

Rethinking high-tech tools for cultural heritage education. In-training teachers' reflections on Musetech web app

Ripensare la tecnologia nell'educazione al patrimonio culturale. Riflessioni di futuri insegnanti sulla web app MuseTech

Antonella Poce^a, Francesca Amenduni^b, Francesco Agrusti^{c,1}

^a *Università degli Studi di Roma Tre*, antonella.poce@uniroma3.it

^b *Università degli Studi di Roma Tre*, francesca.amenduni@uniroma3.it

^c *Università degli Studi di Roma Tre*, francesco.agrusti@uniroma3.it

Abstract

MuseTech is a web app implemented in the frame of DICHE Erasmus + Project. The aim was to train teachers on new methods to develop 4Cs through the use of cultural heritage education and technologies. In this paper we investigate how much in-training teachers are interested in 3.0 web technologies proposed in the MuseTech app, and which kind of opinions and expectations they have about the use of 3.0 technologies for cultural heritage education. Teachers showed a strong interest for high tech cultural heritage educational resources, especially because of the following affordances: ubiquity, multi-sensoriality experience, and immersivity. Through a self-assessment of their skills they declared to develop their research and design skills while stimulating their IT, creativity and critical thinking skills. The MuseTech case has provided teachers with the opportunity to discuss their ideas with peers and to employ technologically tools.

Keywords: cultural heritage; web 3.0 technology; in-training teachers.

Abstract

MuseTech è un'applicazione web realizzata nell'ambito del Progetto DICHE Erasmus +, che permette agli insegnanti di essere formati sui nuovi metodi per sviluppare capacità *comunicative*, di *collaborazione*, di *creatività* e di *pensiero critico* (4Cs) attraverso l'educazione al patrimonio culturale e l'uso delle tecnologie. Abbiamo indagato quanto gli insegnanti in formazione siano interessati alle tecnologie web 3.0 proposte nell'app MuseTech, e che tipo di opinioni e aspettative abbiano circa l'uso di tali tecnologie per l'educazione al patrimonio culturale. Gli insegnanti hanno mostrato un grande interesse specialmente per le caratteristiche di: ubiquità, multi-sensorialità e immersività. Autovalutando le proprie competenze, hanno inoltre dichiarato di aver sviluppato le proprie capacità di ricerca e progettazione stimolando al tempo stesso quelle di IT, creatività e pensiero critico. MuseTech ha inoltre fornito agli insegnanti l'opportunità di discutere le proprie idee con i pari e di utilizzare strumenti tecnologici.

Parole chiave: patrimonio culturale; tecnologie web 3.0; insegnanti in formazione.

¹ A. Poce coordinated the research presented in this paper. Research group is composed by the authors of the contribution that was edited in the following order: A. Poce par. 1, 3, 5; F. Amenduni par. 2.2, 4; F. Agrusti par. 2.1.

1. State of the art

With the advance of technology, jobs' demand continuously changes and new profiles come into being.

Societal transformation has been affecting also the teacher's role in the 21st century and, as a consequence, future teachers would require to receive an adequate level of support for their professional development. Many research reports reveal the crucial role of transversal competencies such as cooperation and collaboration due to the need of developing shared curricula, evaluating student progress, and designing collective learning activities (Goddard, Goddard & Tschannen-Moran, 2007). In addition, collaboration seems to support teacher reflection through dialogical activities (Harris & Muijs, 2002). International research (Jensen, Andrés & Steffen, 2012) has highlighted that teachers that use ICTs (Information and Communications Technology) in classrooms are more likely to adopt innovative pedagogical models such as collaborative and cooperative learning. The adoption of these models requires teachers to develop a wide range of transversal competencies. For example, they need to know how to motivate students and how to support collaboration among them. They need to manage conflicts, to help students to schedule their work and deadlines, to design learning environments, and to set challenging goals. Furthermore, teachers require not only to develop their own transversal and digital skills but also to know how to improve their students' same skills. These competences, which are often referred to as 21st century skills, are extensively debated by scholars at international level. A quantitative and qualitative description of these competences have been attempted by many different institutions, from the European Union to the Organization for Economic Co-operation and Development (OECD, 2008).

