Journal of Advanced Distributed Learning Technology - JADLeT

EXPLOITING INNOVATIVE LEARNING STRATEGIES WITH VIRTUAL MUSEUMS

Alessandra Antonaci*, Michela Ott*

***Abstract**: The paper explores how Virtual Museums (VMs) can contribute to foster cultural heritage learning by adopting innovative learning/teaching strategies. VMs are innovative software applications that use vision, narration and interaction to create immersive experiences that bring visitors, students, scientists inside history, past landscapes, art, towns etc…..They deal with a wide variety of contents and adopt various approaches to support information delivery, awareness raising, knowledge creation and, ultimately, learning. Three different examples of Virtual Museums are briefly presented in the paper with the final aim to show that, despite the specificity of the contents displayed, each of them can contribute to sustain learning by exploiting the potential of three different learning/teaching, strategies, able to support the students' motivation by fully engaging them in the learning process. In this line, VMs can be considered adaptive learning tools effectively supporting learning innovation.*

***Keywords:** Cultural Heritage; Virtual Museums; Learning Innovation; Educational strategies, Gamification, Exploratory learning.*

I. INTRODUCTION

The paper deals with the educational deployment of the new generation of digital museums, that are commonly defined Virtual Museums (VMs) [1], and argues that they can contribute effectively and genuinely to innovate learning [2] by exploiting innovative learning/teaching strategies. In doing so, we refer to Cultural Heritage Education, which is a specific field where the adoption of technological tools is not yet consolidated around Europe [3], but also where expectations are high and the potential of technology is widely regarded as huge and promising [4].

VMs can be employed in formal, non-formal as well as in informal educational settings with different implications, for different purposes [5]. In this paper, we will mainly refer to their adoption in formal educational contexts and envisage the possible benefits of their use for sustaining standard curricular teacher-driven activities.

As a matter of fact, as it happens for other innovative tools, the adoption of VMs in formal educational settings is not straightforward but needs accurate planning and appropriate deployment on the teachers'/educators' side [6]. Only if these two conditions (accurate and appropriate design of the intervention and in-depth teachers' involvement) are fulfilled we can reasonably expect that these tools can contribute to carry out effective learning processes.

While choosing the digital tools to be used in the classroom teachers need to consider very carefully whether it adopts the appropriate learning/teaching strategy; as a matter of fact, the choice of the learning strategy may have a strong impact on the effectiveness of the whole learning process. Teaching/learning strategies (i.e. how the application actually presents/teaches a specific argument) should be regarded in the light of their potential effectiveness in respect to both the subject to be taught and the potential adaptivity to single learner's needs.

In the following, we briefly present three examples of VMs and by highlighting how each of them employs a different educational strategy.

* *Institute of Educational Technology, Consiglio Nazionale delle Ricerche, Via De Marini 6, Genova, Italy,* antonaci@itd.cnr.it, ott@itd.cnr.it

II. DIFFERENT EDUCATIONAL STRATEGIES FOR DIFFERENT VIRTUAL MUSEUMS

VMs are software applications that use vision, narration and interaction to create immersive experiences that bring visitors, students, scientists inside history, past landscapes, art, towns etc…

Following the definition agreed in the network of excellence V- MusT [1] they are also intended as means for supporting dissemination and learning and for fostering communication among actors in the Cultural Heritage sector: "*A Virtual Museum is a communication product accessible by a public, focused on tangible or intangible heritage. It uses various form of interactivity and immersion, for the purpose of education, research, enjoyment, and enhancement of visitor experience*".

Actually, VMs are relevant examples of how cutting-edge ICT technologies can be embedded into software applications oriented to knowledge raising and learning in the field of both tangible and intangible cultural heritage. A list of a variety of available VMs is available in theV-MusT.net website.[1]

Many types of VMs exist, which differ as to the internal structure, the specific objectives addressed, the presentation methods, the implementation techniques and the interaction approaches adopted. They deal with a wide variety of different contents and adopt various approaches to support information delivery, awareness raising and, ultimately, learning.

Actually, educational potential of VMs is being widely acknowledged, although their actual use for educational purposes is still very limited (at least in formal educational contexts) [7].

