Chapter 8
Cross-Reality Technologies in Archaeometry Bridge Humanities With "Hard Science"

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ABSTRACT

As an integral part of archaeology, archaeometry, employs standard laboratory techniques and ICT tools to examine and analyze art and archaeological materials. Most students involved with cultural heritage and Archaeology have a background in the arts or humanities and a minimal, if any, training in the principles and techniques of most natural and engineering sciences. Consequently, when choosing to be enrolled in an archaeometry course, an interdisciplinary field which also requires some background in applied sciences, cross reality labs can be the bridge between archaeology and its sub-disciplines, and "hard science." In this chapter, the authors focus on the use of virtual environments in the digital cultural heritage field, as well as on applications of cross reality laboratories in archaeometry. Finally, they present some evidence in favor of the simulations, pointing out that VR, AR, and MR labs could train, safely and efficiently, pre-service archaeometrists in the use of specialized laboratory apparatuses and help them take advantage of the full spectrum of modern laboratory tools.

DOI: 10.4018/978-1-7998-2871-6.ch008

INTRODUCTION

The evolution of Information and Communication Technology (ICT) over the last decades, alters our lives and affects every domain of scientific research (Collins, & Halverson, 2018). In the field of Archaeology, ICTs are used in many areas but the deliberation about the way new technologies and 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 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 archaeology at every level. 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. Musílek (2015) stated that archaeometry is the application of various scientific fields, like natural sciences and engineering, for exploring archaeological findings. The term archaeometry has appeared for the first time in the journal *Archaeometry* in Oxford in 1958. In the stage of archaeometry, laboratories are used in order to examine and analyze the archeological findings. As there should be a continuous interaction between the people managing the cultural heritage and the scientists, it is essential that both parties are aware of the potentials, each technique used for scientific investigation, can have. Unfortunately, in most countries the conventional academic differentiation between humanistic and scientific curricula in the educational institutions is the most important barrier to the exchange of competences between archaeology and science (Artioli, 2010). Most natural sciences students involved with cultural heritage have minimum training in the scientific principles and techniques they are about to use in an archaeometry lab. ICTs tools like Virtual Reality (VR) and Augmented Reality (AR) laboratories, could create an interface between these different disciplines and offer a deeper understanding for the science principles on which the operation of complicated laboratory equipment is based.

The objectives of the present study are at first, a presentation of studies concerning the use of virtual environments in digital cultural heritage field, secondly a brief review of virtual laboratories in Archaeometry and finally a proposal of how virtual laboratories can be a part of Archaeometry education based on the presentation of student's outcomes in educational scenarios where a VR laboratory application is involved.

BACKGROUND

The results of archeological excavations, the study of the findings and the available written sources, provide the bases of information concerning past cultures and places. Through archaeology, the history is synthesized and past cultures are comprehended (Balla, Pavlogeorgatos, Tsiafakis, & Pavlidis, 2014). The public is informed and educated in the past cultures using the data that the field experts, who work on preserving the cultural knowledge, present. Technology offers new methods to preserve and learn about ancient cultures (Bogdanovych, Rodriguez-Aguilar, Simoff, & Cohen, 2010). Furthermore, the archeological sites are fragile and disposed to possible causes of destruction. Thus, the original findings may be destroyed during an archeological site dig procedure (Forte, 2011). Making the digital