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mgallego@ugr.es
Universidad de Granada
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Sarracino, Fernando
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CAN AUGMENTED REALITY IMPROVE STUDENTS' LEARNING? A PROPOSAL FOR AN AUGMENTED MUSEUM EXPERIENCE

Puede la realidad aumentada mejorar el aprendizaje de los estudiantes? Una propuesta para una experiencia en el museo

Fernando **Sarracino**
Faculty of Education - University Suor Orsola Benincasa - Naples - Italy
E-mail: fernando.sarracino@unisob.na.it

Abstract:
Technological advances in the field of information and communication technologies enable innovative ways to mediate knowledge. The introduction of tablets and others mobile devices in each classroom is a challenge for education; as we understand, the impact on teaching is strong: teaching design must be redefined; the logic of the evaluation must change; should be reconsidered completely the time as a variable.
Augmented Reality (AR) is a technology enriching the real world with digital information and media, such as 3D models and videos, overlaying in real-time the camera view of smartphones, tablets, PCs or others digital devices.
Starting from analysis of the public response to a museum, this article deals with a specific project involving the use of mobile devices in order to achieve a more exciting experience of the museum.
Therefore, it is the aim of this article to examine the possibility for mobile devices to be learning devices in and out the classroom: e.g. AR may improve learning experiences and enrich basic school students' perception of real world through digital devices.
Keywords: *Mobile devices, Augmented Reality, Didactic, Museum Education, Media education.*

Resumen:
Los avances tecnológicos en el campo de las tecnologías de la información y la comunicación permiten formas innovadoras para mediar en el conocimiento. La introducción de las tabletas y otros dispositivos móviles en cada aula es un reto para la educación; tal como lo entendemos, el impacto en la enseñanza es fuerte: la enseñanza del diseño debe ser redefinido; la lógica de la evaluación debe cambiar; se debe reconsiderar completamente el tiempo como una variable.
Realidad Aumentada (AR) es una tecnología de enriquecer el mundo real con la información y los medios digitales, tales como modelos y videos en 3D, que sobreponen en tiempo real la vista de la cámara de los teléfonos inteligentes, tabletas, ordenadores u otros dispositivos digitales.
A partir del análisis de la respuesta del público a un museo, este artículo trata de un proyecto específico que implica el uso de los dispositivos móviles con el fin de lograr una experiencia más emocionante del museo.
Por lo tanto, es el objetivo de este artículo para examinar la posibilidad de que los dispositivos móviles para ser dispositivos de aprendizaje dentro y fuera del salón de clases: por ejemplo, AR puede mejorar las experiencias de aprendizaje y enriquecer la percepción del mundo real a los estudiantes de escuelas básicas " a través de dispositivos digitales.
Palabras clave: ***Dispositivos móviles, realidad aumentada, Didáctica, Museo de la Educación, La educación en medios.***

1. Introduction

Throughout history, man has always created technologies that give him a chance to improve the reality that surrounds him and to benefit from them: he realized tools for hunting and tools for tilling the soil; he built even more comfortable homes; he created means of transportation more and more faster; he invented media increasingly efficient up to the most modern technologies of communication. Communications technologies involve the cognitive abilities of individuals, are critical to the intellectual activity of man and to enter into a relationship with others. According to Prof. Maragliano (2008) we could say that "man without technology would not be such, being nothing more than a *naked ape*" (p.8), as defined by Desmond Morris.

> "The technology is designed as a component of human identity, one of its constituent expansion. […] Unlike animals which, in many cases, show their technical skills inscribed in their biological kit and adaptable to the environment only within a span of predefined possibilities, man holds in its biological predisposition possibility to make and use technology" (Maragliano, 2008, p. 7).

In fact, technology provides opportunities for large numbers of people to communicate and interact in an immediate manner, to meet the needs of contemporary society that is characterized by the progressive increase of its complexity, the speed and multiplicity of changes and innovations produced by globalization and the development of science and technology.

The complexity that characterizes both micro social contexts that the company also invests the educational system in general and the school in particular, which are pervaded by profound transformations; these transformations should make the school able to give answers to the multiple educational needs of users (teachers, students, administrative and technical staff, managers, parents, etc.) who are increasingly heterogeneous, characterized by the diversity of needs, interests, languages, diseases, etc.

