

Educational Games for Cultural Heritage

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Abstract. Educational games appear as a new tool for learning cultural content in an engaging way. The applications with augmented reality in virtual environments are able to support the experience of cultural heritage, overcoming the “tangibility” barriers of museums, exhibitions, books and audio-visual content. We intend to provide a unified view regarding the game genres used to profitably manage the contents of cultural heritage, highlighting the training objectives of the games in this sector and analyzing the complex relationships between gender, context of use, technological solutions and learning effectiveness as well as the identification of the most desirable features for the design phase.

Keywords: Educational games • Game learning design • Maieutica.

1 Introduction

1.1 Game as learning method

Current literature on education repeatedly underlines the resistance, especially on the part of the young, to traditional learning approaches; they do not read books and do not learn from lectures. Traditional teaching is didactic, consisting essentially in the transfer of knowledge or information from one person (teacher) to another (student). In an era when all the knowledge of the world is literally at one’s fingertips this method has become useless.

This was precisely the view of the ancient Greek philosopher Socrates. As a consequence, he did not write any books and never lectured. On the contrary, instead of dispensing answers, he asked questions and claimed to be ignorant. For him, education is a live, dynamic interaction: the “benefit” emerges from the exchange, which is often a conflict. This method is called *maieutic* because he compared his activity as philosopher-educator to that of his mother who was a *maieuta* i.e. a midwife. The child that is born, is not generated by the midwife; her job is to “deliver” him or her [1].

Likewise, Socrates, maieutically, “delivered” the interlocutor: education means to lead out. Plato elegantly illustrates the type of education in his “Allegory of the Cave” (Fig.1).

Here we see education as the process, the journey, that takes the person from darkness and ignorance to the light, to a higher state of consciousness [2, 3].

Its primary objective is the “enlightened man”. Far from being the stuffing of information into a ready-made container, education is a process whereby the “container” is perfected. Education is related to the evolution of the person and the development of those personal qualities which one must have “to be at own best”, and to have success in life [4]. These qualities have to do with *who one is*, not *what he knows*: creativity, good judgment, critical thinking, a sense of value, ability to take a stand, responsibility, passion, motivation, self-esteem, enthusiasm, resourcefulness, sense of humor, reliability, trust, ability to bear frustration, a sense of balance and harmony, love, perseverance, thirst for knowledge, a sense of measure, etc. etc. and the ability to live well in uncertainty, for the condition of uncertainty is continuously evolving, always work-in-progress [5].



Fig. 1: Allegory of the Cave

Traditional education is obsolete and must be superseded by a maieutic approach which has at its center the evolution of the person, the “delivery” of that which is best in us, or in Socrates’ words, that which in us is “noble and divine”.

Greek education was oriented in this direction, their cultural heritage and their identity depended on it. The most important element was the emergence in the young of that which in them is most excellent. It was so not only for the individual but also for the community and the nation, and here, *games* were of the utmost importance, be they the gymnasium, the Olympics or the theatre [6].

Nowadays the transfer of knowledge, the sharing of historical contents related to cultural heritage is influenced by modern technologies. The “enlightened man” has new paradigms to experience knowledge, which he never had before.

New technologies allow the implementation of augmented reality in virtual environments, and promote the dissemination of cultural heritage to a wider public through serious games (SG). These technologies are becoming an emerging tool for the dissemination of multimedia contents belonging to the cultural heritage through more engaging “personal” experiences than tangible assets such as museums, exhibitions and books.

1.2 Research Aims

In this article, we aim to provide a panoramic view of the current proposal of the so called serious games, also referred as educational games, for cultural heritage, looking at both the educational potential of games in this sector and the complex relationships between gender, context of use, technological solutions and effectiveness of learning. Our intent is to provide guidelines for the design and adoption of educational games for the preservation of cultural heritage.