Different educational strategies are adopted by VMs: from the very simple and traditional ones (such as questions / answers) up to some more sophisticated and innovative. Examples for the gamification, the storytelling and the exploratory learning strategies are reported below.

3.1 APA: an example of the adoption of the gamification strategy

The APA game [8] is an example of how game technologies, and in particular gamification, can be employed for "serious" purposes and thus can be incorporated in a VM, with the final aim of enabling users to explore ancient landscapes and, at the same time, learn about them and about the life at ancient times.

Gamification, is gradually becoming one of the pillars of "1st century Education and training. It refers to the "*use of game mechanics in non-gaming contexts*" [9] or, rather, to "*the phenomenon of creating gameful experiences*" [10]. Gamification techniques are increasingly adopted in educational software applications [11] thanks to its perceived potential to make learning more motivating and engaging.

The APA game applies gamification to the context of Cultural Heritage education; this innovative application thrusts players into the role of a merchant's apprentice in 13th century Bologna. Guido, the main character, falls into a time vortex and finds himself in Roman Bologna, where, through the accomplishment of some quests and the solution of funny educational riddles, he must figure out a way to get back home, to the 13th century (figure 1). Bologna is known mainly for its Medieval heritage, still visible around the city.

The Roman Bologna, instead, is present but at an underground level, less conspicuous to the eyes of both citizens and tourists. The game aims at valuing the Roman heritage by linking it to the emerging, visible and well-known aspects of the existing town.

The idea of the game is to appeal the users to start a city tour and to guide them to explore a number of relevant places. When one of the points of interest is reached, the visitor has the possibility to open a window to the past, overlapping, on his device screen, the reconstruction of the ancient city to the actual world, through the use of lightweight 3D assets, sensors, location devices, camera and computer vision algorithms. Some additional contents are also displayed inside the game, enhancing the involvement of young users.

[1] http://www.v-must.net/virtual-museums

Figure 1. APA exploring the ancient Bologna: different situations and contexts

In this application, educational contents are displayed and delivered in a game-like situation; the users, mainly the young ones can, thus, benefit from enhanced motivation and engagement while performing the gaming/learning tasks.

3.2 The Battle of Thermopylae: an example of the adoption of the Storytelling strategy

Storytelling plays an important role in determining a narrative environment in which students are intended to acquire suitable and effective information and to reach the educational objectives in a motivating and non-compelling way. In this motivational process (exposure), extensively documented by Propp [**Errore. L'origine riferimento non è stata trovata.**2] and Campbell [13] the learners are exposed to a sequence of events that motivate them to learn, essentially embarking them on a narrative journey.

The VM "The Battle of Thermopylae" [14], offers some hints to consider how narration can be embedded in a VM and how this can lead to effective learning, if it's true, as Bruner argues [15] that narrative is a form of thought innate in humans, which can be effectively used to communicate and give a meaning to users' experience.

The VM Battle of Thermopylae is an interactive virtual reality application developed by the Department of 3D graphics a Virtual Reality of the Foundation of the Hellenic World Athens in the Museum of Thermopylae located at the site of the original battle, near the city of Lamia in Greece.

The VM refers to the battle that in 480 B.C. was fought between an alliance of Greek city-states led by Sparta, and the Persian Empire of Xerxes I, over the course of three days, during the second Persian invasion of Greece.

It was thought and designed with the goals of enhancing the experience of the users in a very unique way, given them the possibility to see many aspects and to learn many concepts about the battle (i.e. strategies, events, terrain topology, fighting style, weapons, etc).

This application (figure 2) starts with a movie which adopts cinematic techniques that improve the visitor' engagement and involvement, it is divided in three parts and shows the key narrative aspects of the battle.

Subsequently, the visitors are guided to travel back in time to the first day of the battle and have the mission of helping both the Greek heroes and the Persian heroes in the preparation to the fighting.

Following a precise narration: the users "are called to traverse the camp, find the corresponding equipment and weapons and apply them one by one on the main characters. Thus they learn about what happened during the battle but also acquire relevant and useful information about the culture, the battle preparations, tactics and weapons of these ancient warriors."

Figure 2. the Battle of Thermopylae (image taken from the V- Must.net website)

While following the narration the players can also have the support of a human guide (the museum guide or the teacher/educator), that covers a key role in supporting the discussion and helping the process of collaborative learning.