As Winston Churchill said, "a pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty". This quote seems to perfectly represent the response of the operators of the school to the changes which complexity and technological innovations are subjecting to it.

Through the connective nature of digital technologies, learning does not translate more lonely in a relationship entirely between you and your computer, but it becomes a social dimension in terms unimaginable even a few years ago. Connectivity influences learning both in the classroom, thanks to computers in the network, both on the road, thanks to mobile devices.

> "Connectivity, however, represent the most recent key development occurred in the field of digital technologies. Unlike previous technologies of Web 1.0, the connectivity between digital devices, and made possible by Web 2.0, is ambivalent: more connectivity picks up speed, it becomes economical and available, the more we find ourselves embroiled in a society that is connected in more ways than one. In particular, the widespread use of Web 2.0 technologies can be a dimension of communication and collaborative ubiquitous learning. The speed and power of digital technology give rise also to a multimedia dimension in which transactions, in different modes and through a certain amount of digital resources, allow the activity of learning to take place in a number of different environments, in any place and time" (Jessel, 2012, p.13).

Technological innovations expand, then, the times and places of learning that is no longer relegated solely to the time at school; in this perspective also changes the role of the student in a participatory dimension that makes it at the same time producer and consumer (*prosumer*) of the learning object.

> "The concepts of the *prosumer*, one who is both *producer* and *consumer*, and of *prosumption*, involving a combination of production and consumption, are certainly not new. They were implied in earlier work such as that of Karl Marx and later by scholars such as McLuhan and Nevitt, who wrote about the process by which the "consumer becomes producer" (Nevitt, 1972, p. 4). However, the terms themselves were created by the futurist Alvin Toffler in 1980" (Ritzer et al., 2012, p. 379).

Thus, media represent a real opportunity to act on the development of critical thinking, for their potential to produce reflection and suggest operational strategies (Rivoltella, 2006) to acquire teenagers' tools to analyze the global media and, at the same time, to turn them into media producers, helping them to become informed consumers and, by relating them to other cultural areas, stimulating critical thinking.

> "The skills related to media literacy can be summarised in four areas of ability: access, analysis, evaluation and creative production. All of these skills boost aspects of personal development: consciousness, critical thinking and problem-solving abilities" (Rivoltella et al., 2012, p.64).

Therefore, education extends its time and its spaces: it takes place not only inside "the four walls of the school" but it goes beyond and involves "spaces" and "times" previously considered out of educational fields. In this area, there are several proposals to achieve the utopia of a school that can achieve mutual exchange and investment relationships with educational agencies in the area. In today's complex society, there is a need to offer a

greater number of educative opportunities; then the task of education is not only incumbent schools, universities, colleges.

> "Computers and other aspects of Information and Communication Technologies (ICTs) allow children and young people a wide variety of activities and experiences that can support learning, yet many of these transactions do not take place in traditional educational settings. In fact many of these may not be considered 'educational' according to our conventional understanding of that term. For most of us, discussion about learning is inextricably related to formal education systems (how schools should be organised, managed and run). However, any interest in the role of ICTs in children's learning forces the recognition that many children are immersed in ICT-related activities in their homes and with their friends. This recognition requires us to acknowledge a wider 'ecology' of education where schools, homes, playtime, the library and the museum all play their part" (Sefton-Green, 2006, p.2).

So, when we think about learning, we have to go a little further and think about learning outside school: we might begin to consider museums, galleries and science centers. What we often tend to overlook, however, is the sort of learning that goes on as part of our normal day-to-day activities when we don't even think we are learning (Sefton-Green, 2006).

In this sense, museums become places of discovery, spaces within which to achieve learning fascinating paths: the museums are no longer seen as a repository of dusty antiques or holy and untouchable archaeological objects, but should be considered as a time machine, in which you can travel with the eyes and mind.

1.1 Experience, mediated experience, media and learning

We learn through experience. Better yet: we learn through a learning experience. It is not necessarily an experience we live in the first person; we learn by comparison with the experiences with which we relate and that can provide us with information, points of view, elements of reflection through which we can enrich our store of "knowledge" and mature expertise that allow us to deal with different aspects of everyday life.

