

The Use of Serious Games as an Educational and Dissemination Tool for Archaeological Heritage Potential and Challenges for the Future

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Abstract In the last decades, digital technologies have pervaded every aspect of the production of archaeological knowledge and they have been massively used to communicate the past. This contribution analyses the potential and benefits of serious games as they appear a promising tool for engaging the users in active learning of cultural contents, for attracting new audiences and promoting knowledge and awareness around archaeological heritage. Moreover, the need for multidisciplinary collaborations between archaeologists and developers and the necessity of assessment studies on learning levels to implement their effectiveness will be highlighted.

Keywords Archaeology. Digital technologies. Game-based learning. Edutainment. Serious games. Heritage enhancement. Public engagement.

Summary 1 Introduction. – 2 Digital Games as Educational and Engaging Tools. – 3 Gamifying the Past: an Italian Perspective. – 4 Serious Games & Archaeology: Potential and Benefits. – 4.1 Education and Learning. – 4.2 Public Engagement. – 4.3 Touristic Outcomes. – 5 Future Challenges: Assessing Archaeological Serious Games. – 6 Conclusions.



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1 Introduction

In recent decades, digital technologies have pervaded every aspect of the production of archaeological knowledge, from data collection to their analysis and interpretation, to interaction with the public (Hugget 2019; Morgan 2019). Archaeologists have been experimenting with digital data for a long time. The main reason for this “curiosity” is the nature of the cognitive process related to the discipline: the stratigraphic excavation method, in fact, requires the destruction of stratigraphy, hence the importance of tracking the information obtained to recover and interpret any data even after a long time. Moreover, the archaeological record is often difficult to read and to explain to a non-specialist. Digital technologies have been helping archaeologists to fill the communication gap between the traces of the past and their potential audiences, a necessity that has gained more and more importance through the years. University courses on digital technologies, 3D modelling, or computer simulation – to name just a few – which until a few years ago were considered niche, are gradually included in a growing number of undergraduate and post-graduate archaeology curricula. At the same time, as 3D and interactive technologies are becoming ever more affordable, a proliferation of digital tools, ranging from virtual and augmented reality applications and interactive displays to mobile apps, have been made available for the communication of the past in museums and via the internet (Hageneuer, Schmidt 2020).

At the same time, over the last few years, the use of new technologies has grown exponentially, permeating every aspect of everybody’s lives. It has consequently also affected the way different communities around the world experience heritage. People are increasingly encountering sites and monuments and learning about the past through digital media, in the form of virtual reconstructions, digital representation of artefacts, online videos, and so on (Bonacchi 2017). This is particularly the case for younger generations, whose first experience of cultural heritage is often through a digital surrogate that shapes their understanding and perception (Shapiro 2018). The expansion of Web 2.0, the increasing use of smartphones, and the demand for almost constant access to the Internet also mean that social interaction with other visitors or staff at heritage sites, as well as face-to-face discussions about heritage, are increasingly transferred to the digital space. Digital media in all its different forms, such as the multitude of social networking tools that Web 2.0 encompasses (including blogs, podcasts, RSS feeds, YouTube, Facebook, Instagram, Twitch etc.), the mobile apps designed for individual use, virtual reality, digital collections, and interactive kiosk applications in exhibitions, all have been offering new possibilities for heritage organizations to interact with their public (Boom et al.

2020). Moreover, the increasing convenience of 3D and interactive technologies has led to a proliferation of digital tools (VR, AR, mobile applications), used to communicate the past. Heritage institutions have been experimenting with these tools for quite some time as part of their efforts at greater democratization, opening up to diverse communities and inviting different viewpoints and interpretations of their sites and collections. But have these hopes actually materialized in practice? As Economou (2015, 224) argues, heritage digitization programs are creating digital resources which constitute the building blocks of research, learning, management, cultural tourism, and the general understanding and appreciation of heritage. These digital resources are often used to create interpretative and “edutainment” applications related to heritage. However, it is not the tools or the digital assets themselves which are causing concerns, but rather the use that these are being put to. Who is producing them and towards what means? In what way are these being used and by whom? Are they actually effective and engaging? Other scholars (Mortara et al. 2014) have raised the same questions. They argued that although they may be helpful to allow the general public to appreciate “remote” (in space and time) cultural content through an immersive experience, these applications still lack a powerful mechanism to engage the large public into an active state of lasting commitment and learning where spectators are motivated to create their own knowledge rather than to receive information passively.¹ 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 (Dörner et al. 2016) – have become more and more popular and they are starting to get recognition even from academics and cultural institutions² of those countries – the Italian case will be analysed more in detail – where the focus on university-based courseware in the historical and archaeological domain has remained quite entrenched.

