized virtual museum of the Stoa. In the latter, information on wine production

is presented as well as the trade routes in the eastern part of Mediterranean basin of that time [SKG17]. No user evaluation or follow up research is presented in the study although there is intensive use of virtual content. Further shortcomings identified in the literature are: (i) decrease in attention span, (ii) cost of game design and virtual content development, and (iii) progress evaluation.

Subject of attention, a mechanism that, for example, determines what part of the scene we focus on and what we ignore, is well researched area [Ram12]. In addition, according to [?] attention can either narrow of expand our view area. Most research studies deal with the concept of attention span decrease. Limitations in regard to memory and attention overload are viable limitations in addition to already mentioned physical ones. For example, according to [IA96, LV97], we can only store up to 5 different "chunks" of information in visual short-term memory.

The aim of serious game "Admotum" was to present the Roman Empire with a combination of museum collections in four cities and their digital content [PAD15]. The users participated in a treasure hunt involving objects from all participating museums. Since all objects were described by storytelling of virtual characters complete immersion of users could have not been achieved due to users being preoccupied with the not-so-simple gesture-based navigation. Hence, the game failed to uninterruptedly communicate information about the historical context of the heritage object or site.

Cost involved into implementing a storytelling approach of information presentation is twofold: (i) time investment and (ii) advanced equipment of strong processing power. These resources are wasted in case users cannot perceive full potential of the interactive storytelling as the case was in "White Bastian" [ROP16]. For this reason, authors in [RDA17] proposed new interactive digital storytelling method that will include motivation factors that will result in users viewing the whole panel of offered content. In addition, serious games although stem from entertainment games do not hold the same appeal to wider audience hence financial and human resource infrastructure necessary for cultural heritage serious games development is absent.

Each game, according to Paliokas et al. has predefined message for the audience that can be grouped as: (i) educative, (ii) informative, (iii) persuasive and (iv) subjective [PS16] with educative being the most and the subjective being the least common message. The question remains whether the user and the creator of the game see "eye-to-eye" on the content and the message of it. Salen and Zimmerman [STZ04] believe that user's perception of the game cannot be controlled. Having access to this information could gain museums insight into how visitors view their attempts in improving the museum experience.

## 4   Conclusion

Game based learning is rapidly gaining interest from the research community of cultural heritage domain for the purpose of promoting it, raising awareness of its importance and motivating users to visit cultural institutions such as museums more often. Since the migration of traditional museums to virtual world is inevitable, they often provide easy access to the exhibit collections but often fail to engage audience in presenting content of those collections. Game-based learning could be one of the solutions to alleviate this inevitable transition and offer active learning in the process. This paper attempts to address pros and cons of game-based learning in general and reflect on the choices of using serious games in the museum environment.

Serious games based on or containing heritage content are abundant. Since globalization trends are allowing for increased mobility and individual exposure to different cultures, and at the same time they jeopardize preservation of its uniqueness. Safeguarding bodies, research community and to a lesser extent entertainment industry are combining their efforts on preserving cultural versatility. Web technologies are allowing cultural heritage organizations such as museums to have their content available to anyone on-line. In the future each museum could become a possible point belonging to an interconnected cultural heritage Web for future generations of humankind initiative supported by EU projects. When considering cultural heritage representation in museums we observed that tangible cultural heritage is in advantage in the virtual worlds and mainly based on applications of 3D technology. Recently, intangible cultural heritage is gaining more visibility within cultural heritage scope as a domain in which game-based learning could assist in its preservation.

Nevertheless, in this study we presented examples of serious games that have been implemented and tested. Each of those examples failed to identify a unified framework that could be used for design and development of serious games applied to the cultural heritage domain. In addition, further research is required to explore the real effects of serious games on cultural heritage learning, as to our knowledge although the virtual content in the museums exists, we lack evaluation data and consistency. Therefore, research community must change its focus, attempt to classify existing methods, offer unification of guidelines for the publication and evaluation

of museum content. Furthermore, analysis following evaluation of museum content will lead cultural heritage domain to new insights of cultural presentation and preservation and open new research directions.

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