

# Virtual Museums, Cultural Heritage Education and 21st Century skills

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## Abstract

A wide variety of Virtual Museums (VMs) exist, which are different not only as to the contents, but also as to structure, objectives, implementation techniques, presentation methods, as well as interaction approaches. Nowadays the educational potential of VMs is widely acknowledged, although their actual use for educational purposes is still very limited (at least in formal educational contexts). This is what emerges from a survey conducted by the authors among Italian teachers and students, showing that the adoption of VMs in schools is still infrequent and not fully integrated in the standard educational practice. In the paper, after defining the concept of VMs and giving the results of a survey conducted by the authors witnessing the limited use of these tools in formal educational contexts, a reflection is conducted on their educational potential: VMs, besides addressing cultural heritage education, can often contribute to enhance some of the “transversal” 21st Century skills, referred to as “social, cultural skills and citizenship”, as well as communication, collaboration, digital literacy and creativity.

## Keywords

Virtual Museums, technology enhanced learning, cultural heritage education, 21st Century skills.

## 1. Introduction

This paper deals with the role that Virtual Museums (VMs) can play in education, with a specific attention to formal education, that is interventions carried out in schools and other formal educational settings with the support of teachers and/or facilitators.

In particular, it aims at discussing the impact of VMs not only on cultural heritage education: actually the paper, while referring to the educational use of VMs, highlights that teaching and learning in the field of arts and cultural heritage, being deeply intertwined and strongly linked to other disciplines (Van der Leeuw-Roord, 2004), also entails the development of other transversal skills (Billing, 2007), that are widely recognized as “underpinning and informing” the learning processes, irrespectively of the different subject matters.

Considering the intrinsic educational potential of VMs (Twining, 2005; Ott & Pozzi, 2008) and taking into account the relevant educational opportunities given by the adoption of ICT-based innovative learning approaches (Ott & Pozzi, 2011), this paper discusses the educational use of VMs.

In the following the concept of ‘VM’ is defined, and some examples of existing VMs are provided; then, drawing on a survey conducted by the authors with both teachers and students, data are reported on the actual use of VMs in schools; ultimately the authors argue that VMs should be considered not only for their capacity to support awareness raising in the field of cultural heritage itself, but also they can contribute to the development of some relevant 21st Century skills, that are key to live (and be lively actors) of the Knowledge Society

## 2. Virtual Museums: what are they?

The concept of VMs is not new (Antinucci, 2006), but only recently the term has become popular and widespread. According to a still “in progress” definition elaborated by the V-MUST-net (Virtual MUSEums Transnational NETwork)<sup>1</sup> the thematic Network of Excellence (NoE) financed under the 7th Framework Programme, “a Virtual Museum is a digital creation organized on a permanent or temporal basis in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits, in a digital way, the tangible and intangible heritage of humanity and its environment. It uses various forms of interactivity and immersion, for the purpose of education, research, enjoyment and enhancement of visitor experience” (Farouk & Pescarin, 2013).

From a technical perspective, the term VM may cover various types of digital creations, ranging from repositories of multimedia contents, to virtual reality and 3D reconstructions, etc. They need a dedicated space to be accessed: either a dedicated physical space inside a traditional museum or visitor center (Forte et al., 2003), or a cyberspace (visual presentations accessible via Internet, content distributed on DVDs, etc.).

Independently of the technical implementation, VMs are applications oriented to knowledge raising and learning.

### 2.1 Examples of VMs

As already mentioned, many different types of VMs exist, focusing on various topics, adopting different approaches as far as presentation and description of the contents, and – last

<sup>1</sup> <http://v-must.net/>

but not least - using different implementation techniques and various technologies. In the following some examples of existing VMs are provided; the aim of this section is not to be exhaustive at all, but simply to give the reader a clearer idea of the kinds of artefacts that may be labelled as ‘VMs’.

An example of a virtual museum showing existing cultural heritage artefacts in their present form, is the ‘CENOBIUM’<sup>2</sup> (Cultural Electronic Network Online: Binding up Interoperably Usable Multimedia), a web-based application for the study and the presentation of the Romanesque cloister capitals from the Mediterranean region (specifically from Monreale, Aosta, Cefalù). Images, texts and 3D models regarding these cloisters can be explored and compared in an integrated, manner (Figure 1).