Despite the difficulties to define 21st century skills, arts and cultural heritage are proved to be valuable tools to encourage the development and use of the skills. Children need to adapt themselves to a continuously changing context like today's society. The national guidelines for primary school issued by the Italian Ministry of Education (MIUR) in 2012 stress the importance of studying arts and cultural heritage in the early years of schooling, especially in the context of experiential education where children learn about the world through a multisensory approach, based on different techniques: "Children's encounter with art allows them to look at the world with different eyes. Exploring materials through the senses, experimenting with new techniques in the school laboratory, observing places (squares, gardens, and landscapes) and works of art (paintings, museums, and architectures) help children to improve their perceptive skills and nurture the pleasure of enjoying and creating art, thus bringing art and cultural heritage closer to children" (p. 20).

Policy makers have been recognizing also the educational value of arts and aesthetic for the improvement of the so-called 4Cs: *communication, collaboration, creativity* and *critical thinking* (P21).

Communication skills are defined by McCroskey and McCroskey (1988) as the "adequate ability to pass along or give information; the ability to make known by talking with or writing" (p. 109). In the Italian national guidelines for preschool and primary school education (MIUR, 2012), issued by the Ministry of Education, it is clearly stated that arts and cultural heritage education encourages the development of communication, feeling expression, and language skills, since it allows children to experience new media and new languages of communication. This happens because communication is intrinsically associated with the concept of *mediation*. Cultural means could support communication among cultural heritage, museum artifacts and people from different ages and social backgrounds. Collaboration is described as the activity of working together towards a

common goal or a desired result, at both individual and group level (Griffin & Care, 2015; Kuhn, 2015). As communication, also collaboration skills can be developed in informal education contexts related to cultural heritage (Lu et al., 2011). Creativity is the most relevant competence connected to activities concerning artistic production at an individual level. Although creativity is generally agreed by educational policymakers to be an important skill in all education and work contexts it remains a disputed concept with a lack of consensus regarding what creativity is (Wegerif et al., 2010). Having said that, the need for creativity-related skills concerns all education and work contexts, especially in the field of museum education. Grever, de Bruijn and Van Boxtel (2012) underline the importance of teaching students how to explore cultural heritage from different perspectives, through imagination and creativity skills. Ministry of Education clearly mentions the opportunity to develop not only children's creativity through laboratory activities focusing on art and image, but also critical thinking: "being familiar with quality images and artworks increases and refines the aesthetic and expressive dimensions of students' creativity skills, strengthens cultural knowledge and contributes to educate them to be active and responsible citizens" (MIUR, 2012, p. 73). In the area of museum education, critical thinking is often associated with Visual Thinking: watching and enjoying a work of art, comparing different artworks, artists, styles, and trends, allows the museum audience to develop their thinking, analysis and evaluation skills (Housen, 2002).

The use of digital tools in the field of arts and cultural heritage education represents a real innovation challenge because new teaching and learning methodologies may be developed, especially for the younger generation of users. Indeed, during the last decades, different pedagogical approaches that combine the use of technologies with cultural heritage education have been developed, such as Object Based Learning (Paris, 2002), Visual Thinking (Hubard, 2011), and Digital Story Telling (Liguori & Rappoport, 2018). In addition, it should be also considered how the progress, that has been made about the web and related technologies, affects cultural heritage educational practices. It was shown that different affordances of the web are related with different cognitive processes that can be enabled (Aghaei, Nematbakhsh & Farsani, 2012; Fuchs et al., 2010) and, as a consequence, different transversal competencies. The Figure 1 compares the technical, cognitive and behavioral features related to the three generations of the web.

Definition	Web 1.0 or The web	Web 2.0 or Social web	Web 3.0 or Semantic web
Year	1996	2006	2016
Possible behaviours and actions	Read only web	Read and write web	Read, write and execute web
Cognitive functions	Information sharing, connect information	Interaction, connect people	Immersion, connect knowledge
Number of users	Million of users	Billion of users	Trillion of users
Grade of immersivity	Brain and Eyes (= Information)	Brain, Eyes, Ears, Voice and Heart (= Passion)	Brain, Eyes, Ears, Voice, Heart, Arms and Legs (= Freedom)
Technical features and devices	Pushed web, text/graphics based flash. The Hypertext/CGI Web (the basics)	Two way web pages, Wikis, video, pod casts, shading, Personal publishing, 2D portals. The Community Web (for people: apps/sites connecting them)	3D portals, avatar representation, Interoperable profits, multi-user virtual environment (MUVes), Integrated games, education and business, Artificial Intelligence

Figure 1. A comparison among technical, cognitive and behavioral features of web 1.0, web 2.0 and web 3.0. Adapted from Shivalingaiah and Naik, 2008, p. 503.