Supporting the player to achieve learning targets through a playful experience is the objective and main feature of a serious game. Thus, the design process of a serious game differs from the one of a

1 Many authors (see Champion 2017, 26 and reported references) also argue that AR and VR have several use limitations: they can require extra and special devices (3D glasses, specific system features), and the user is typically restricted to certain types of online browsers, operating systems, and platforms. Moreover, they contain too much data for many people to download, and walkthrough, especially on portable devices (smartphones and tablets).

2 For a recent analysis on the changing practices of cultural institutions which are increasingly involved in the production of serious games, considering them as strategic digital marketing tools to promote cultural heritage, see Bonacini, Giaccone 2021.

common e-learning application since an intrinsic balance between learning and gaming should be found. Indeed, the learning content in a serious game has a predominant role in the game-play, but the game interactions and mechanics should not simply be a playful layer added atop a digital learning tool.

This paper aims at presenting serious games as a promising tool for promoting and engagingly learning cultural contents, attracting new audiences and encouraging knowledge and awareness on archaeological heritage. The potential benefits of this tool will be analyzed and the role of archaeologists in the process of creating archaeological serious games will be stressed. The aim is to underline the need for a digital content that goes beyond the mere digitalization of the existent and its simple presentation in a different form (just more eye-catching) that adds nothing. The challenge for the future is the exploitation of tools that can promote the creation of awareness, lasting engagement, and critical knowledge starting from a specific and scientifically validated cultural content (Watrall 2002); that's why this paper is specifically addressed to archaeologists interested in the use of original means to make the past relevant for the present: archaeological expertise shall be a crucial asset in this area and it can determine a whole bunch of professional possibilities over the coming years. Besides, this intent is consistent with the most recent and significant European conventions and documents concerning cultural heritage sustainable development (Council of Europe 2005, Council of the European Union 2014) and with the deepest intent connected with the widespread of digital and sustainability aspects in Public Archaeology projects (Bollwerk 2015; Gould 2018).

2 Digital Games as Educational and Engaging Tools

Gamification is defined as “the use of game design elements in non-game contexts” (Deterding et al. 2011, 10). Another definition describes it as “the process of game-thinking and game mechanics to engage users and solve problems” (Zichermann, Cunningham 2011, XIV). There are many other aligned terms of gamification, such as productivity games, surveillance entertainment, playful design, behavioral games, game layer, and applied gaming; however, gamification is the term that is widely accepted in related literature (Bozkurt, Durak 2018). Though it was first used for marketing purposes, it has been used in relation to many issues - the pervasiveness and ubiquity of computer and video games in everyday life; the need to arouse and maintain students' interest in learning - to involve users and encourage them to achieve more ambitious goals, following rules and having fun. The basic purpose of using gamification is to increase users' motivation to provide more effective, efficient, engaging, endur-

ing and entertaining experiences. In other words, the main goal of gamification is to keep the users, that is to say, players, *in* the game.