**Figure 1.** Images from the CENOBIUM VM

One of the main values for education is that this VM presents monuments that are far from each other and thus allows direct comparisons and juxtapositions, which would be otherwise impossible. Differently, the VM of ‘the Santiago de Compostela Cathedral’<sup>3</sup>, is a reconstructed environment: the user interacts with a three-dimensional model of the Cathedral, where s/he can explore the main building elements and stylistic details (Figure 2).



**Figure 2.** A 3D reconstruction of the Cathedral in Santiago de Compostela

<sup>2</sup> This project was developed by ISTI-CNR and Kunsthistorische Institut in Florence. Available at: <http://cenobium.isti.cnr.it/index.php>

<sup>3</sup> The VM is due to Universidade da Coruña E.T.S. de Ingenieros de Caminos, Canales y Puertos. Available at: [http://videalab.udc.es/en/3dv\\_cathedral](http://videalab.udc.es/en/3dv_cathedral)

It is an installation based on a multi-touch system, where the user interacts directly with the three-dimensional virtual model of the Cathedral (zooming, panning, rotating and sectioning it in any plane and in real time); at the same time s/he can also access information about the elements of the basilica.

Another example of VM is the ‘The Ancient Agora of Athens’<sup>4</sup> VM, which brings to light the main features of the ancient Athens Agora, an area which, in ancient Greece, was the main place for political gatherings and commercial transactions, the locus of the administration and justice and ultimately a religious and intellectual centre. This VM is the result of the accurate and scientifically documented reconstruction of the places and related life made by the scientists of the Foundation of the Hellenic World, who have thus created an original digital documentation of the political and cultural life of the Athenian Democracy. The virtual representation urges the visitors on a journey of discovery: they can explore the accurate virtual representation selecting their course during their visit to the virtual world. They can examine the architectural details of the buildings and the landscape from many different perspectives and, by taking part in virtual interactive activities, they can also live experiences and explore the arts and the everyday life in a period ranging from the 5<sup>th</sup> century BC to the 3<sup>rd</sup> century AD. For instance in one of the possible tours, namely the: “Interactive tour” the Ancient Agora of Athens can be visited, through jumps in time, in three different important moments: Classical Agora (approx. 400 BC), Hellenistic Period (approx. 150 BC) and Roman Agora (approx. 150 AD). This virtual collection also includes objects and other elements of the living environment of that period and original music so to give an overall view of the life in those times. As shown in Figure 3 living bodies are represented in their original habits and documented features.