2. The context of the research

The results here presented were collected during a prototyping project of a web app developed for primary school' teachers in order to give them the opportunity to:

- be updated about new methods to develop 4Cs through the use of cultural heritage education and technologies;
- assess and express their opinions about teaching methods based on cultural heritage education and technologies;
- self-regulate their professional learning by the use of flexible technologies.

The designing and validation of the web app were realized in the context of the Erasmus Plus DICHE project, *Digital Innovation in Cultural Heritage Education*. The project was focused on training primary school teachers, including both in service and in-training teachers, on new pedagogical approaches which employ technologies in cultural heritage education.

Roma Tre University Museum Education Center (CDM, <http://cdm.uniroma3.it>) was in charge of the design of pilot activities taking into consideration the theoretical model of the DICHE project. One of the core activities was the creation and validation of the web app.

The following paragraphs describe the design of the web app and the results on its employment, integrating evidences of previous researches with new data collected to deepen our analysis.

2.1. MuseTech web app

The name of this web app originates from the combination of the expressions *museum and technology* which represent the underpinnings of the DICHE project. The idea of designing a web app came into being from the need for a unique application which could be used on different platforms and operating systems, without the need to be installed on devices from an app store and continuously updated. It is basically an internet-enabled app that is accessible via the mobile device's web browser and which does not need to be downloaded onto the user's mobile device in order to be accessed. From the point of the final user, a wide number of native and web apps look and work in the same way, with very little difference between them. Therefore, we decided to develop a user-centric app instead of an application-centric app.

For what concerns developing a native app, every mobile platform uses a different native programming language (iOS uses Objective-C, Android uses Java, Windows Mobile uses C++ and so on). For the MuseTech app (and for web apps in general), on the other hand, we used languages such as JavaScript, HTML 5, CSS3 that are supported by any major modern mobile browser. The main advantages to use web app are summarized in the Figure 2 web apps are much easier to maintain, as they have a common code base across multiple mobile platforms, and they can be manipulated so as to be made compatible with any older mobile device. Users need not bother with visiting an app store to download web apps or updating the same on their mobile devices.

MuseTech app allows users to use the DICHE resources and, simultaneously, to evaluate and share their contents just accessing the Internet without any app installation.

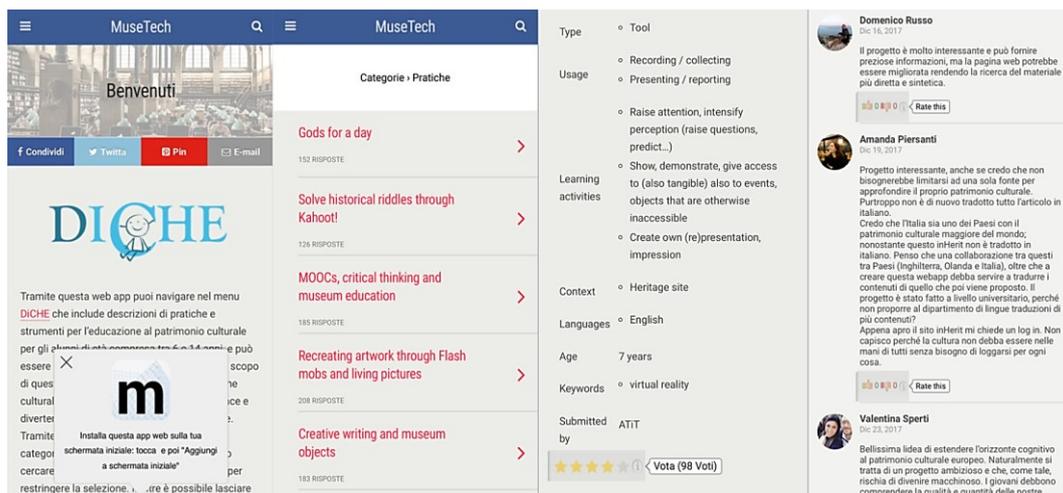
The DICHE menu is the digital tool which includes all the contributions offered by projects' partners and which renders the theoretical approaches to basic skills' development into practical teaching scenarios through cultural heritage enjoyment and technology use.

The menu, available at <http://www.diche-project.eu/resources>, is an online database which contains best practices and educational tools for teachers (Figure 3).