The process of modern education takes place in the rapid growth in volume of new information, which is so rapidly becoming obsolete that students have no time to acquire the necessary useful knowledge but gained quickly loses their relevance. Rapidly developing technologies facilitate new leisure activities, and time for obtaining information becomes smaller for everyone. Also, the cognitive process is not required to take place in the formal (and often boring) environment and can turn into wholesome entertainment, with the acquisition of knowledge at the same time. Edutainment is a feature of technological implementation of modern forms of entertainment in traditional lectures, lessons, classes, workshops and masterclasses. Without television programs, desktop, computer and video games, movies, music, web sites, multimedia software is already impossible to imagine modern training and communication. Classes and activities held in the format of the technology edutainment can be conducted in cafes, parks, museums, offices, wherever you can obtain information on any informative topic in a relaxed atmosphere. Currently, in education, there is a transition to more interactive, engaging, and experiential learning methods in which also emotions play a fundamental part. According to Buckingham and Scanlon (2005), edutainment is “a hybrid genre that relies heavily on visual material, on narrative or game-like formats computer games-education-implications for game developers and more informal, less didactic styles of address”. Edutainment is the act of learning heavily through any of various media such as television programs, video games, films, music, multimedia, websites and computer software. Moreover, the importance of instrument-mediated activity through the use of edutainment environments is consistent with the learning theories derived from Piaget (1962) works focused on cognitive development.

The use of games and video games as learning tools, known as game-based learning, is not a recent innovation, but it has been gaining prominence in recent decades.³ Game-based learning has assumed greater interest since the beginning of the century with the Internet and the World Wide Web and, more recently, with the paradigm of Web 2.0 and social networks. Video games are popular among younger generations, designated by some as “digital natives” (Prensky 2001). For them, all these technologies always existed and are used as something that was always part of their lives. Moreover, all the researchers tell us that kids learn things through play: they learn to interact with each other, to follow rules, the executive func-

3 An extensive bibliography and some of the most significant contributions are discussed and summarised in Sailer et al. 2017.

tions and problem-solving skills. Video games are successful because they seem to address today's approaches to challenges and are consistent with the needs of our time (Shapiro 2018; Mariotti, Marotta 2020; Singh 2021).

According to the last reports shared by the Entertainment Software Association, 2020 was a record-breaking year for the US industry, with total video game sales exceeding \$57 billion. Over 214 million adults in the United States play video games, and three-quarters of all Americans have at least one gamer in their household (Entertainment Software Association 2020). Things are not very different if we focus on Europe: the size of the European video gaming industry reached € 21.6 billion in 2020 (Interactive Software Federation of Europe 2020). According to the most recent report (Italian Interactive Digital Entertainment Association 2020), Italian trends mirror these growth forecasts: in 2020 the industry turnover (including physical and digital hardware and software) was € 2.179 billion with an exceptional growth of 21.9% compared to 2019. Another very interesting fact revealed by the report is related to the profile of Italian gamers: 16.7 million people played video games in 2020, meaning 38% of the Italian population between 6 and 64 years. From a gender perspective, a quite similar proportion of men (56%) and women (44%) is also attested. The age groups of 15-24 and 45-64 are the most represented, followed by the range 25-34. In general, we can observe that the diffusion of video games is quite uniform and another very interesting data comes from the 6-14 range with an average of 10% of the total (considering both boys and girls as the difference between them is almost inconsistent). It appears quite obvious that, also due to the COVID-19 pandemic, 2020 marked a record in the use of digital content. A very recent survey (Creative Keys 2020) shows that, during the lockdown, video games were amongst the tools cultural institutions used to engage with their public. According to the survey, people who played serious games linked to a cultural institution stated that: they have the perception of having learnt something (78%), they enjoyed that time (85.8%), they were encouraged to try other digital games with cultural content (81.1%), and more than half of them (54.4%) confirmed their willingness to visit those sites or museums in the future.

3 Gamifying the Past: an Italian Perspective

In this global context, another interesting piece of data emerges: in fact, a brief perusal of video games' content also reveals themes that often incorporate archaeological content, sometimes highly accurate, other times (most frequently) not so much (Christensen, Machado 2010). As Watrall (2002) argues, archaeological content has been of-

ten used as a triggering subject but archaeologically inspired interactive entertainment titles are often an outlet for some of the worst kinds of pseudo-archaeological ideas (e.g. *Tomb Raider* series).