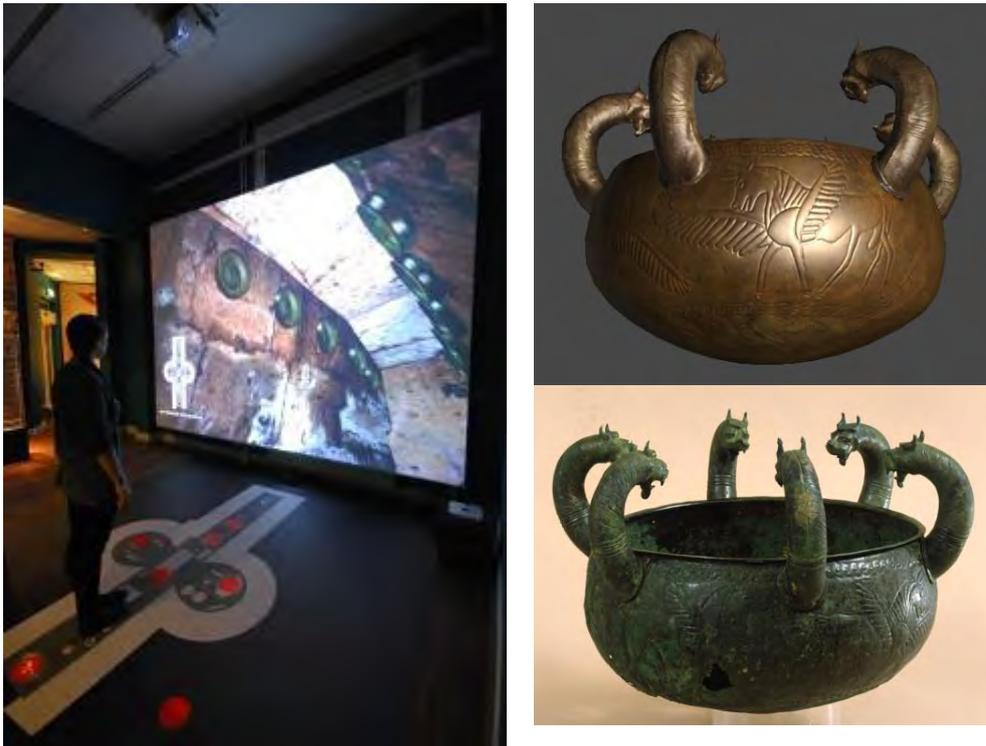
**Figure 3.** The Ancient Agora VM

Highly innovative technologies are employed in the most recent VMs, allowing different types of fruition/interactions besides the simple “vision”. This is the case, for instance, of Etruscanning<sup>5</sup>, a virtual reality (VR) installation dedicated to the digital reconstruction of the famous Regolini Galassi Etruscan tomb in Cerveteri, which was discovered intact in 1836. Inside the VR installation, the extraordinary objects of the mortuary equipment - today

<sup>4</sup> The Museum was developed in 2006 by the Foundation Of The Hellenic World. Info are available at: [http://project.athens-agora.gr/index.php?lang\\_id=en](http://project.athens-agora.gr/index.php?lang_id=en)

<sup>5</sup> Etruscanning 3D is an European project (Culture 2007 framework). It is due to the Collaboration among: Allard Pierson Museum - University of Amsterdam; CNR-ITABC; Visual Dimension bvba; National Museum for Antiquities in Leiden; Gallo-Roman Museum in Tongeren; Musei Vaticani; Museo Nazionale Etrusco di Villa Giulia; CNR ISCIMA.

preserved at the Etruscan-Gregorian section in the Vatican Museums - have been re-contextualized (see Figure 4).



**Figure 4.** Installation of the Etruscanning pilot (left) and an example of reconstructed vs. original pottery (right)

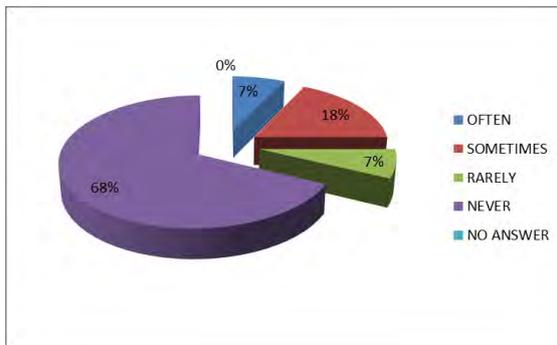
The tomb, acquired by laser scanner, has been reconstructed, as it probably could be in Etruscan age (half of the VII century BC), just after being closed. Nevertheless, the most innovative element of the application is the paradigm of interaction based on the use of natural interfaces, that means that the user moves inside the 3D space just through her/his body movements, as represented in Figure 4. The public has the possibility to explore the virtual tomb, to get near the artefacts, 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 natural way. The user walks on a real map of the grave, attached on the floor, on which some “hotspots” are indicated. While changing her/his position from one hotspot to another, s/he moves in the virtual space, going deeper in the tomb, close to the objects and make storytelling emerge.

### **3. Virtual Museum: a survey on actual use in schools**

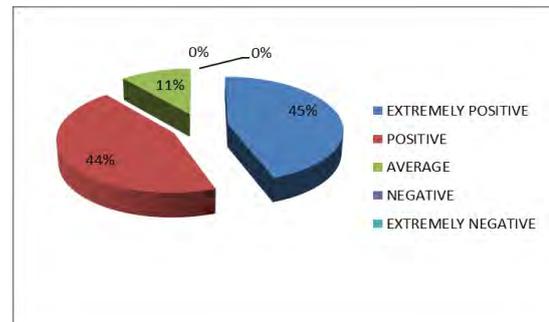
In 2012, during a scientific event called “Festival della Scienza” (Science Exhibition) taking place every year in Genoa-Italy, the authors set up an exhibit where a number of selected VMs was shown to teachers and students, with the support of an Interactive Whiteboard (a technology relatively spread in Italian schools). Objective of the authors’ exhibit was to stimulate the interest of schools around the educational use of VMs.