- | | |
|--|---|
|  <p>Developed one time only
It is not developed specifically only for one particular mobile device</p> |  <p>Same functionality
From the point of the final user native and Web apps look and work in the same way</p> |
|  <p>User centric
It is a user-centric app instead of an application-centric app</p> |  <p>No installation
It does not require any direct installation onto the device itself</p> |
|  <p>Instant bug correction
Bugs correction is committed instantly to the final user</p> |  <p>Avoid app stores
The final user does not need to visit an app store to install or update it</p> |
|  <p>Easy maintenance
It is easier to maintain since it is written in standard programming languages supported by any major modern mobile browser</p> |  <p>No limits or rules
It is free from app stores ties and limits</p> |

Figure 2. Main benefits and advantages of the web app (retrieved from <http://formazione.uniroma3.it/files/00f3581b-a3b5-47a9-99a6-7ebe3e863793.pdf>).

MuseTech app is dedicated mainly to university students of educational sciences, primary and secondary school teachers, who want to design, create and evaluate innovative programs for students aged between 11 and 14 years, in formal and informal education contexts. The description of teaching practices and digital tools is available in English, Italian and Dutch, in order to better spread the application and to increment the number of potential users.



The screenshot displays the MuseTech web app interface. On the left, there's a navigation menu with 'Benvenuti' and social media links. The main content area shows a list of resources under 'Categorie • Pratiche', including 'Gods for a day', 'Solve historical riddles through Kahoot!', 'MOOCs, critical thinking and museum education', 'Recreating artwork through Flash mobs and living pictures', and 'Creative writing and museum objects'. On the right, there's a detailed view of a resource with 'Type: Tool', 'Usage: Recording / collecting, Presenting / reporting', 'Learning activities: Raise attention, intensify perception...', 'Context: Heritage site', 'Languages: English', 'Age: 7 years', and 'Keywords: virtual reality'. Below this, there are user reviews from Domenico Russo, Amanda Piersanti, and Valentina Sperti, each with a 'Rate this' button and a star rating.

Figure 3. Examples of usage scenarios of MuseTech web app.

Research within the app can be carried out by either selecting options inside the main menu or by typing keywords or by filtering the different types of resources (teaching scenario or

digital tool), uses (tracking, mapping, routing, presenting, reporting, exploring, researching, inquiring, instruction, assignment, recording, collecting), contexts (classroom, museum, heritage site, home).

The database can also be accessed to read its contents directly and to adapt them to the educational needs of the real-world context of use, and of the tools available.

One of the main aims of the MuseTech app is to support the web 2.0 social dimension in order to reach an increasingly higher number of users and to obtain their contribution to improve the resources database. In this way, the audience gets wider and wider, and this creates a network of researchers, teachers, students and museum educators, and education professionals interested in the web app and in its future developments. To achieve this, MuseTech app allows its users to vote for the resources and like the most thanks to a five-star rating system, such as, among others, TripAdvisor® and Yelp!®. Furthermore, it boosts communication between users allowing them to share a tool or a practice that they found of particular interest on their preferred social network.

MuseTech web app does not require any registration to browse tools or practices and it allows to conduct an advanced search through the whole resource database thanks to filters and categories. Nevertheless, it requires a social account (Facebook® or Twitter®) in order to access to the social sharing, commenting and voting functionalities. To enhance the collaboration dimension, we developed the MuseTech app like a social plaza where is possible to share thoughts, question, ideas and solutions into the dedicated comment section present at the end of each resource. Moreover, the MuseTech app allows users to follow a thread of comments for a specific resource, receiving a notification by email once new comments are added for that resource.

2.2. Evidences of previous research on MuseTech web app and DICHE project

In previous publications (Poce, 2018; Poce, Agrusti & Re, 2018), results both on the validation of the app and on the users' skills were presented. In Cultural Heritage and Development of XXI Century Skills in Primary Education (Poce, 2018), where the findings of DICHE project are reported in detail, various activities carried out in the project, are described. Some were dedicated to ask the students (in-training teachers) to self-reflect on the teaching and learning path they were undergoing.

Here, evidences of the previous researches are briefly presented in order to better understand the meaning of the results of the present work. Researchers created an *ad hoc* online assessment questionnaire including three main sections:

1. knowledge assessment through 5 closed-ended questions concerning the DICHE project contents, including the Research Agenda, the concept of competence, the 4C skills, the KSAVE model, museum education, and innovative teaching methodologies;
2. self-assessment of the competences promoted, the knowledge acquired and the activities carried out during the pilot phase of the DICHE project through Likert scale questions;
3. reflection on the knowledge acquired with respect to students' university and career paths through open-ended questions.