In the last decades, with the increasingly widespread use of advanced personal device technology such as smartphones and tablets and thanks to broadband internet access, the number of multimedia products developed within the archaeological community has certainly increased. However, the focus on peer-to-peer communication and university-based courseware has remained quite entrenched until recently. Archaeologists rarely ever considered exclusively targeting their interactive media towards the commercial market. As a result, the increasing public desire for sensational representations of the human past has been largely fulfilled by commercial interactive media producers who rarely have anywhere near the level of expertise necessary to produce titles that conform to the high content standards archaeologists desire and archaeology deserves. While, in a global perspective, serious games, edutainment, and gamification have been well-known concepts and many museums have been using digital playful activities for a long time, an increasing emphasis on these aspects is quite evident in the last years, especially in Italy where a certain resistance among the academics was still strong, with more and more archaeologists who have finally put their pre-conceptions aside and started considering video games as a useful tool for their objectives (Mariotti 2020a). The recent development of institutionalized public archaeology programs in Italy has had the potential not only to face the interactive entertainment industry's increasing encroachment into archaeology, but also to change the sentiments that many Italian archaeologists hold toward interactive entertainment. It is not a coincidence that video games are a growing concern in global academic research in the archaeological field and present a considerable attraction for archaeologists who wish to present their research in a media format that can incorporate multiple perspectives, alternative narratives, and 3D representation to audiences that may not be engaged with other forms of academic literature or media regarding archaeology.⁴

In the last years, serious games in the archaeological heritage domain in Italy have received more and more attention, gaining the interest of museum institutions, academics, and local administrations. They appear in a wide variety of forms spanning from trivia, puzzles and mini-games (e.g. *Time Tales - The Etruscans*, a serious game for children designed by two archaeologists (Mariotti, Marotta 2020) in collaboration with a serious games company, Entertainment Game

⁴ Some of the most significant contributions in the field are Champion 2011; Mol et al. 2017; Reinhard 2018; Politopoulos et al. 2019; Hageneuer 2020; Pescarin 2020.

Apps Ltd.), to engage in interactive exhibitions/visit (e.g. *Inventum* (2018), a 3D application in AR to enhance the Archaeological Park of Venosa, Potenza) to mobile applications for museums or touristic sites visits motivated by some reward/engagement mechanism (e.g. *Mi Rasna*, developed by Entertainment Game Apps Ltd. and dedicated to the Etruscan civilization (Amoroso 2020); *Mediterranean* developed by the same society as part of an European project dedicated to the Phoenician civilization; *Father and Son* (Solima 2018) created by Tuo Museo for the Archaeological Museum of Naples; *Beyond Our Lives* an adventure game by Tuo Museo to promote the main ancient Etruscan cities in Tuscany), to simulations of past events (e.g. *Difendiamo le Mura* based on the siege of the city of Paestum by Alexander Molossus and until recently available inside the local archaeological museum) to adventures set in faithful reconstructions and/or digital counterparts of real sites (e.g. *A Night in The Forum* (Ferdani et al. 2020; Pescarin et al. 2020), a 3D video game for PlayStation VR created by VRTRON in collaboration with Italian CNR and set in the Forum of Augustus, one of the Imperial fora of Rome; an ongoing 3D project (Mariotti 2020b) dedicated to the Park and Archaeological Open Air Museum of Poggibonsi, Siena and to the medieval phases of the site discovered by archaeologists.

Generally speaking, a proliferation of video games projects connected with heritage sites, museums and institutions can be observed in the last few years. This encouraging figure, however, must be evaluated carefully: the risk is that fostering the creation of a serious game is reduced to the trend of the moment and that to an increasing number of projects does not correspond an equally high level of quality and relevance. Quality standards in terms of content, game design and objectives should be always respected and assessed wisely.

4 Serious Games & Archaeology: Potential and Benefits

While, in the last decades, we have witnessed the introduction of serious games to support cultural heritage purposes, such as historical teaching and learning, or to enhance archaeological sites and museum visits, the increasing emphasis on and eye for the opportunity of this in the last years – especially in Italy – is beyond any doubt. The main reason is that this tool has the potential to be very adaptive and to allow a wide range of possibilities. These benefits can be classified into three different groups (with many spaces of interaction): education, public outreach and audience engagement, and touristic development.