In this context, in order to better estimate the current level of knowledge and awareness of teachers and students about the concept of VM, as well as their perception and actual use, a questionnaire was distributed to 372 students and 29 teachers of upper secondary schools.

As to the actual use of VMs in schools, the results of the questionnaire show that 19 out of 29 teachers had never used a VM, 5 teachers had used them sporadically, 2 very rarely; only 2 teachers declared they had used VMs often, as shown in Figure 5.



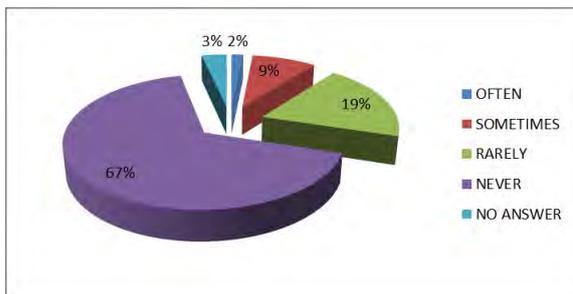
**Figure 5.** Teachers' use of VMs



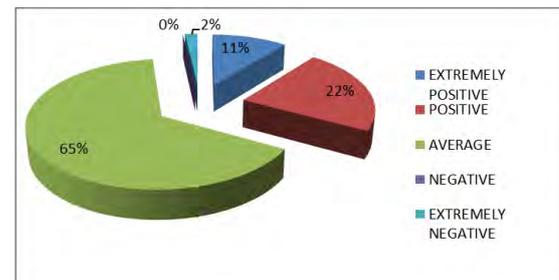
**Figure 6.** Teachers' opinions on the educational potential of VMs

Besides, as reported in Figure 6, the majority of teachers who had previously experienced the use of VMs in their classes, gave a positive evaluation of their effectiveness for educational purposes (the judgment was “extremely positive” for 4 of them, “positive” for other 4 teachers, and “average” for the last teacher involved in the sample).

As to students, 248 out of 372 (67%) declared that they never used a VM at school, 72 (19%) stated rarely, 33 (9%) sometimes and only 6 out of 372 (2%) affirmed that they had used them frequently (Figure 7).



**Figure 7.** Educational use of VMS by students



**Figure 8.** Students' opinions on the educational value of VMs

The students who had claimed some experience with VMs at school (111), gave the following evaluation: none reported a negative feedback, but 2 evaluated it “extremely” negative, 73 (65%) defined it as “average”, 12 (11%) felt it was extremely positive and 25 (22%) just positive (Figure 8).

All in all, the data collected during the survey reveal that the level of use of VMs in Italian schools is still pretty low, although both students and teachers think they are (potentially) powerful tools.

#### 4. The role of Virtual Museums in contemporary education

The limited use of VMs in the Italian schools revealed by the survey, can probably be ascribed to a number of reasons, among which the lack of information and appropriate training from the teachers' side, as well as the complex technological requirements of some applications with respect to the standard hardware available in most Italian schools.

In addition, one should also consider the fact that VMs are mostly felt as tools oriented to enhance learning “exclusively” in the field of cultural heritage.

Conversely, VMs can be used to foster other transversal skills that are nowadays considered key for the knowledge society. This should be considered as an added value, given that their use could foster not only knowledge and competences related to the specific domain (i.e. arts and cultural heritage), but also the development of ‘higher order’ skills.

In order to understand what these skills are, in the following section the 21st century skills are firstly defined and then in the subsequent section a focus is done on what skills can be potentially addressed by VMs.