Virtual worlds are used in the field of cultural heritage, because they allow for the appreciation of cultural content through an immersive experience. Many virtual museum applications offer the opportunity to explore a remote site in first person, and through a digital alter ego, allow to manipulate fragile finds without risk, and to access multimedia information in a personalized way. Nowadays these intriguing applications are still not able to give an active learning experience which would foster a traditional dissemination of information. In Serious Games (SG) on the contrary, this involvement is evident, and well-designed experiences keep the player-visitor active in long-lasting sessions. In fact, the main purpose of a SG is to help the player to achieve learning objectives through a fun experience and through the use of different graphic and interactive functions [7]. However, the design process of a SG differs from that of a classical learning application, and through a pedagogical approach, takes into account both the learning and the recreational factor.

The design of a SG varies according to the learning objectives, the genre (i.e., adventure, simulation), and the application context (i.e. virtual visit). Previously, studies presented the state of the art of serious games for cultural heritage, mainly by referring to technological aspects [8].

To provide a broad vision, it is necessary to identify the characteristics for the design of SG useful for dissemination of cultural contents. Thus, it is important to consider the game genres and to highlight the game environment and the ways of interaction, such as to ensure an intriguing experience that promotes the dissemination of cultural heritage. Finally, we refer to the opportunities and obstacles related to the adoption of SG for the cultural heritage field and to the best practices usable to improve the effectiveness of SGs. The application of games as solutions that favor the transfer of content must be done taking into account multiple perspectives, such as the correlation between learning and gamification and coexistence between playability and pedagogical learning approaches inside theoretical models of games.

All the technical design features, such as game design elements, must be aimed at facilitating learning through cognitive, behavioral, emotional and socio-cultural engagement in line with the topic under discussion. It will be necessary to recall the basics of the design elements in a functional way related to the key theories of education and psychology relevant to gaming-based learning.

The combination of cognitive, motivational, affective and socio-cultural perspectives is necessary for the design of the game that fully captures the content to be offered for learning. The design of SG, used to promote the dissemination of content belonging to the cultural heritage field, must take into account the specific aspects of learning, exploiting the potential of digital games for educational purposes. The application context of the games will take into account field of application, the kinds of content, and the genre of games like first person shooter (FPS), multiplayer online game (MMO), role play, and so on.

We believe it is useful, to facilitate a clear reading, to take a look at definitions of learning based on the game in theoretical models that can describe learning with games. Only then can we move on to the description of design elements of functional games for learning.

2 Key factors for Game-Based learning

An important issue that cannot be ignored is the identification of the elements that make games effective learning environments. In particular, we will focus on the topics most cited in scientific research contexts, leaving out those without empirical support.

Motivation

The motivational function is one of the most important factors to ensure that users, living an engaging game experience, remain active for a long time in the game. This aspect is implemented by providing incentive structures such as medals, stars, goals to reach, leader-boards, badges and trophies, or access to elite endowments [9]. This is the reason why, during the implementation phase, it is essential to provide a rich variety of incentive structures, through which the user can be more involved. In this way, it is possible to release information of various kinds (text, audio, video) that favor the transfer of contents of interest.

Player Engagement

One of the aspects that most favor learning in digital games is to provide a wide range of ways of involvement. The concept of player engagement is defined in terms of cognitive commitment, emotional and behavioral involvement [10].

Do not forget the socio-cultural commitment understood as the set of social interactions incorporated in a specific cultural context. Therefore, a game can predict the behavior of characters that can interact with the virtual context using certain gestures as input, or invite other players to perform certain actions as an integral part of the game. We understand how the characters emotionally involve the user, lending themselves to be digital alter egos, and how the collaborative characteristics of the game provide support for the socio-cultural transfer.