This narrative VM was designed by professionals from different fields follows a narrative "fil rouge" which also incorporates game technologies and adopts novel techniques derived from the entertainment industry.

Thanks to these technologies, it provides "an educational experience that should put visitors in touch with what is fundamentally engaging about the historical battle of Thermopylae, help them build a scaffolding of the historical core concepts and motivate them to go deeper into the subject themselves".

3.3 Etruscanning: an example of the adoption of the discovery learning strategy

The "Etruscanning 3D installation [16], offers the opportunity to enter the virtual world of the "Tomba Regolini Galassi", in the Sorbo necropolis in Cerveteri, discovered in 1836 which is one of the most famous and rich Etruscan funerary monuments endowed with wonderful objects showing an oriental influence. The virtual reconstruction aims to visualize the tomb at the moment it was closed, in the VII century B.C.

From an educational viewpoint, this application is grounded on the educational strategy of discovery learning which can be defined as ''*an approach to instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments*" [17]. The idea is that students are more likely to remember concepts that they discover on their own and this results in significant educational added value.

The Etruscanning installation (figure 3) is now located at the Vatican Museums in Rome and poses the visitor(s) in a genuine Virtual World where he can navigate with natural gestures (using Kinect camera) and explore the tomb, selects objects and can learn the related stories told by the Etruscan characters buried inside.

Figure 3. Aspects of the Etruscanning VM Installation

The most innovative element of the Virtual Reality application developed for the Regolini Galassi tomb is the paradigm of interaction based on the use of natural interfaces, which means that the user moves, as said above, inside the 3D space just thanks to his body actions and movements. The user has the possibility to explore the virtual tomb, to get near the artifacts, to listen to narrative contents from the voices of the prestigious Etruscan personages buried inside, to which such precious objects were dedicated. All this is possible moving in the space in front of the projection, in the simplest and most natural way, without mouse, keyboard, joystick or console (as shown in the Figure IV below).

The educational potential of this installation is high. Indeed, it offers the possibility to enter a Virtual World and see objects in their natural environment (and not in a museum, separate from the context) and to listen ancient virtual characters telling the story of each object. This provides users with the possibility to live a unique experience, and this can also help them to better understand and memorize what proposed/ explained (the actual educational contents).

III. REFLECTIONS ON THE LINKS BETWEEN VMs AND LEARNING INNOVATION

The three examples of VMs we have briefly presented are very different in nature both as to the contents they present and to the underpinning educational strategy. What we have outlined shows how VMs can adopt innovative learning strategies thus also supporting, we argue, learning innovation. As a matter of fact, if we follow the definition by the Center for Educational Research and Innovation (CERI) of the Organisation for Economic Co-operation and Development (OECD) [18] Learning Innovation is a: "*dynamic change intended to add value to the educational process and resulting in measurable outcomes, be that in terms of stakeholders satisfaction or educational performance*".

The concept of Learning Innovation itself, thus, directly recalls the idea of a "positive change" of something that is different from what has been done before and provides the educational process with significant added value (which is, hopefully, also measurable) [19].

In the case of VMs, especially of those adopting innovative learning strategies, if used by educators in combination with appropriate and suitable educational approaches (figure 4) we can say that they can be considered suitable means to both inform learning processes and produce interesting/ innovative outcomes of the learning process itself.

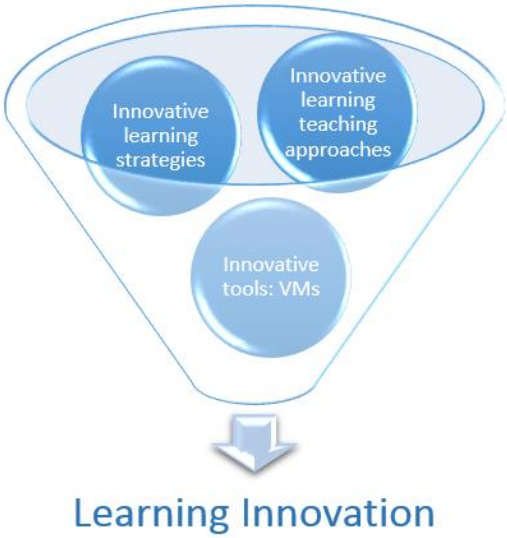

Figure 4. Learning innovation in relation to VMs adoption and the deployment of related innovative teaching approaches and educational strategies

In particular, we should consider and value the variety of multimedia assets available through VMs, including those related to the authentic reconstruction of objects, building, characters, landscapes and whole environments. We should then, also take into account their plasticity and flexibility of use so to adapt to a variety of users different as to age, background, related experience and overall expectations.

