Digital Cultural Heritage: From Educational Experience to the Artefact in Augmented Reality

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Abstract. Several national and international research studies have highlighted important aspects linked to the application of augmented reality in the educational contexts, with particular reference to education concerning the cultural patrimony. The augmented reality ambients indeed offer different training opportunities: some with cognitive finalities others in terms of active participation, others, again by means of the realisation of experiences of an expressive-creative kind with high coefficients of imagination. Specifically speaking, this contribution aims to propose the results of research carried out on three case studies, relating to school projects that are situated in the field of a process of knowledge, participation and recreation of the cultural patrimony in ambients of augmented reality through the construction of new digital artefacts.

Keywords: Education · Artefact · Heritage · Augmented reality · Digital environments

1 Introduction

Several studies have shown the educational potential of the digital ambients (virtual, augmented and hybrid), in which each student can experience concrete learning models of a cognitive and socio-relational nature. In this regard, the mediation of educational contents in ambients of augmented reality represents an innovative research field (Rivoltella 2010; Rossi 2013; Ranieri and Pieri 2014; Billinghurst and Duenser 2012; Brown 2015; Diegmann et. 2015; Guerra and Rossi 2016; Hills-Duty 2017…), with particular reference to education in the cultural heritage (Bacca et al. 2014; Smith 2016…). The design and construction of digital ambients in augmented reality for education in heritage falls within the actions of the PON – National Operative Program "For the school, competences and ambients for learning 2014–2020" (MIUR 2017) that

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support the need to sensitive the students in regard to their own cultural, artistic and landscape heritage to construct full citizenship. In particular, the public notice for the enhancement of cultural heritage education recognises among the significant project proposals also "the access, exploration, knowledge and valorisation, also digital, through technological experimentation, of the heritage." In this perspective, the schools are trying out new experiences with the heritage, oriented to the diffusion of a digital culture, for the knowledge and valorisation of the cultural assets through forms of digital artistic creation (i.e. performing arts) and digital communication (i.e. digital media, e-learning).

2   Ambients of Augmented Learning

The scientific literature shows how in the educational ecosystem physical-virtual didactic spaces and different languages are interwoven in an the increasingly natural way within a multimodal perspective (Kress 2004). The reference is to the ubiquitous ecologies as emerging systems in which old and new media, physical and digital ambients are designed, realised and enjoyed as a homogeneous whole (Rosati 2013). In the specific case of school teaching, the digital ambients can take on the role of mediators as a function of a renewed and expanded knowledge: they allow the student to converse with the world and with knowledge and to build bridges between different levels of the same knowledge (Damiano 2013). Furthermore, the digital ambients represent a privileged context of re-elaboration and creation (Panciroli 2017): they allow the user not only to access the information but also to experience and create new artefacts bearing original meanings in an ecosystemic perspective. Indeed, each artefact carries with it a series of visible and invisible connections with other elements of experience and with other artefacts that constitute the actual added value of that product.

Hence, with the spreading of visual wealth provided by technology and the development of the possibilities of interaction, the digital ambients become the place in which both the manifestations of creativity and expressivity can be connected in the educational ambient and those of design and experimentation. "The new technological instruments and their application are capable of offering concrete potential only is they are put at the service of critical models of didactic mediation and are developed within a precise educational, mindful and coherent project" (Panciroli 2016). Specifically, augmented reality can be used for visual forms of learning, capable of producing a significant impact on the experiences, enhancing them in terms of knowledge and re-elaboration (experiential amplification). Indeed, unlike the virtual reality, in the ambients of augmented reality it is possible to continue to see what surrounds the user via digital data that are overlapping and enrich the real world (Rossi 2013), providing new learning experiences. The immediate reference is to the distributed character of knowledge, with the possibility to access multiple informational resources. By means of augmented reality we have a shift in focus from instructing to learning transforming the spaces of knowledge from places for codified knowledge to laboratories for the acquisition of knowledge (Bonaiuti et al. 2016). The student therefore is not an acritical consumer of knowledge but rather a constructor and interpreter. The experimentations of the last few years in the school domain have been made possible above all by the growing use both of the smartphone (hand-held display) equipped with powerful

microprocessors, cameras, accelerometers and sensors as well as digital compasses and GPS, and applications based on the video-see-through technique that allow one to superimpose virtual graphic elements upon the real environment.