Adaptivity

Adaptivity implies engaging the player in a way that reflects its specific situation. Referring to the player, it is possible to implement Adaptivity through current level of knowledge, cognitive skills and emotions or various other related variables to allow adaptive design. This may involve the use of scaffolding, guidance and feedback in a way that responds to gambling actions [11]. Design principles that have proven to be effective are often not incorporated into educational games. Another important aspect is the way in which education in such games is offered. In the design phase, it becomes necessary to focus on various players and gameplay features that can be integrated into a framework that conceptualizes player-centered, person-centered adaptability in Education Games. Targets or adaptive recipients include:

- (a) *Mechanics* (by adjusting the speed, endowments and abilities of the opponents).
- (b) *Scenarios and missions* (are related to the ability to configure the level's detail of the missions and therefore of learning delivery; providing tips and tricks through a mentor or *maieuta* that facilitates the achievement of objectives; adjusting the game scenarios based on a player's learning style).
- (c) *Worlds and objects* (are related to the ability to adjust the level's difficulty of the mini games, balancing well difficulties and expected rewards, or by teaming up with fellow players able to provide small suggestions or with other online players, joining teams and sharing common goals to pursue).
- (d) *Feedback* (by following the success or failure in the game, immediate feedback may be issued (prizes or incentives issued at run time) [12], or deferred (prizes or incentives for level or end of the mission) [13]. The affective orientation of feedbacks is also a salient feature, both in the case of positive feedback following success or negative feedback in the event of failure. In games, overly positive feedback is referred to as *juicy feedback*, and serves to reinforce learning through rewarding actions for success. The negative feedback in games likewise encourages new attempts to succeed and learn while at the same time letting go the feeling of failure).

Graceful Failure

As introduced in the previous paragraph, another aspect to implement to facilitate the transfer of contents concerns the management of failure. In order not to dissuade from the gaming experience, it is advisable to foresee a graceful failure; therefore in design, failure must be foreseen by configuring the same as a natural process of learning through errors, avoiding the loss of the evolutionary stages matured by the character used [14]. In this way, the player will be encouraged to take on new risks, researching in different ways within the virtual scenarios [15]. The same gaming experience is conditioned by the failures which advise the adoption of different strategies to achieve the desired objectives. Typically in mini-games it is possible to decide the amount of risk to be faced in relation to the increase of rewards [16].

The ability to fail gracefully favors motivation, commitment and adaptability. Motivation is often supported through the sharing of tips and tricks that explain how to deal more effectively with repetition of the game instance. Even the possibility of using game aids gained in previous instances, increases the wealth of experience for a more fruitful gaming section.

3 A Model for Game Based Learning

During the implementation of educational games, game designers take into account aspects related to behavior, but not ignoring the cognitive context and the implications for programming steps. It is appropriate to refer to general macro-models to describe learning regardless of the genre of the environment used for its implementation [17]. Virtually the design of any game can be realized by considering three main directions:

- Challenge
- Response
- Feedback

As shown in figure 1, the model illustrates how the characteristics of the game design are at the center of the learning experience: each of these elements transforms the learning experience in different ways while maintaining a playful aspect.

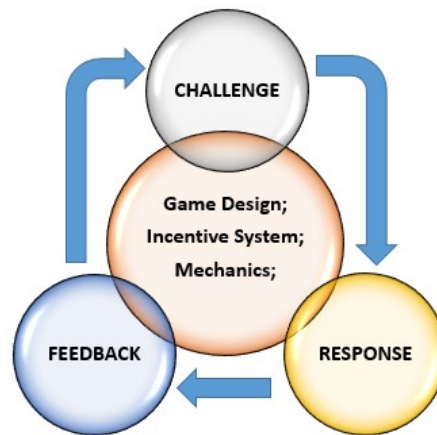


Fig.2 Model of game-based learning.

The recalled model uses all the approaches related to affective, behavioral, cognitive and socio-cultural engagement, within the recreational context [18].

Taking into account the macro phases of a framework inspired by the proposed model, it will be possible to implement existing learning models using playfulness as a new design opportunity to make games as a genre more attracting than other traditional ones. The learning transfer will take advantage of the recreational experience to effectively implement all the approaches discussed. In contexts such as cultural heritage, this is innovative, favoring greater attraction on the part of younger people, including digital natives, stimulating the possibility of social implications with educational games and dedicated apps. These potentials favor the diffusion of knowledge going beyond classical approaches, such as visiting tangible places, and reading books. Learning game design elements include features such as Skills, Learning Mechanism and Aesthetic Design.