Summing up, we can say that VMs can be considered suitable engines for innovating learning processes in that they:

- introduce a "positive change" in terms of new elements introduced in the learning process and offer a proper ground to implement a variety of advanced educational strategies [4] as those we have outlined above;
- support a change in terms of expected augmented learning outcomes in that students can:
    - learn more (new concepts, ideas but also new ways of thinking, managing data, etc.…) and also become more able to find strategies for solving problems
    - be more confident and learn more easily
    - acquire more in-depth knowledge of topics and concepts
    - sustain students' engagement and flow [20] which is an important aspect of games, stories and virtual immersive worlds and is also a fundamental pre-requisite for sustaining students'/users' motivation and engagement [21], two key factors to sustain and guarantee learning effectiveness and as a consequence, learning innovation [22].

IV. CONCLUSIONS

We have drafted a few notes on the educational potential of VMs.

From what said and from the examples provided, one can see that VMs can be employed for a variety of educational goals involving aspects of both formal and informal education. They can effectively support the development of the so called 21st Century skills [7].

They can be used in schools, to respond to personal interests and for serious entertainment (edutainment) or even to back up and augment the educational impact of real museums and exhibitions.

Should they be employed in formal educational settings, we must recall that schools teachers and educators have an important role to make the most and fully exploit their educational potential by relying on the most appropriate and suitable educational strategies.

The adopted/embedded educational strategies should be regarded as one of the multiple perspectives from which we can look at them and weigh their educational potential.
It can also be argued that VMs can provide significant added value to sustain, "learning innovation" in that the concept itself of learning innovation is strongly linked to the adoption of new educational tools, mainly those ICT-based and, what's more, we must acknowledge that they:

- offer the possibility to learn more (i.e. a wider spectrum of contents never accessed before, for example through the precise ICT- based reconstruction of ancient environments)
- allow a more in-depth knowledge of objects, landscapes and environments by relying on multimedia presentation techniques
- sustain flow, which, in turn facilitates learning by helping to learn in a more immediate and easy way
- contribute to better retain (and transfer to other educational areas) what learned, thus also resulting in increased sustainability of learning actions.

This paper goes in the direction of showing that one teacher who intends to use a VM for educational purposes can be confident to find a suitable and effective tool, provided that he carefully considers not only contents but also the educational strategies embedded into the software itself [23].
As shown in this paper, VMs can embed innovative educational strategies thus effectively contributing to globally sustain leaning innovation.

References

[1] Hermon, S., & Hazan, S. 2013. Rethinking the Virtual Museum. Proceedings of *Digital Heritage Conference 2013*. IEEE Edition. Page 625

[2] Ott, M., & Pozzi, F. 2011. Towards a new era for Cultural Heritage Education: Discussing the role of ICT. *Computers in Human Behavior*, 27(4). Page 1365

[3] Branchesi, L. 2006. La pedagogia del patrimonio e la sua valutazione: ambiti di ricerca, metodologie, risultati e prospettive. In: Branchesi, L. (ed.): Il patrimonio Culturale e la sua pedagogia per l'Europa. Armando Editore.