#### **4.1 21st Century skills: what are they?**

Different definitions and classifications have been proposed so far, with the aim of defining the so - called 21<sup>st</sup> century skills. Redecker et al. (2011) in the JRC report of the EU Commission, propose to look at the matter from the perspective of three general categories: 1) Personal skills (initiative, resilience, responsibility, risk taking, creativity), 2) Social skills (team-, networking, empathy, compassion, co-constructing), 3) Learning skills (managing, organizing, metacognitive skills, failing forward).

Furthermore, ICT literacy and competence are considered important by other authors (e.g. Dede, 2010) and in particular “the ability to rapidly filter huge amounts of incoming data, extracting information valuable for decision making” and “the ability to separate signal from noise in a potentially overwhelming flood of incoming data”, the so-called “information problem solving” skill. As underlined by Kickmeier-Rust & Dietrich (2012), the difficulty of finding a unique shared definition probably arises from “the unclear, probably vague, and highly informal nature of these 21<sup>st</sup> century skills”. As a matter of fact, the concept is “an overarching term for many kinds of meta abilities, soft skills, communication and collaboration skills, of attitudes, self-awareness, strengths in non-linear thinking, and innovative problem solving, as well as the ability to reflect about one’s own thinking and being”.

In this light, some organizations have developed structured frameworks for defining the 21<sup>st</sup> century skills: this means not only that they have identified and listed a set of skills, but that they have also organized them into conceptual frameworks. In a paper by the University of Twente (Voogt et al., 2010), for example, a thorough list of the skills is proposed, which includes skills that had been previously mentioned in other six existing frameworks (namely: P21<sup>6</sup>, ENGAUGE<sup>7</sup>, ATCS<sup>8</sup>, ISTE<sup>9</sup>, OECD<sup>10</sup>, CASE<sup>11</sup>).

<sup>6</sup> P21- Partnership for 21st Century Skills (2011). Framework for 21st Century Learning. (USA). Available at: [http://p21.org/storage/documents/1.\\_\\_p21\\_framework\\_2-pager.pdf](http://p21.org/storage/documents/1.__p21_framework_2-pager.pdf)

<sup>7</sup> Engauge 21st Century Skills Literacy in the Digital Age (Meteri/NCREL 2003). (USA). Available at: <http://pict.sdsu.edu/engauge21st.pdf>

<sup>8</sup> ATCS (2010) “Draft White Paper 1 - Defining 21st century skills” Binkley M., Erstad O., Herman J., Raizen S., Ripley M., Rumble M. (Australia). Available at: <http://atc21s.org/wp-content/uploads/2011/11/1-Defining-21st-Century-Skills.pdf>

<sup>9</sup> ISTE ET, NETS and 21st Century Skills. Available at: <http://isteemergingtech.wordpress.com/about-21st-century-skills-and-emerging-technologies/>

<sup>10</sup> OECD – Organization for Economic Cooperation and Development. (2005). The definition and selection of key competencies: Executive summary. Paris, France: OECD. Available at: <http://www.oecd.org/dataoecd/47/61/35070367.pdf>

<sup>11</sup> Gordon, J., Halsz, G., Krawczyk, M., Leney, T. et al. (2009). Key competences in Europe. Opening doors for lifelong learners across the school curriculum and teacher education. Warsaw, Center for Social and Economic Research on behalf of CASE Network. Available at: [http://ec.europa.eu/education/more-information/doc/keyreport\\_en.pdf](http://ec.europa.eu/education/more-information/doc/keyreport_en.pdf)

The overall list of the skills proposed by Voogt et al. (2010) is reported in Table 1, which also gives an idea of the “frequency” of each skill in the six frameworks (skills mentioned in all frameworks, skills mentioned in most frameworks, skills mentioned in few frameworks, skills mentioned in only one of the framework).