All the features are fed by the discussed approaches. This creates a reference template that acts as a guide in designing educational games to be applied to the context of cultural heritage (Fig. 3).

LEARNING Game Design			
<p>Affect: Representation Interactions Attitudes</p>	<p>Motivation: Self-Determination Attribution Goal Orientation</p>	<p>Cognition: Contest Feedback Gesture</p>	<p>Social/Cultural: Interactions Social Context Learning</p>

Fig. 3 General model for game-based and playful learning framework

Starting from this macro model relative to the basic features of learning game design, it is possible to proceed with a more specific level of detail, descending to the level of game characteristics (fig.4):

GAME Characteristics					
<p>Cognitive Skills: Observation Reflection Action</p>	<p>Learning Objectives: Knowledge Comprehension Application Analysis Synthesis Evaluation</p>	<p>Complexity: Mini Complex</p>	<p>Players: Single Multiple</p>	<p>Theme: Strategy Action Adventure Shoot'em up Board Role knowledge Observingness</p>	<p>Technology: Online Desktop Mobile</p>

Fig. 4 Game Characteristics for Educational Games Design

A fundamental aspect to implement the effectiveness of the game concerns the correlation between mechanics and theme of the game: it's seem like there's a quite linear correlation between "theme" and "mechanics". The reality is more complicated. "Theme" and "Mechanics" mean a number different things in different situations. So it becomes very fuzzy to declare which is more important in designing, playing, or purchasing games. A Venn diagram with two non-overlapping circles is often referred to game designers to visualize the aspects to be taken into account (fig.5).

Depending on the made choices, both the theoretical models of game-based learning, to be read with a top-down approach, and those of design engineering with a bottom-up perspective, converge.

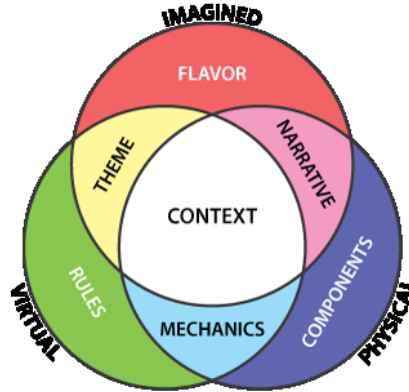


Fig. 5 Venn diagram on elements of game design

The decline of the reference context, in our case related to the transfer of cultural heritage content, inevitably ends up influencing the design of all the other elements that characterize a game.

4 Cultural Game Design

From all the above discussion, it emerges that the design of serious games for cultural field is a multifactorial and complex process. Considering the various proposals as reference models [19, 20], the macro model that we referred to in the previous paragraph is proposed as a model characterized by a degree of abstraction useful for the design of different games. In this sense, the model must be considered as a useful starting point for the identification of the key aspects that will allow a lower level implementation. This top down approach is quick and simple, allowing an effective organization of materials and their conceptualization.

Even today, quantifying the performance of different games is a very demanding task, because the performances are defined according to many dimensions (learning, entertainment, usability, etc.).

The proposed macro model of reference indicates game, player and organization as three main descriptive categories of educational games for cultural heritage. Our intent has been to provide a general macro model that serves as an effective starting point for the design of an educational games for cultural heritage.

The European community is supporting targeted actions to change people's views on European history and cultural heritage through the use of digital resources aimed at creating personalized interactive experiences for visitors [21].

In this manner, people have the opportunity to explore historical events and information and to perceive history in an innovative way, with “new eyes” [25], living it as a multi-directional maieutic experience. In these themes, games are a central element, attracting new visitors through compelling ways [19].

Educational Games can be profitably used as tools for profiling users, and as techniques to promote the location, also for creating digital souvenirs usable in social media.

We have underlined how an integrated point of view is necessary to take into account the cognitive, motivational, affective and socio-cultural perspectives both for the design of the game, and for fully manage the contents to be transferred. The resulting global perspective emphasizes the power of games in education by helping also to outline the implementation aspects that must be considered in preliminary design steps [22].