[4] Ott, M., & Pozzi, F. 2008. ICT and Cultural Heritage Education: Which Added Value?. In Emerging Technologies and Information Systems for the Knowledge Society. Springer Berlin Heidelberg. Page131

[5] Eshach, H. 2007. Bridging in-school and out-of-school learning: Formal, non-formal, and informal education. *Journal of Science Education and Technology*. 16(2). Page 171

[6] Ott, M., Popescu, M., M., Stanescu, I. A., & De Freitas, S. 2013. Game-Enhanced Learning: Preliminary Thoughts on Curriculum Integration. In New pedagogical approaches in Game enhanced learning: curriculum integration. IGI global

[7] Antonaci, A., Ott, M., & Pozzi, F. 2013. Virtual Museums, Cultural Heritage Education and 21st Century skills. Learning & Teaching with Media & Technology. Page 185

[8] Delli Ponti, F. et ali. (2013). 3D Computer Graphics short films for communicating cultural heritage, proceeding at *Digital Heritage Conference.* IEEE special edition. Page 325

[9] Deterding, S., Dixon, D., Khaled, R., & Nacke, L. 2011. From game design elements to gamefulness: Defining gamification. Proceedings of *the 15th international Academic MindTrek Conference: Envisioning Future Media Environments*. Page 9

[10] Koivisto, J., & Hamari, J. 2014. Demographic differences in perceived benefits from gamification. In Computers in Human Behavior.35, Page 179

[11] Romero, M., Usart, M., Ott, M., Earp, J., de Freitas, S., & Arnab, S. 2012. Learning through playing for or against each other? Promoting collaborative learning in digital game based learning. Proceedings of 20th European Conference on Information Systems. ESADE, Barcelona.

[12] Propp, V.1998. Morphology of the Folktale. University of Texas Press. (1st English translation published 1958)

[13] Campbell, J.1949. The hero with a thousand faces. Fontana Press

[14] Christopoulos, D., Mavridis, P., Andreadis, A. and Karigiannis, J. N. 2013. Digital Storytelling within Virtual Environments: "The Battle of Thermopylae", in Z. Pan et al. (Eds.) Transaction on Edutainment. Springer-Verlag Berlin Heidelberg. Page 29

[15] Bruner, J. 1990. Acts of meaning. Harvard University Press

[16] Pietroni, E. et al. 2013. Etruscanning 3D: the tomb n.5 on Monte Michele in Veii. Multi-Angle VR Application, proceedings of *Digital Heritage Conference 2013*. Marseille, IEEE.

[17] Kebritchi, M., & Hirumi, A. 2008. Examining the pedagogical foundations of modern educational computer games. In *Computers & Education*. 51(4), Page 1729

[18] OECD/CERI. 2010, Inspired by Technology, Driven by Pedagogy: a systemic approach to technology-based school innovations, educational research and innovation. OECD Publishing. Paris
[19] Ala-Mutka, K., Punie, Y., & Redecker, C. 2008. ICT for learning, innovation and creativity. Policy brief prepared by the Institute for Prospective Technological Studies (IPTS). Joint Research Centre, European Commission. Luxembourg: Office for Official Publications of the European Communities.
[20] Csikszentmihalyi, M. 1990, Flow: The psychology of optimal experience. NY: Harper & Row, Publishers, Inc.
[21] Ott, M. & Tavella, M. 2009. A contribution to the understanding of what makes young students genuinely engaged in computer-based learning tasks. *Procedia Social and Behavioural Sciences*. Page184
[22] Whitson C. and Consoli J. 2009. Flow Theory and Student Engagement. In *Journal of Cross-Disciplinary Perspectives in Education*. 2(1), Page 40
[23] Benigno, V., Bocconi, S., & Ott, M. 2007. Inclusive education: helping teachers to choose ICT resources and to use them effectively. eLearning Papers, 6.

AUTHORS

Alessandra Antonaci is a research fellow at the Institute for Educational Technology (ITD), part of the National Research Council of Italy (CNR). She is an educationalist specializes in Adult Education. Her research is mainly focused on entrepreneurship and how improve it through a game based learning approach. She is currently involved in two projects: one deals with the development and use of digital games to enhance transversal skills in adult students, the other on cultural heritage.

Michela Ott has been working as researcher at the Institute for Educational Technology (ITD), part of the National Research Council of Italy (CNR) since 1980 and presently she carries out research in the field of: cognitive processes underpinning learning, educational use of software tools, e-learning effectiveness, learning design, digital game-based learning (DGBL), distance education, special education & e-inclusion, cultural heritage education. She has participated in, led and coordinated many national and international research projects in the field of Technology Enhanced Learning and game-based learning. She is a member of the editorial board of scientific journals in the field of TEL, is the author of more than 150 international scientific papers and is the author of a variety of software products /educational games for education.