Specifically, the experiences of augmented reality are the result of the combination of several elements: the application, contents, interaction, physical ambient and participants. The application is the programme that allows for the organisation and the control of the different aspects of the augmented reality experience, amongst which the recognition of the physical world with reference to the digital contents and the synchronisation between physical and virtual world, so as to add the digital elements to the user's vision. The augmented content, the digital layer, includes all the objects, the idea, the stories and the sensorial stimuli and can appear in different formats (texts, images, video and animations). The interaction allows the user to observe the digital layer from different points of view or perspectives. Also, each experience of augmented reality is closely tied to the physical ambient in which it is realised and to the real object that is augmented with virtual information. Those participating in the experience have a central role, because their needs, actions and movements influence the whole system of creation and recreation of the contents of augmented reality (Herrington and Crompton 2016; Hills-Duty 2017). Hence, by means of augmented reality technologies virtual objects and real objects end up coexisting in another space, an ≪intelligent distributed space in which it becomes ever more difficult to distinguish between real and virtual and where the mobile technologies mediate the experience of a new sense of space, which we can call augmented≫ (Ranieri and Pieri 2014, p. 22). In this new space, several subjects can collaborate and construct new digital artefacts composed of fragments, each one of which not only maintains its own autonomy and identity but, being inserted in a shared system, can converse with other artefacts. In this sense, the experience with these artefacts is configured as a process, that is an evolution in space and time, facts and behaviours tied to one another.

3   Augmented Reality and Digital Heritage

Recent studies attest to how the "Sciences and Humanities & Arts are the fields of education where AR has been applied the most" (Bacca et al. 2014). Indeed, vis-à-vis the heritage, augmented reality is configured as a "stimulating agent" which leads, according to original approaches, to discovering, knowing, narrating and reinterpreting the cultural objects and elaborating new ones, in turn, to convey and share with the community (Arduini 2012; Di Serio et al. 2013; Ranieri 2015; Smith 2016; Chen et al. 2017; Gabbari et al. 2017). The experiences that some pilot schools have carried out in the past few years can provide some significant elements for a reflection on some fundamental aspects tied to the experimentation of didactive pathways on the heritage in augmented reality. In particular, here we shall examine three case studies relating to experiences with the heritage developed by secondary schools. These projects fall within the scope of events and/or cultural events and expositions that promote the cultural heritage via the digital (Global Junior Challenge, Competition Crowd-dreaming: the young co-create digital culture," Monumenti Aperti, Settimane della cultura Digitale, Biennale dei Licei Artistici…). Some of these initiatives can be traced

back to the DiCultHer - Digital Cultural Heritage, Arts & Humanities School, a network agreement finalised, as regards the educational sphere, to "endowing the pupils with a series of cultural and scientific instruments addressed to stimulating interdisciplinarity (…) and developing a digital culture in the conservation and the valorisation of the cultural heritage in the arts and the human sciences" (DiCultHer 2015).

First Case Study "Hostel Project"
The "Hostel Project" (https://www.progettohostel.it/) was realised by the Liceo Artistico Musicale Foiso Fois of Cagliari in the school years 2016–17 e 2017–18 (referent Prof. Beatrice Artizzu) and involved fifty students from the third, fourth and fifth years, besides some former pupils. The project's main aim was to make known, through the digital technologies, the transformations that in the course of the centuries have characterised the ambients of the Complesso Monumentale di Sant'Antonio di Cagliari: ancient convent before, already starting from the 15th century, it was converted into a hospital; in the second half of the 20th century, the rooms of the ancient convent were transformed into a school building and then, in more recent times, the current hostel was built. These spaces have been reproposed by the students through the planning, realisation and setting up of a virtual museum, a space of continuous work-in-progress correlated to the platform DiCultHer and accessible by means of augmented reality technologies. Specifically, via augmented reality the virtual museum user can access the three-dimensional reconstructions that show the transformation of the ancient monumental complex, the previous planimetries and the animations with period photographs. By means of this project, the students have been able to gain skills in the environmental, naturalistic, territorial, urban, architectural, artistic, historical-literary, chemical, physical-mathematical, computer, musical fields, through a series of creative laboratories that have seen the disciplines taught at the secondary school interact according to different moments of the sharing of intents (Fig. 1).

