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The Educational Application Of Virtual Laboratories In Archaeometry

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ABSTRACT

The digital cultural heritage field has been developing in parallel with modern archaeology by collecting and storing data from all aspects of field work, from excavations to virtual representations and to exhibitions, and by transforming data into knowledge and new services, ranging from supporting scientists to offering edutainment content. As an integral part of archaeology, the field of archaeometry deals with exploiting laboratory techniques and ICT tools to examine and analyze archeological findings. The present article briefly review works on the use of virtual environments in the digital cultural heritage field, and secondly reviews applications of virtual laboratories in archaeometry and, finally, based on the observation that virtual laboratories are now increasingly finding their way into education, to highlight the key aspects of a proposal to integrate virtual laboratories in Archaeometry education.

KEYWORDS

Archaeometry Education, Cyber-Archaeometry, Digital Cultural Heritage, Educational Applications, Onlabs, Preparatory Tool, Virtual Laboratories

INTRODUCTION

The evolution of Information and Communication Technology (ICT) over the last decades affects every domain of scientific research. In the field of Cultural Heritage, ICT technologies are used in many areas but the deliberation about the way new technologies and the potential of the Internet affect the electronic processing and presentation of museum artifact collections and monuments is still strong and already going on for about 20 years (Liritzis, Al-Otaibi, Volonakis, & Drivaliari, 2015). A popular adage mentions that the 21st century archaeologists are no longer excavators (Djindjian, 2015). Archaeologists and scientists from variety of scientific fields play a key role in the difficult task of reconstructing the past and providing people with the necessary information about the civilizations of past societies. Digital tools have been employed in cultural heritage applications at every level and their increased use facilitates the information processing and presentation, concerning the field investigation and the post excavation phase (Wilhelmson & Dell'Unto, 2015).

The digital cultural heritage field, as major part of synchronous Archaeology, depicts to the end user all the information from excavation to the virtual representation, using ICT tools at every step. Nowadays, there are various virtual applications of digital cultural heritage presentation, including virtual museums and exhibitions, serious games and virtual representations. According to Kiourt et al.

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(2017), *virtual museums have a prominent role in realistic simulations of Cultural Heritage*. The idea for virtual museums has been initiated as a solution to the problem of the physical space limitations and additionally as an opportunity for remote visitors to have a virtual tour (Tsichritzis & Gibbs, 1991). Several research and development works have led to a significant number of projects relating to virtual museums and exhibitions, mainly for a particular cultural stakeholder (Kiourt, Koutsoudis, & Pavlidis, 2016). In Sylaiou, Liarokapis, Kotsakis and Patias (2009), virtual museum technologies are presented. Another approach concerning digital archaeology is the virtual environments (cities, places, buildings etc.), which, apart from historic information, they include sociocultural information concerning the past cultures (Abdelmonem, Selim, Mushatat, & Almogren, 2017). These applications offer users the possibility to experience virtually reconstructed historic places as visitors.

While virtual museums tend to saturate (Kiourt et al., 2017), the virtual labs (in archaeometry) are flourishing significantly in the field of cultural heritage (Liritzis, Volonakis, Vosinakis, & Pavlidis, 2015). Musílek (2015), stated that archaeometry is the application of various scientific fields, like natural sciences and engineering, for exploring archaeological findings. In the stage of archaeometry, laboratories are used in order to examine and analyze the archeological findings. Thus, science students (such as physicists, chemists etc.) are educated in laboratory experimentation to acquire haptic skills and instrumentation consciousness, which will be used in the analysis of archaeological findings. Laboratory education can be enriched by using virtual laboratories due to the advantages they offer, concerning mainly cost and time for preparation reduction and improved safety (Ma & Nickerson, 2006). Even so, the literature review concerning the use of virtual laboratories in archaeometry education revealed their limited use, especially in the application of analytical techniques used for dating and artifact-use determination.

Scientists working on virtual worlds have already started to realize the potential of new technologies for the development of edutainment content and services for their users (Bickmore, Pfeifer, & Schulman, 2011). In addition, gaming for educational purposes is a significant and active research domain (Brown & Vaughan, 2010; Nicholson, 2011, 2012; Seaborn & Fels, 2015). This has taken either the form of Game-Based Learning (GBL) or Serious Gaming (SG). The importance of the playing activity has been emphasized in many studies from various domains. Serious games can be used as an alternative approach to education in cultural heritage, as numerous works are used to enrich history education and actual museum visits. And now serious games technologies are used to increase the effectiveness of virtual laboratories for cultural heritage applications (archaeometry), focusing in development of more dynamic, pleasant, user-friendly, attractive, personalized educational environments.

The motivation of this paper is the identification of the lacks and the needs of educational approaches based on virtual laboratories in the field of cultural heritage applications (archaeometry). Although, the virtual laboratories are used for some years in science education, their adoption in archaeometry is limited. So, the advantages they may offer as educational tools in the field of archaeometry are not fully exploited. In addition, an important incentive was the need for more safe, effective and without pressing time constraints laboratory preparations of the students, for almost all sciences domains as well as in cultural heritage domain, before they conduct the experiment on site.

The main contribution of this work is, firstly, to present a review of studies, concerning the use of virtual laboratories in the domain of digital cultural heritage (archaeometry), in order to reveal the limited use of this tool in the specific area and also to present the most well-known innovative virtual laboratories in archaeometry for educational uses. Secondly, to propose a gamified educational approach/framework in archaeometry education, based on a virtual laboratory (laboratory already in use in other cases), which has produced the necessary infrastructure for allowing the performance of educational experiments that require complex equipment. This approach focuses mainly in the preparation of the students in virtual experimentation in processes involved in the field of archaeometry, in order to reduce the cost of using of hands-on laboratories (real tools), costs such as maintenance staff, materials, expendables and high cost equipment wear. Also, to prevent students from exposures

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