The questionnaire was submitted online to students on the *Orbis Dictus* platform (www.orbisdictus.it), where students also worked on part of the didactic unit design and undertook other learning activities. As regards knowledge assessment, in general, most

students gave correct answers to the five questions, especially when related to the 4C skills definition and the distinction between teaching tool and practice (Figure 4). Accordingly, it can be said that, in the main, students acquired the theoretical aspects of the project, which was mainly addressed in enhancing participants' 4Cs skills.

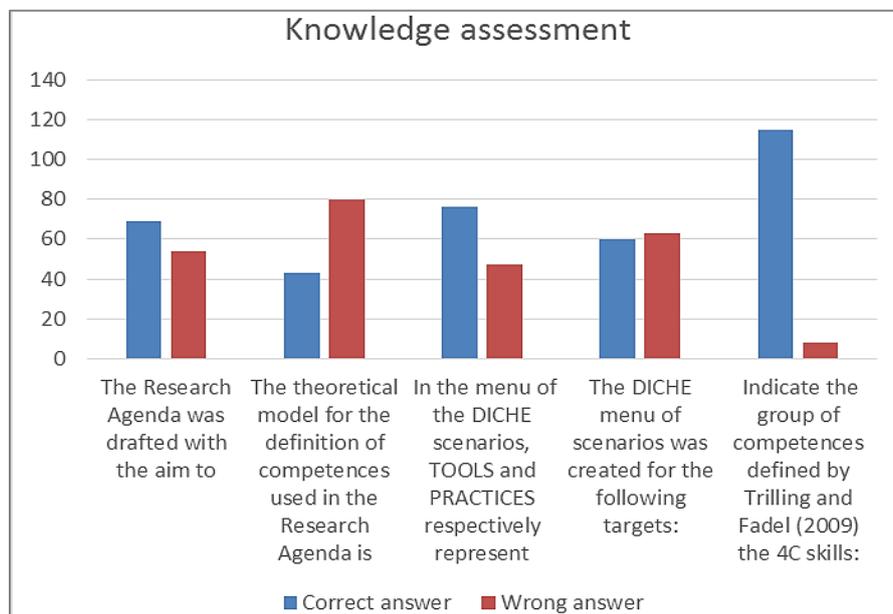


Figure 4. Number of correct and wrong answers to the five questions aimed at assessing students' knowledge.

As concerns self-assessment, it is interesting to highlight what were the most developed skills (Figure 5) and technological competences (Figure 6) in student training and what were the group activities students particularly appreciated.



Figure 5. Skills self-assessment through Likert Scale (from 1 = I did not develop this skill at all to 5 = I strongly developed this skill).

In general, despite the predictable difficulties in group work, students were very pleased with the final product, which allowed them to successfully develop their research and design skills while stimulating their IT, creativity and critical thinking skills. According to students' answers, content accessibility is quite high along with the user-friendliness of digital support tools.

The opinions expressed by students with respect to the project themes, namely museum education, technology use and transverse skills development in primary school, suggest that their analysis of the Italian education system is critical and detailed, even in non-formal contexts. Most of the students agreed that culture is the memory of the universe, men, arts and crafts. Museums are the places where this memory is safeguarded, they witness history unfolding with its events and protagonists, they observe the very nature of things. Therefore, they help citizens to know reality more in depth and to develop critical thinking and social awareness. Students underline the need to care, enhance and modernize them, also thanks to the use of new technologies. They all agreed on the idea that museums are a valuable and endless tool for education. About the link between technology and teaching in primary school, some object that, unfortunately, this link is still too weak probably due to either teacher's lack of knowledge or schools' lack of suitable facilities. Technology has not been fully acknowledged as a teaching tool in Italian education. On the contrary, it is often considered to be a distraction and a very few teachers actually try to introduce technology in their courses. In some cases, they considered the Italian school system as anachronistic in its approach to teaching. The introduction of digital technologies may remedy certain lacks and allow all students to learn effectively.