Second Case Study "Discovering Hidden Paths Through Augmented Reality"
The project "Discovering hidden paths through augmented reality" (http://www.gjc.it/it/progetti/alla-scoperta-dei-cammini-nascosti-attraverso-la-realt%C3%A0-aumentata) was realised by the Istituto di Istruzione Superiore Alberto Castigliano of Asti in the school years 2016–17 and 2017–18 and continues to be developed in the school year 2018–19 (referent Prof. Maria Stella Perrone). The project, which took part in the international competition Global Junior Challenge on the innovative use of technologies in education, involved twenty students from the fourth and fifth years for the realisation of a historical-geographic pathway of valorisation of the Piedmontese territory. The students first of all tried out new techniques of representation through augmented reality; subsequently they collected information, also with the collaboration of experts from institutions and associations. Lastly, they started to construct digital pathways in augmented reality addressed to illustrating the historical, social and economic peculiarities of some "hidden routes," "ways and paths" that cross Piedmont and that, with the passing of time, have been forgotten (Perrone 2017).

Fig. 1. Hostel project: digital pathways in augmented reality.

Third Case Study "Augmented Music"

The project "Augmented Music" (http://www.museumreloaded.it/musica-aumen
tata-parma-passeggiata-pubblica-restituzione-del-progetto/) was realised by the Liceo
Musicale Attilio Bertolucci of Parma, in the school year 2017–18, and involved twenty-
six first year pupils (referents Prof. Maria Chiara Iemmola, Agnese Ferrari and Alessandra
Mancino).

The objective of the project, which has won the tender "Future Present" promoted
by MIUR and UNESCO Young Professionals, was to rediscover one's own city,
starting from the ideas produced by the texts and the tunes of the songs that describe it.
The students went on the discovery of new viewpoints of the city, guided by the words
of different performers and singer-songwriters. In a first phase, the students graphical
re-elaborated a specific place described in a song, each one according to his/her own
vision, new and original. In a second phase, through augmented reality, the illustrations
were overlapped with the real places, thus transforming the public spaces into scenarios
of a personal imaginary.

Comparative Analysis of the Case Studies

From a comparison of these case studies, the educational potentials of augmented
reality emerge in the field of the valorisation of the material (libraries, archives,
museums, archaeological and architectural heritage) and immaterial heritage
(demo-ethno-anthropological assets), in regard to three main dimensions: knowledge,
participation and re-elaboration.

In the first case study, the "Progetto Hostel", the augmented reality is tied to a strongly
cognitive educational dimension, which has ed the young generations to know, deepen
and reconstruct the architectural heritage of their own territory of belonging, by means of
hypermedia creations and projects of urban regeneration. As highlighted by the project

referent, Prof. Beatrice Artizzu: "Augmented reality has helped to compose a history of the monument by encompassing the different plans of the students according to a unitary project, but with different ways of interacting with the public and different digital media, reviving the relationship of proximity with beauty."

In the second case study, "Discovering hidden paths through augmented reality," the participative dimension of the heritage is valorised. The rediscovered "routes," described and communicated by means of augmented reality, are made accessible not only to the inhabitants of the territory but also to tourists and cultural, economic and political operators. Augmented reality has thus fostered the cohesion and the social integration, promoting both the rediscovery of a 'hidden' and 'forgotten' heritage, and the sense of belonging to the community. The students have indeed been able to deepen the history of the territory in which they reside, keeping alive its historical memory and the traditions, and sharing it also with their companions coming from other territorial realities and from other countries. Through these digital itineraries both the material heritage has been rediscovered, experienced and shared, and the immaterial contents and values bound to the territory.