4.1 Education and Learning

The popularity of video games, especially among younger people, makes them an ideal medium for educational purposes. Serious games can provide player engagement by creating a fun experience for users while also supporting them to achieve learning objectives. That is why games can also aid in familiarizing young people and adults with specific cultural heritage topics, such as ancient history or archaeology, and significantly increase their interest levels and engagement (Mortara et al. 2014). Supporting the player to achieve learning targets through a fun experience is the objective and main feature of a serious game. The fun aspect of a serious game provides engagement and can be determined by several factors like storyboard, graphics, usability, collaboration/competition mechanisms, and interaction devices (Mariotti, Marotta 2020). The learning aspect implements a pedagogical approach, by structuring the educational content and organizing its presentation (Capdevila Ibáñez et al. 2011). An appealing and meaningful environment, a compelling narrative, and a suited and intuitive interaction paradigm are the three main elements to create engagement. Moreover, serious games for cultural heritage seem particularly suited for the affective domain. Empathy with a game character and plot may be very helpful to understand historical events, different ancient cultures, other people's feelings, problems, and behaviors, on the one hand, and the beauty and value of the past, architecture, art, and heritage, on the other one. This persuasive approach should be combined with the rigour of the scientific method, which is a balance not easy to achieve, not only in games. As pointed out by Mortara et al. (2014), adventure games are particularly suited to implement the "learning by doing" approach (Dewey 1938), which is related to the constructivism theory, where the player learns by constructing knowledge while doing a meaningful activity. In this approach to education, the learner does not passively receive information – as in a simple explanation, a panel or a virtual reconstruction although accompanied by a description – but rather actively constructs new knowledge by finding information in the game, understanding it, and then applying the new knowledge to fulfil tasks (Boyan, Sherry 2011). As underlined in Froschauer (2012), players remember more the knowledge related to task completion than information directly provided by the game, not to mention that simply responding to direct instructions would not be fun at all.

Moreover, serious games allow a personalized approach to learning: except for games located in exhibitions or designed as mobile applications for augmented visits, all the other games can be consumed at home or school, or both; a game can even be played partially at school, in small groups and with the support of the teacher, and partially at home for example as a tool to review the acquired knowledge.

4.2 Public Engagement

In a 2017 article discussing whether archaeologists and games could mix, Erik Champion (2017) concluded saying:

My solution is to suggest that rather than concentrate on the technology, archaeologists should focus on the expected audience. What do we want to show with digital technology, for what purpose, for which audience, and how will we know when we have succeeded? (27)

I think he pointed out a key issue regarding this discussion: different professionalism and different competences are essential for a good result. Archaeologists have their area of expertise regarding historical and archaeological content, narrative, storytelling; on the other hand, the technological aspects should be determined by other professionals whose knowledge about the game industry better fits the requests. But this also means that since we, as archaeologists, are entering a completely new way of communicating, we have at least to understand the ‘new rules’ of video game form. One of the main risks is to be too didactic since we are used to telling historical events and explain processes. In a video game, this would be totally wrong. In this case, you have to create the system to show the player, do not tell them. They have to be put in a situation in which they have to use the acquired knowledge to go on in the game: these are the keys to children’s engagement (Haddad 2016) and they work for adults too, as suggested by the already cited “learning by doing” approach.

Moreover, public engagement and the communication of archaeological data have been on the top list of the major concern in Italian archaeology debate in the last decade (Volpe 2020) and the natural development of multiple strategies exploiting different mediums was a natural consequence of this new experimental attitude in which technology has been playing a central role. While archaeological content has always evoked a certain interest and fascination, archaeological sites or museum have often been perceived by the general public as places for experts and professionals. Archaeologists have finally learned that a different approach, less patronizing and truly more informative and inclusive, makes people enjoy the content more easily and experience the visit in a more friendly way; in doing so, they will feel engaged, free to appreciate the past and also have fun.