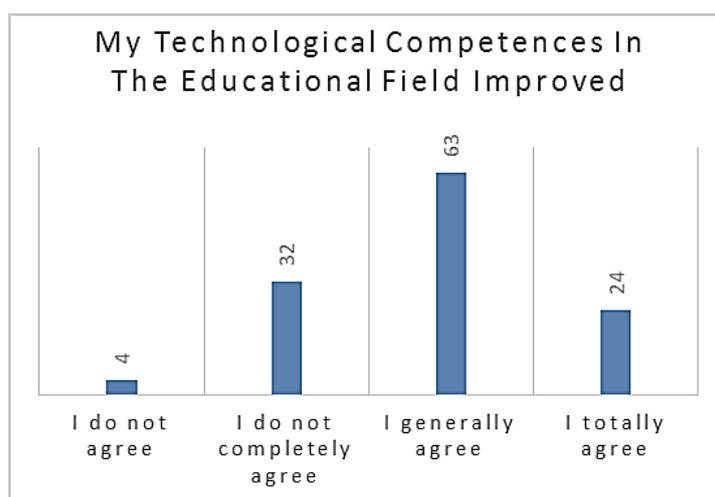


Figure 6. Technological competences self-assessment. Most of the students (63) generally agreed with the statement.

Technology is part of adults and children's everyday life. This is the reason why it is essential that schools teach people how to responsibly use technology, especially for education purposes.

If questioned on how technology can promote the development of the 4C skills, some answered that Communication, Creativity, Critical thinking and Collaboration are inherent in technology. When students are presented with a problem, in order to find a creative solution, they collaborate and communicate in a way they are familiar with. The amount of information available online, for example, actually requires people to be able to distinguish

reliable sources from unreliable sources. Today, online research provides people with different stimuli which are deeper and globally-scaled if compared with those of encyclopedias. Even a very basic skill like writing, renews itself with technology: with real-time collaborative writing, a group of people from different places can access the same texts, comment and review them and read other members' comments and remarks. They communicate, discuss and collaborate to finally create something new, the result of the interaction between people of that specific group.

3. Research questions and methodology

The results of the survey described above supported the development of the further analyses presented below.

This contribution, in fact, is specifically aimed at investigating in-training primary school's teachers' attitudes regarding 3.0 web technologies for cultural heritage education. In particular, the research group have tried to address the following research questions:

1. are future teachers interested in 3.0 web technologies?
2. which kind of opinions and expectations in-training teachers have about the use of 3.0 technologies for cultural heritage education?

The above research questions are based on the idea that the MuseTech app could potentially develop future teachers' attraction towards high technologies, although they might not be familiar with them. Indeed, one of the expectations, shown by previous research, highlighting teachers' reluctance to adopt technologies in their teaching practice (Sadaf, Newby & Ertmer, 2016), is related to the fact that their background is mainly in humanities on average. The existing literature has emphasized teacher preparation as the most important step towards effective use of new technologies (Groth, Dunlap & Kidd, 2007), including web 2.0 tools.

The analysis carried out in this study aimed to deepen the understanding of teachers' perception of technology use in heritage fruition within primary school curricula.

MuseTech was used by 170 students attending the degree course in Primary Education Sciences at Roma Tre University.

In order to answer the first research question, the research group firstly categorized the resources downloaded on the Musetech app as web 1.0 technologies or web 2.0 technologies and web 3.0 technologies. The level of interest was measured considering the number and the average of comments for each kind of resource.

To answer the second research question, comments to the two most commented resources about web 3.0 technologies were analyzed qualitatively through thematic analysis (Anderson, 2007).

Information about 58 digital resources for cultural heritage education was collected. Each resource was categorized according to the kind of technologies it contains. For example the resource *CK plus Dutch Arts And Culture Search Engine* (http://www.musetech.it/context/at_home/dutch-arts-and-culture-search-engine/) was categorized as web 1.0 technology. An example of a web 2.0 technology is *MOOCs, critical thinking and museum education* (<http://www.musetech.it/practise/moocs-critical-thinking-and-museum-education/>). An example of web 3.0 technology is *Cardboard: a VR app for*

Themes that emerged frequently in the users' comments are *ubiquity*, *sensory experience* and *immersive experience*. The three themes are in line with the affordances provided by the web 3.0 technologies. This means that the in-training teachers grasp the real meaning and potentiality of the technologies, like in the following extract (E1): "The tool allows you to visit places that you thought to be unattainable. Physical obstacles disappear and each person can enrich his or her knowledge about new places without the need to be there".

Another emerging topic is related to the metaphor of the *object-building*. In the following extract, one future teacher compares passive and active affordances of technologies (E2): "In my opinion 3D printing gives the opportunity to re-produce actively the museum object and, thus, I guess that students' engagement could be higher than passive object fruition, such as watching photography".