In the third case study proposed, "Augmented Music," the students discovered/ rediscovered the material assets of the heritage (certain places of the city) through immaterial goods (the texts and the melodies of the songs). Of these assets, the students provided their own personal interpretation, through a graphic re-elaboration, digitally transposed and communicated with the applications of augmented reality. Each place/asset of the city has thus been enriched through the augmented reality with new meanings constructed by the students and shared with the whole city through a perspective of a diffuse and involving cultural heritage. These artefacts in augmented reality, as explained by the referents of the project, have led to "creating a full-fledged virtual map, a digital exposition of street art works of the future in which the visions of the students will be stratified upon the reality."

4   Augmented Reality and Educational Experience

By projecting and developing digital and augmented environments, it is possible to improve communicative and digital skills in the production and dissemination of images and in knowledge of art and the heritage.

The digital environment can not only be used as a simple means of transmitting contents but it can also help us experience spaces and things. This is possible thanks to particular techniques for the production of sounds and moving pictures, which allow us to have real, sensory, cultural and artistic experiences. In any case, they can be thought of as educational experiences because the person develops knowledge and skills thanks to the relationship with objects, ideas and sensory and emotive perceptions.

According to John Dewey's philosophy of Pragmatism, aesthetic experience is more than a bare observation of reality because it leads to real processes of knowledge. For this to happen, experience has to be the result of interaction between the body and the environment and must develop strong emotive and aesthetic perceptions.

Emotions, in particular, lead to knowledge processes by generating meanings.

An emotive situation, which can be created by both an artist and a teacher for didactic purposes, can develop new perceptive and cognitive modalities. According to Dewey, objects or only intellectual thoughts can generate an experience.

In order to create knowledge, however, there has to be a proper balance actions and feelings. Therefore, Dewey compares teachers to artists. The former, indeed, are able to create situations where both what is being learned and the learner, through situations and tasks, play an important role. To sum up, the quality of the experience and its emotive power determine the quality of the learning ability itself (Dewey 1949, 1951, 1954).

Dewey's philosophy leads us to rethink the relation between art and technology. In the case of augmented reality, which makes use of visual arts and media language techniques, interactive and virtual media play the role of re-projecting reality. The latter has more than a merely contemplative function, because thanks to art, it acquires the role of mediator. These media are iconographic and make use of moving images.

Therefore, audiovisual language is widely used. Both cinema and these types of media have a strong relationship with art, on one hand, and education, on the other.

According to Dewey, art and education create a common space, which can be occupied by many different realities such as cinema and its languages, forms and knowledge-mediators (Fig. 2). This is an active dimension that contains structures and ideas of both worlds, ending up looking a little like one and then a like the other.
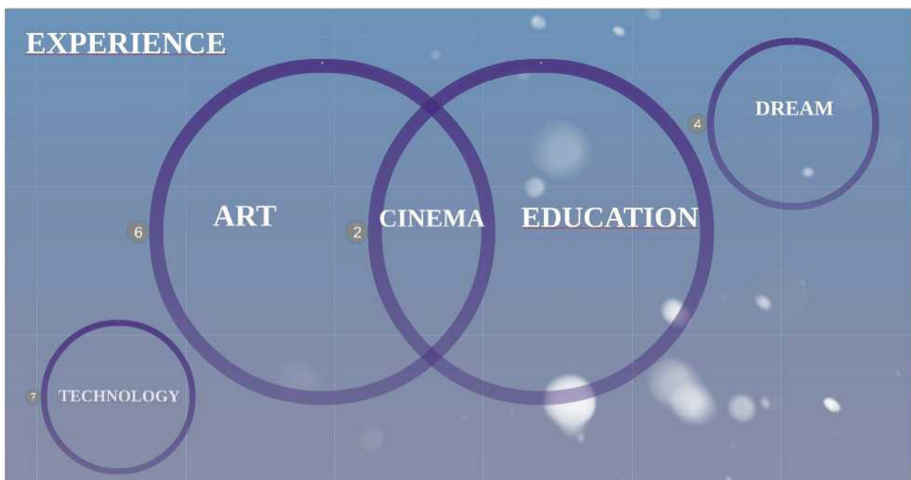

Fig. 2. Experience between art and education

In the 20th Century, the so-called "philosophy of cinema" demonstrated that cinema is art. A movie is considered art form because it gives rise to emotion and thoughts, questions and different worldviews (Carroll 2011). Central to this is the concept of experience, because a movie is a cultural product. Furthermore, it is a strong experience for the public because it transmits temporality and dynamism and offers a strong emotional impact.