Video games, in particular, are a form of new media, whose novel affordances facilitate active participation and agency through player interaction with both content and digital systems, thus providing the player with the ability to direct or alter the course and outcome of the game as it progresses. The thrill of discovery and exploration combined with the opportunity to relive the past is something that

appeals both on an instinctive and emotional level. Video games have played into this desire in several ways. First of all, because they allow players to immerse themselves in the experience: in the case of a serious game set in the past, the authenticity of the space (whether stylized or not) and of the narrative is fundamental. 'Experience' is a keyword when people discuss using game-based learning. Games engage people psychologically - they can be very emotional experiences - and they also engage people physiologically. What is going on beyond the peripheries of the TV screen or computer monitor ceases to register to the user. His/her heart rate increases, the hair on the back of the neck stands up and s/he may well end up laughing out loud at (or furiously cursing at) a virtual character who is actually nothing more than a collection of pixels and programming code. Games are very good at using drama, storyline, humour and characters to create a compelling experience which, from a training point of view, develops memory hooks and means that learners not only remember *what* happened but also *why* it happened.

In an archaeological serious game project, archaeological expertise becomes essential and it can be easily translated both in set dressing and in information conveyed through boxes, dialogues, meaningful objects etc. (Anderson et al. 2010). To encourage an actively involved player, free to explore and to interact, the creation of a 'safe' setting in which errors, mistakes, wrong moves are allowed and have no 'real' consequences is necessary. This 'safe virtual space' is also supported by the 'avatar' or in general by the possibility to play through someone else (a character) and with an interface screen that provides the player with the 'right distance' between what is real and what is not. Moreover, games, more than any other medium, have the advantage of establishing a direct relationship with the player: the game and the story only evolve if he/she makes a move and this occurrence makes players feel like they are the protagonist of the story. In this way, cognitive and emotional responses for vigorous historical engagement can be created: apart from the stimulation of reflection, people have the opportunity to explore past events and information and to perceive history in an all-encompassing way.

Focusing back on Champion's suggestion, I too believe that knowing the audience we are addressing is fundamental, as it is crucial in every practice of communication. However, I would say that, for an archaeologist, the main focus of the creative process of a serious game should be the content. One could argue that the more creators master the content, the more they will be able to translate it into a comprehensible language for the target public. As I said, it's not always so easy. This represents a crucial moment in the creative process because it requires working with professional game designers and developers: by creating together, we all found ourselves constantly pushing up against the boundaries of our disciplines and by

doing so, we, as archaeologists, have the opportunity to critically reflect on our own perspective and to experiment a completely new way of communicating our research by adapting our language to the video game medium as well as the audience (Coppelstone 2017).

4.3 Touristic Outcomes

Towards the end of 2009, Ubisoft released the second chapter of its series *Assassin's Creed*. One of the settings of the game was Monteriggioni, a small medieval Tuscan village near Siena. Economic results regarding the tourism sector from the first half of 2010 (from January 1st to June 30th) pointed out an increase of 7.24% in arrivals and 16.28% in overnight stays in town compared to the same period in 2009 (Capone 2011). Six years later, in summer 2016, the municipal administration of Monteriggioni launched a survey asking 500 tourists to fill out a questionnaire. Among the questions, there was one that concerned the knowledge of *Assassin's Creed II*. The result was that 11.4% of people answered that they knew Monteriggioni thanks to the video game.

According to recent studies, as in the case of films or books, video games should be considered as a driver of tourism (Dubois, Gibbs 2018; Sajid 2018). A very recent survey of 827 Italian gamers carried out by the project Italian Videogame Program (2019) confirmed that the majority of them (79.9%) are willing to visit a place they got to know through a video game and that 47,9% already have done so.

First of all, this potential breaks the cliché according to which video games have a very negative influence on players (especially the youngest) because they would induce them to isolation and disconnect from reality. Secondly, this possibility deserves to be carefully considered and exploited for many good reasons: to enhance the knowledge and the value of cultural heritage in general, to address public engagement and audience development, and to promote archaeological sites, parks, museums. The development of public archaeology as a field of study and the significant European conventions and documents released in the new millennium (Council of Europe 2005; Council of the European Union 2014) contributed to placing laypeople and sustainable development through the promotion of cultural heritage at the centre of the archaeological discourse. The commitment to public participation is of pivotal importance for archaeology, given the need to clearly demonstrate the extent of its economic and socio-cultural impacts. Once again, archaeological serious games can be a strategic asset for achieving these objects. Games, in fact, are increasingly being played online (on the browser) and/or on mobile devices. The latter ones, in particular, have a great potential to engage museum visitors. Mobile applications typically feature