A few comments are focused on how web 3.0 technologies could affect 4Cs such as critical thinking through cultural heritage education in primary schools. More than 90% of the comments are endorsements of the two resources. The qualitative data retrieved by the comment are confirmed by the quantitative data presented in the Figure 10. Indeed, the resource Object-Based Learning and 3D Printing received 4,3 on 5 stars, whilst Cardboard, a VR app for Android smartphones 3,8 on 5 stars.

Resource/Teaching scenario Title	1 star	2 stars	3 stars	4 stars	5 stars	avg stars
Object-Based Learning and 3D Printing	0	2	13	69	63	4,3
Cardboard, a VR app for Android smartphones	2	3	34	34	25	3,8

Figure 10. Stars' average for each resource.

Having said that, the in-training teachers add also critical comments to the resources, like in the following extract (E3): "I do not like the use of virtual reality at school, but it would be useful to teach geography and to show places that cannot be visited. More details about the tools are necessary".

In addition, some of them seem to evaluate the web 3.0 technologies with 1.0 mental models, like in the following extract (E4): "Unfortunately virtual experience has nothing to do with the live one".

5. Discussion and conclusive remarks

The rapid societal and technological changes have been affecting many jobs, including teaching. Teachers require to be constantly updated about new pedagogical approaches to support the 4Cs in their students. In the intersection between cultural heritage education and digital technologies, new teaching methods have been developing in order to improve communication, collaboration, creativity, and critical thinking skills.

MuseTech is a web app developed to inform teachers about best-evidence practices related with cultural heritage education through the use of technologies. The main idea is to support in-training teachers' awareness of the use of technology in their teaching and learning. It is important to notice that users had the opportunity to know about free digital scenarios and practices that otherwise were completely unknown. The present contribution shows that in-training teachers were strongly interested in the 3.0 web technologies available in the MuseTech web app, despite their general background in humanities. Most of them showed

to be aware of the affordances provided by high-tech tools, such as ubiquity, sensorial and immersive experiences. They appreciated the tools because the use of digital technologies could facilitate students' involvement and support to the development of the 4Cs. These results are in line with previous research that shows that when teachers could access to web 2.0 tools, they are able to translate their intentions into actions (Sadaf et al., 2016). In addition, the focus on software review resulted in a greater awareness of what was available and an understanding of the importance of carefully reviewing and selecting appropriate software (Groth, Dunlap & Kidd, 2007).

The MuseTech case has provided in-training teachers, who participated in the research, not only with the opportunity to discuss their ideas with peers and to be informed but also with the actual possibility of employing different technologically advanced tools available online for free and adaptable to any teaching and learning objective easily identifiable thanks to the specific characteristics of the MuseTech web app developed and validated by the CDM Roma TRE research group.

References

- Aghaei, S., Nematbakhsh, M.A., & Farsani, H.K. (2012). Evolution of the world wide web: From WEB 1.0 TO WEB 4.0. *International Journal of Web & Semantic Technology*, 3(1), 1–10.
- Anderson, R. (2007). *Thematic content analysis (TCA). Descriptive presentation of qualitative data*. <http://rosemarieanderson.com/wp-content/uploads/2014/08/ThematicContentAnalysis.pdf> (ver. 15.04.2019).
- DICHE. *Digital Innovation in Cultural and Heritage Education*. <http://www.diche-project.eu/> (ver. 15.04.2019).
- Fuchs, C., Hofkirchner, W., Schafranek, M., Raffl, C., Sandoval, M., & Bichler, R. (2010). Theoretical foundations of the web: cognition, communication, and co-operation. Towards an understanding of Web 1.0, 2.0, 3.0. *Future Internet*, 2(1), 41–59.
- Goddard, Y.L., Goddard, R.D., & Tschannen-Moran, M. (2007). A theoretical and empirical investigation of teacher collaboration for school improvement and student achievement in public elementary schools. *Teachers college record*, 109(4), 877–896.
- Grever, M., de Bruijn, P., & Van Boxtel, C. (2012). Negotiating historical distance: Or, how to deal with the past as a foreign country in heritage education. *Paedagogica Historica*, 48(6), 873–887.
- Griffin, P., & Care, E. (eds.) (2014). *Assessment and teaching of 21st century skills: Methods and approach*. Cham (CH): Springer.
- Groth, L.A., Dunlap, K.L., & Kidd, J.K. (2007). Becoming technologically literate through technology integration in PK-12 preservice literacy courses: Three case studies. *Literacy Research and Instruction*, 46(4), 363–386.
- Harris, A., & Muijs, D. (2002). *Teacher leadership: A review of research*. National College for School Leadership. https://www.researchgate.net/profile/Alma_Harris/publication/238508986_Teach