Mentioned in <i>all</i> frameworks	Mentioned in <i>most</i> frameworks (i.e., P21, EnGauge, ATCS and NETS/ISTE)	Mentioned in a <i>few</i> frameworks	Mentioned only in <i>one</i> framework
<ul style="list-style-type: none"> <li>- Collaboration</li> <li>- Communication</li> <li>- ICT literacy</li> <li>- Social and/or cultural skills; citizenship</li> </ul>	<ul style="list-style-type: none"> <li>- Creativity</li> <li>- Critical thinking</li> <li>- Problem solving</li> <li>- Develop quality products / Productivity (except in ATCS)</li> </ul>	<ul style="list-style-type: none"> <li>- Learning to learn (ATCS, EU)</li> <li>- Self-direction (P21, En Gauge, OECD)</li> <li>- Planning (En Gauge, OECD)</li> <li>- Flexibility and adaptability (P21, EnGauge)</li> </ul> <p>Core Subjects:</p> <ul style="list-style-type: none"> <li>- Mathematics; communication in mother tongue; science (EU, P21, ATCS);</li> <li>- History and arts (P21 and ATCS)</li> </ul>	<ul style="list-style-type: none"> <li>- Risk taking (En Gauge)</li> <li>- Manage and solve conflicts (OECD)</li> <li>- Sense of initiative and entrepreneurship (EU)</li> </ul> <p>Interdisciplinary themes (P21)</p> <ul style="list-style-type: none"> <li>- Core Subjects: economics; geography; government and civics (P21)</li> </ul>

**Table 1.** List of the 21st Century skills according to Voogt et al (2010)

#### **4.2 What 21st Century skills can be addressed by means of VMs?**

As said above, VMs are digital artefacts that exploit ICT potential to address social/cultural skills by sustaining awareness and knowledge raising in the field of heritage, arts and history, and these skills are mentioned in at least two of the frameworks considered by Voogt et al. (2010) (see Table 1).

This had been also acknowledged by the EU Commission in 1995 that had also recognized the importance of cultural heritage education, by maintaining that: “Recalling and understanding the past is essential in order to judge the present. Knowledge of history (including scientific and technological history) and geography has a dual function as a guide in time and space, which is essential to everyone if they are to come to terms with their roots, develop a sense of belonging and to understand others”. Later on, Whitby (2005) while surveying extension, features and aims of the arts curricula in EU, had also found that, already a decade ago, arts education was considered an important aspect of contemporary education all across Europe. Besides, other research studies (Bamford & Wimmer, 2012; Sharp & Le Métais, 2000; Whitby, 2005) have highlighted the pressure for curriculum development in the arts, to include the study of new media (including film, photography and digital arts) and to enable pupils to use ICT as part of the learning process.

Thus, VMs can be regarded as learning/teaching tools addressing address a field (namely cultural heritage education), which is considered highly relevant in in contemporary education.

Besides, VMs, being digital artefacts, can contribute to enhance ICT literacy, which is also widely considered one of the core 21<sup>st</sup> Century skills (see Table 1); this is true if we accept that the concept of “ICT literacy” extends up to the boundaries of “ICT competence” and therefore to the concept of “ability to properly use and make the most of digital artefacts” (Olimpo, 2008).

Thus VMs, by their own nature, address at least two of the 21<sup>st</sup> Century skills mentioned in the examined frameworks (Voogt et al, 2010) (see Figure 9).



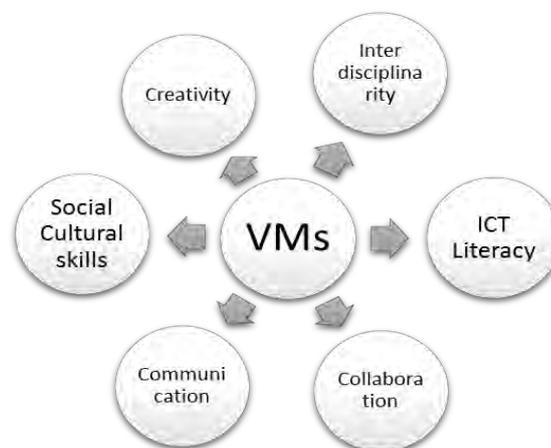
**Figure 9.** 21<sup>st</sup> Century skills and VMs

Nevertheless, VMs can also be used (and this largely depends also on *how* they are employed), to sustain other relevant 21<sup>st</sup> Century skills.