images, bar-codes, and QR codes and exploit GPS position (e.g. the already cited *Inventum* and *Mi Rasna*). One popular type of feature in this perspective is 'location-gaming': the mechanic is that players go to places, do fast, simple tasks (like typing something into their phone, or simply confirming their presence by pressing a button in the app), and win a reward (either virtual points as in *Mi Rasna*, or the possibility to unlock new areas or options as in *Father and Son*, or even something tangible). The opportunity given by this mechanism motivates players on one hand and concretely involves cultural spaces on the other. This also allows museums, cultural institutions, and even local administrations to make themselves known, develop a network of multiple connections, and share common benefits deriving from this growth.

The 'visiting time expansion' is another very interesting key point and it is probably the litmus test for the effectiveness of the serious game project because it allows us to evaluate what links the virtual scenario offered by serious games and the real space they represent or refer to in their interconnection. Let us consider, for instance, an archaeological site: tourists may visit it and then go back home. If we are lucky and it happens that they are particularly interested in the historical context and/or amongst those who grow a particular fascination with the remains, they may be interested in coming back for a second visit or in developing their own research and curiosity afterwards. This is unfortunately a very rare occurrence. A serious game offers the opportunity to expand visitors' time on the site and it can provide further information about it (potentially much more than any guide can do during a generic visit – just think for example of the *Assassin's Creed Discovery Tours* (Porter 2018) – and providing more fun than a book for the majority of people). Moreover, it gives players the chance to choose when to access that information: in some cases, it can be done before the visit, in others after, but nothing prevents them to do it even during the visit. Serious games can be adjusted and conceived to offer a tailored experience and to overcome time and space limitations, especially given that the great challenge of our time is to move from a mass-oriented approach towards a personalized experience (Mortara et al. 2014). However, the benefits of serious games applied to archaeological heritage are not limited to a post-visit moment. As we have seen, they can actually be extremely convenient to engage a larger and more diversified audience and by doing so, to attract the public and bring people physically to specific places. In this sense, and by linking the touristic benefits to the educational ones, teachers can also use serious games to prepare the visit to a specific site or museum and, in particular circumstances, they can also be used as a temporary substitute for the visit (e.g. in case of bad weather referring to open-air archaeological sites or under any other inconvenience).

5 Future Challenges: Assessing Archaeological Serious Games

While several serious games have been developed in the last years, and despite the consensus that they have as a tool for instruction, still the literature stresses a lack of significant, extensive user tests: their effectiveness in terms of learning outcomes is still understudied mainly due to the complexity involved in assessing intangible measures (Bellotti et al. 2013). A systematic approach - based on established principles and guidelines - is necessary to enhance the design of serious games, and many studies lack a rigorous assessment. An important aspect of assessing serious games, like other educational tools, is the user performance assessment. This is an important area of exploration because serious games are intended to evaluate the learning progress as well as the outcomes. This also emphasizes the importance of providing appropriate feedback to the player. Moreover, performance assessment enables adaptability and personalization to meet individual needs in various aspects, such as learning styles, information provision rates, feedback, and so forth. Despite the globally growing interest in digital game-based learning and the significant efforts in researching and evaluating serious games, considerable weaknesses remain, including a lack of comprehensive frameworks for comparative evaluation: it is possible to evaluate a single title, problems come when you have to deal with more than one since it is very difficult to assess all the characteristics and the relative level of learning they allow for. While some game-based learning models have been developed in the literature (Mayer et al. 2014), they do not specifically tackle the evaluation of the learning impact produced in the learner by playing (serious) games. Despite many methodologies that have been elaborated in the last years (Catalano, Luccini, Mortara 2014), this remains nowadays one of the most important challenges researchers have to deal with.

This applies all the more to Italy where serious games are now slowly starting to be recognized as effective tools applied to cultural heritage enhancement. Further research is necessary to investigate in greater detail the real effectiveness of the various types of serious games, to define a methodology based on metrics and evaluation tools (Bellotti, Berta, De Gloria 2010), even more so those with archaeological content.