Cinema has the incredible ability to show several points of view, first and third person at the same time, with different filming techniques, photography and sound editing (Cabrera 2000). Viewing becomes an artistic rather than a technological experience. Like any other form of art, it withstands time, and any type of technological innovation (Casetti 2005, 2015).

The connection between cinema and technology is shown in the picture as a separate bubble together with experience and the dream, which is another typical element of art, education and cinema. Cinema is the expression of soul and feelings. It shows the soul of things and artists show their soul in things (Godard 1971).

Cinema is inspired by poetry and dreams are its major component. The "Cinema of poetry" is the artistic and metaphorical experience of past and emotions (Pasolini 1979). According to Pier Paolo Pasolini, cinema is an artistic language because it plays the role of a parabola and it is not a direct philosophical expression. It belongs to poetry and not to the novel or drama. Cinema contains an irrational element that cannot be removed. The attempt to turn cinema into pure technology has the effect of leading the unconscious and the dreamlike element back into the background, making it invisible to a superficial view. This allows people to use cinema inappropriately and to seek rationality through specific formats, that is, a production of commercial and standardized movies.

On the contrary, a film director who aims to produce an arthouse film knows that an unconventional glossary is needed, in order to express his ideological and poetic vision of reality. Therefore, cinema can exist only as a metaphor. Reverie plays a huge and important role in it (Pasolini 1972).

Pasolini often highlights the audiovisual nature of cinema, which means that images are as relevant as words and sounds and they all make up the final product. Their connection, in the overall editing, creates a huge amount of stylistic and expressive possibilities. The viewer, on the other hand, is required to have good skills in understanding and interpreting the audiovisual product that modifies, as a narration, the relation between viewer and what he/she sees (Manzoli 2001).

Augmented Reality is similar to cinema. Their production and their enjoyment are similar to production and enjoyment of audiovisual products. Their strong multimedia connotation needs the same knowledge of multimedia and audiovisual language as a film. In the collective imagination, a movie is easier to understand than a book. That is not actually true. Never mind. The reason is that audiovisual narration fascinates the viewer and makes us live a captivating cultural experience. This is particularly true in our contemporary society, where there are even more and different spaces and chances to use video contents (Casetti 2015). The Internet is one of these spaces, as well as mobile apps and Augmented Reality software that reads and rebuilds narratives through images and sounds. We believe that the characteristics of the cinematographic and aesthetic experience as well, together with the language of poetry and emotions of art, make these experiences educational.

5   Conclusions

The augmented digital environments highlight the complex structure of the skills to be put on the web, facilitating the integration between different disciplinary fields (literary, historical, artistic, archaeological, philosophical, anthropological, scientific…), along with the re-elaboration and reinterpretation in a creative way of the heritage, through new means of participation. In the case studies taken into examination, the ambients of augmented reality become suitable spaces for the creation and production of artefacts that reinterpret, also in narrative form, the objects of the cultural heritage. The real objects enriched with digital contents allow the youngsters to describe and tell their own experiential context and share it with others. If indeed every digital artefact is part of an ecosystem, then it should be conceived and analysed as part of a complexity and not as an isolated entity, with particular reference to the co-creation of digital culture. In this regard the Digital Cultural Heritage "identifies entities, processes and phenomena whose essence, manifestation and expression lie in the transferability and reproducibility in space and time of the assets that categorise, identify and qualify the history and the existence of the communities with their social and cultural context" (DiCultHer 2017). In this sense, the artefacts of augmented reality, constructed by the youngster starting from the direct relationship with the cultural objects/gods, also by means of the language of art and specifically that of cinema, reinterpret the heritage creatively and allow the aesthetic experience to be enjoyed to the full.

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