- [er Leadership A Review of Research/links/0046352cf9eb970f50000000/Teacher-Leadership-A-Review-of-Research.pdf](#) (ver. 15.04.2019).
- Housen, A.C. (2002). Aesthetic thought, critical thinking and transfer. *Arts and Learning Research*, 18(1), 99–131.
- Hubard, O. (2011). Rethinking critical thinking and its role in art museum education. *Journal of Aesthetic Education*, 45(3), 15–21.
- Jensen, B., Andrés, S.H., & Steffen, K. (2012). *The experience of new teachers: Results from TALIS 2008*. Paris: OECD Publishing. <http://dx.doi.org/10.1787/9789264120952-en> (ver. 15.04.2019).
- Kuhn, D. (2015). Thinking together and alone. *Educational researcher*, 44(1), 46–53.
- Liguori, A., & Rappoport, P. (2018). Digital storytelling in cultural and heritage education: Reflecting on storytelling practices applied with the Smithsonian Learning Lab to enhance 21st-century learning. *International Digital Storytelling Conference 2018: Current Trends in Digital Storytelling: Research & Practices*, Zakyntos, Greece.
- Lu, F., Tian, F., Jiang, Y., Cao, X., Luo, W., Li, G., & Wang, H. (2011). ShadowStory: creative and collaborative digital storytelling inspired by cultural heritage. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1919–1928. New York (NY): ACM Digital Library.
- McCroskey, J.C., & McCroskey, L.L. (April 1988). *Self-report as an approach to measuring communication competence*. Paper presented at the Annual Convention of the Central States Speech Association, Cincinnati, OH.
- MIUR. Ministero dell’Istruzione, dell’Università e della Ricerca (2012). Indicazioni nazionali per il curricolo della scuola dell’infanzia e del primo ciclo d’istruzione. *Annali della Pubblica Istruzione*. No. Speciale. http://www.indicazioninazionali.it/wp-content/uploads/2018/08/Indicazioni_Annali_Definitivo.pdf (ver. 15.04.2019).
- MuseTech. *Cardboard: a VR app for android smartphones*. <http://www.musetech.it/?s=Cardboard,+a+VR+app+for+Android+smartphones> (ver. 15.04.2019).
- MuseTech. *Digital teaching scenarios for cultural and heritage education*. <http://www.musetech.it/> (ver. 15.04.2019).
- MuseTech. *Dutch arts and culture search engine*. http://www.musetech.it/context/at_home/dutch-arts-and-culture-search-engine/ (ver. 15.04.2019).
- MuseTech. *MOOCs, Critical thinking and museum education*. <http://www.musetech.it/practise/moocs-critical-thinking-and-museum-education/> (ver. 15.04.2019).
- OECD. Organisation for Economic Co-operation and Development. (2003). *DeSeCo: Definition and Selection of Competencies*. <http://deseco.ch> (ver. 15.04.2019).
- Orbis dictus. <http://www.orbisdictus.it/> (ver. 15.04.2019).
- P21. Partnership for 21st century skills. *Framework for 21st Century Learning*. <http://www.p21.org/our-work/p21-framework> (ver. 15.04.2019).

- Paris, S.G. (2002). *Perspectives on object-centered learning in museums*. New York, NY: Routledge.
- Poce, A. (2018). *Cultural heritage and the development of XXI century skills in primary education*. Milano: FrancoAngeli.
- Poce, A., Agrusti, F., & Re, M. (2018). Heritage Education and Initial Teacher Training: An International Experience. *Journal of e-Learning and Knowledge Society*, 14(2), 127–143.
- Sadaf, A., Newby, T.J., & Ertmer, P.A. (2016). An investigation of the factors that influence preservice teachers' intentions and integration of Web 2.0 tools. *Educational Technology Research and Development*, 64(1), 37–64.
- Shivalingaiah, D., & Naik, U. (2008). Comparative Study of Web 1.0, Web 2.0 and Web 3.0. *International CALIBER-2008*, 499–507, University of Allahabad.
- Università degli studi Roma TRE. *Centro di Didattica Museale*. <http://cdm.uniroma3.it> (ver. 15.04.2019).
- Wegerif, R., McLaren, B.M., Chamrada, M., Scheuer, O., Mansour, N., Mikšátko, J., & Williams, M. (2010). Exploring creative thinking in graphically mediated synchronous dialogues. *Computers & Education*, 54(3), 613–621.