Since the purpose of a serious game is twofold: to be fun and entertaining, and to be educational, therefore, assessment of a serious game must consider both aspects of fun/enjoyment and educational impact.

Standardized assessment methods often take less time and are easier to conduct, and their results are readily interpretable. The easiest way in this sense is appropriate questionnaires administered

before and after the experience. However, in the case of an archaeological serious game, the intent is often much more complex than the mere learning aspect. Serious games have proven to potentially be an independent instrument, capable to bring information, lasting engagement, knowledge, and curiosity to a very diversified public. So, how to assess these further aspects? Recent studies have explored how play-based assessment can provide more detailed and reliable evaluation and emerging interests reflect the needs for an alternative or supplemental assessment tool to overcome limitations in the standardized approach. Play-based, or in-game, assessment (which can also be personalised in case of different users) can provide more detailed and reliable information, and the emerging interest in this field reflects the need for alternative and/or supplemental assessment tools to overcome limitations in the standard approaches (Bellotti et al. 2013).

I strongly suggest that, in the case of an archaeological serious game, all the aspects discussed before (the recognised benefits) must be taken into consideration and carefully assessed since they can be considered the learning outcomes linked to knowledge acquisition and skills development. Learning is a complex construct difficult to measure since it deals with personal behavior and emotions, and as Brockmyer et al. (2009) suggest, indirect measures of learning must be applied to assess the levels of engagement of players. These indirect measures in the archaeological field must take several other data into account as Koutsabasis (2017) suggests: from touristic numbers to scholastic results, and visitors' retention referable to the development of serious games project connected to a site or a museum, just to name a few. When it comes to the benefits of cultural heritage, as archaeologists, we know that this account cannot be calculated in terms of cash, but on a much larger scale, in reason of the productive assets generated by the activities that revolve around this particular type of resource and, I would add, in terms of public engagement: the most important economic calculation is the one that measures the wealth produced in terms that I would define 'intangible' and longer-term. We must, in fact, calculate the lower expenditure generated over time by that which we can define it as 'active social protection', that is, a cultural and participatory growth, which leads to responsible social behavior respectful of monuments, of landscape and environment. It goes without saying that by cross-referencing these - apparently - different data, a more detailed and defined assessment can be provided and the real benefits generated by an archaeological serious game can be estimated.

6 Conclusions

Serious games are an acknowledged tool for several purposes and amongst this range of possibilities, they can meet archaeological aims and so, represent an extraordinary medium for archaeological heritage dissemination and enhancement. First of all, they are a potential for public outreach and education, because they can strongly motivate learners and create awareness about a topic. They can also provide immersive environments where a large variety of users can practice knowledge and skills, and finally, they can be used as an asset to promote tourism and sustainable cultural heritage development. The design of a serious game, by its nature, requires the iterative collaboration of various experts with specific competencies and skills: educators, art directors, game designers, scriptwriters, software developers, graphic and sound designers. Additionally, a serious game in the archaeological heritage field cannot ignore the domain experts who select the educational contents and provide scientific validity and reliability. This teamwork aims at preventing the project from being just a game with an extra layer of pedagogical and pseudo-archaeological content. There needs to be a new breed of archaeologists who take an active participatory role, as consultants, developers, and writers. This is an ethical responsibility but also a very stimulating possibility for archaeologists who are interested in exploring new ways to engage the public, share their research and promote archaeological sites and knowledge: actually, this kind of new interdisciplinary professional profiles can take up the challenge and, through serious games, create a brand new set of opportunities for professionals and cultural and archaeological heritage (Mariotti 2020a).

However, for serious games to be considered a viable educational tool, they must provide some means of testing and progress tracking. As Kevin Corti of PIXELearning stated (Michael, Chen 2005). Again, archaeologists must take care of this issue in collaboration with other professionals. This will increase efficiency in designing games and authoring contents, which is a key requirement for the serious game industry. By doing so, archaeologists can also get the chance to explore how and why creating and communicating through serious games might provide powerful new ways to think about, do, and present the past.

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