In this way, it will be easier to incorporate principles of recreational learning already in the design phase, rather than to perform grafts on existing structures [23]. Therefore, game-based learning by design and non-gamification, as a game design strategy based on well-established cognitive, emotional, motivational and socio-cultural foundations-in a world, in the *whole person*- aimed at a more systematic process of conceptualizing and designing games.

5 Possible Applications in Cultural Heritage

The model for game-based learning described in the third paragraph can be adopted for a more effective design of Educational Games in the cultural heritage field allowing greater customization and maieutic effects of the characteristics of the game, and of the player.

The characteristics of the game are essential to prepare a gaming experience that can be used both for players already attracted by a particular cultural site or for new types of players. In Educational Games the possibility to choose both a character and a mentor (*maieuta*) of the game, favors a greater engagement of the player also through a heightened empathy with its digital mentor. This possibility allows a greater wealth of language facilitating possible social interactions. Therefore, the cognitive abilities that the game aims to improve will be reflected in the desired learning objectives favoring the understanding, and the interiorization of knowledge [24].

The characteristics of the player can also take into account age and type of visit (visitor only or in a group) and contingent factors such as the time of day, levels of stress that can suggest breaks in the visits, and even time management of visits within the site. It is therefore understood, that the characteristics of the game and of the player must be defined in the domain of the organizational context considering both the type of site / museum and budget and personality of the organization.

All these system variables will allow the preparation of appropriate flow-charts indicating the phases of the site visit process. So, in each of these phases it will be possible to take into account the role of the visitor, and of his/her engaging gaming experience, which maximizes the possibility of transferring contents and cultural heritage values exploiting the new available technologies.

For example, consider a visit to a museum that has archaeological finds. There are sites and platforms on Internet, where users share their impressions on a particular site (Museumness) [26]. These platforms are increasingly used by visitors who are hypothesizing a visit to a site. The behavior of the user is in some ways similar to the consultation of Trip Advisor when choosing a restaurant in a particular city or Booking for the choice of their hotel accommodation.

Users share their opinions, photos and short videos, influencing the choice of other visitors: the possibility of greater personalization is useful in the whole context of cultural heritage.

With a view to favoring the choice and diffusion of a given site, it is important to be able to release personalized "trophies", which can be obtained by the visitor by placing his or her face on the body of an ancient statue or within a famous painting. Obtaining these souvenirs involves above all the "conquest" of a particular find through the resolution of a puzzle, that is, through a treasure hunt or through the resolution of certain quizzes. As a reward, players can currently customize their souvenirs by sticking their own face. The proposed reference model could allow the customization of the photos of the statues taking into consideration the characteristics of the player. The personalization of the souvenir would better reflect and positively influence the self-image of the visitor through poses, details and configurable objects. Pictures could also be suggested together with figures of the past like philosophers, kings, sculptors who resemble the face of the visitor, using face recognition algorithms [27]. The use of external links could facilitate the transfer of additional content by allowing the expected process of cultural dissemination.

The release of more customizable trophies can be an aspect that can be improved on a wide range of educational games. The same interface of the games can be dynamic, referring to visualization templates customized for user's type. For example, in the case of players / visitors over the years, it might prefer a more concise interface that facilitates usability, for example through the adoption of larger fonts. The adoption of the proposed reference model will allow:

1. the promotion of the site by encouraging interactions with social media,
2. a more detailed profile of the user,
3. the interaction with the findings on the site.

With this approach, the games can be designed for players of all ages allowing the creation of personalized souvenirs that can also be used as a profile picture on social networks. The player would use the contents of the museum for play, and this would favor a further exploration of the contents of the works, favoring the knowledge of the cultural heritage of the visited site.

The implementation of players' behavior assumes a predictive key to possible scenarios that may arise. For these purposes, the adoption of solutions based on neural networks or on deep learning represent an interesting opportunity. On the other hand, these paradigms are recovering considerable interest in various fields, from the medical one [28] to those of cultural heritage [29].

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