Certainly creativity is one of these, as underlined by Ján Figel (Commissioner responsible for Education, Training, Culture and Youth in 2009) who, while acknowledging that “the role of arts education in forming the competences for young people for life in the 21<sup>st</sup> century has been widely recognized at the European level” also affirms that “The European Commission [...] acknowledges the value of arts education in developing creativity” (EACEA, 2009). Furthermore, another study by the Commission (KEA, 2009) maintains that: “Art and culture have the ability to stimulate people’s imagination and creativity in schools, in colleges and universities and in lifelong learning” and suggests that arts education should be also aimed at supporting creativity development by defining that: “Creativity in learning is about fostering flexibility, openness for the new, the ability to adapt or to see new ways of doing things and the courage to face the unexpected. Imagination, divergent thinking and intuition need to be considered as important characteristics of progressive arts education by schools, universities and further education providers”. In this line, Taggart et al. in 2004 while examining the arts curricula in EU countries, had already found that cultural education in the member States had “a new interesting focus on creativity (often in relation to its importance in innovation) and in relation to both individual identity and promoting intercultural understanding”.

From the above mentioned studies, it emerges that, together with creativity, at least other three key 21<sup>st</sup> Century skills can be fostered by means of digital artefacts, such as VMs, namely: communication, collaboration and interdisciplinarity.

The rationale behind Figure 10 is well expressed by Whitby (2005), who include among the expected outcomes of arts education (which, in their view, should adopt a genuinely social approach) the development of “personal and social/cultural skills such as confidence and self-esteem, individual expression” but also of “teamwork, intercultural understanding and cultural participation”.



**Figure 10.** Positioning VMs among the 21<sup>st</sup> Century skills

These concepts have also been reinforced by the Council of Europe, who launched a Framework Convention on the value of cultural heritage for society (Council of Europe, 2005); in this Convention, it is established that art education should contribute to fulfill the need for European countries to: “preserve cultural resources, promote cultural identity, respect diversity and encourage inter-cultural dialogue”.

As a matter of fact, in all these documents collaboration, communication, sharing, exchanging and dialogue are keywords that are meant to inform future and present cultural heritage education. The role and relevance of VMs to this end is self-evident, and could be nurtured by the research already carried out in the field of Technology Enhanced Learning and in particular of online collaborative learning (Ott & Pozzi, 2008).

The importance of interdisciplinarity is also acknowledged by EU, so that in Article 13 of the above mentioned Convention (see Table 2), while discussing the role of cultural heritage and arts education, they recommend to “develop linkages between courses in different fields of study”. From this perspective VMs, can help enhancing cross-disciplinary studies.

Article 13 – Cultural heritage and knowledge
<p>The Parties undertake to:</p> <p>a) facilitate the inclusion of the cultural heritage dimension at all levels of education, not necessarily as a subject of study in its own right, but as a fertile source for studies in other subjects;</p> <p>b) strengthen the link between cultural heritage education and vocational training;</p> <p>c) encourage interdisciplinary research on cultural heritage, heritage communities, the environment and their inter-relationship;</p> <p>d) encourage continuous professional training and the exchange of knowledge and skills, both within and outside the educational system</p>

**Table 2.** Article 13 of the Council of Europe-Framework Convention on the Value of Cultural Heritage for Society

## 5. Conclusions

In this paper the educational potential of VMs has been discussed, by putting forward the idea that when using VMs in classrooms, coherently with the overall mission of 21<sup>st</sup> century education, a wider spectrum of learning objectives can be addressed in addition to those that are considered “standard” in the field of cultural heritage education.

Of course this doesn’t happen ‘automatically’, which means that it is not the use of technology that *per se* guarantees the development of certain skills, but whenever teachers design the learning activities properly and adopt suitable educational methods, VMs can represent an important asset to the development of some of these 21<sup>st</sup> century skills.

Besides, VM developers should carefully design the educational affordances of their tools, by embedding functionalities (such as learning analytics, data mining, turn over options...) able to foster the adoption of advanced educational methodologies and techniques (e.g.: personalized, active and discovery learning, collaborative learning, etc.). These affordances should be considered as integral part of VMs, and should be taken into account from the very beginning of the design process, so to transform the learner’s “virtual visit” into an effective “learning experience”.

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