According to Gee (2008),

> "earlier learning theory argued that the mind works like a calculating device, something like a digital computer. On this view, humans think and learn by manipulating abstract symbols via logiclike rules. Newer work, however, argues that people primarily think and learn through experiences they have had, not through abstract calculations and generalizations. People store these experiences in memory - and human long-term memory is now viewed as nearly limitless - and use them to run simulations in their minds to prepare for problem solving in new situations. These simulations help them to form hypotheses about how to proceed in the new situation based on past experiences" (p. 21).

However, things are not quite that simple and a little more complex because certain conditions must be met so that the experiences are truly effective for learning.

> "First, experiences are most useful for future problem solving if the experience is structured by specific goals". People best store their experiences when they can associate to them some goals and if these goals are or are not being met. "Second, for experiences to be useful for future problem solving, they have to be interpreted".

> Giving meaning to the experience means thinking - in action and after action - about how our goals are linked to the way in which we are building the learning situation. That is, it means to be able to extract lessons learned and anticipate where or when this becomes necessary. "Third, people learn best from their experiences when they get immediate feedback during those experiences"; people can best learn form experience when they can immediately recognize and assess their errors and see where their expectations have failed. It is therefore essential that learners are encouraged to try to recognize, interpret and clarify their mistakes and, on the one hand, to explain in their view results that they have not reached and, on the other, what strategies they could implement to obtain a different result. "Fourth, learners need ample opportunities to apply their previous experiences - as interpreted - to similar new situations, so they can "debug" and improve their interpretations of these experiences, gradually generalizing them beyond specific contexts. Fifth, learners need to learn from the interpreted experiences and explanations of other people, including both peers and more expert people" (Gee, 2008, p. 21).

But if lived in the first person, a learning experience for sure is most effective for learning because it allows students to live out the key elements, to recognize them and make them their own.

It seems clear, however, that not all learning experiences can be experienced in person, at least not in a "real" life!

One of the challenge to education that the new technologies introduced in recent years has been to extend the range of experiences that we can achieve.

1.2 Museum experience and museum education

The museums are one of the privileged places, outside of school and university, where it is possible to achieve formal training

They have a complex and important task to fully exploit their educational potential by making possible a rational use of it, so that a motivated and conscious learning responsive to the expectations of the public may be encouraged. It is a fundamental task for the realization of a "society educating", ie a society that considers it essential to the cultural growth of its citizens, throughout their life, and then organizes a "dense network of training agencies."

Thanks to direct contact with the objects contained in it, the museums offer unique educational and training opportunity because they activate a profound experience, arouse emotions, feelings, impressions, peculiar moods. In this way, the museums allow the development of the reflections, the maturation of awareness, the consolidation of learning, etc..

So, the museum is a place of learning privileged, an area of knowledge not only for students but for society as a whole.

In order for the museum experience can truly become a learning experience you need to offer visitors a variety of communication devices that enable the best access to information and that arouse curiosity, interest, desire to know. To fulfill its educational role, the museum must become an interactive place through the use of multiple media, evaluating the potential of each instrument and adapting it to the needs of the public.

The museum communicates with multiple devices: first of all the exhibits, but also through the architecture of the buildings, the design of the interior spaces, the organization of the exhibition. You can reduce the heterogeneity of the media in four types: natural media, textual tools, symbolic messages, electronic media (Monaci, 2005).

When the museum's spaces are enhanced by the tools described above, the quality of the "visit" is improved: the visitor moves from a passive and contemplative enjoyment to an active one, as he is involved also sensory, albeit in virtual contexts.

The technological tools, therefore, can improve and develop the quality of the visit, but cannot replace the experience of presence that is necessary and is important because it allows you to build a stream of links and exchanges with the objects preserved and displayed in the museum.

In this regard, Calvani (Calvani et al.1999) argues the importance of establishing a perfect media ecology: multimedia must be tightly integrated with the exhibition, searching for the right balance between message content and media.

Thus, museum education is a strong overcoming the conception of passive learning within the school walls made only through textbooks and teacher's lesson; it represents the overcoming the idea of school closed in his ivory tower; museum education is the idea of making the connection of the school with local emerging resources, in the perspective of the construction of an integrated educative system: this is going beyond those operational criteria of fragmentary parallelism or simple collaboration that characterized many of the initiatives existing between schools and cultural institutions, to arrive at an integrated proposal, designed, built and evaluated in real synergy (Calidoni, 1999).

Therefore, as we have seen, there are two types of museum education: one "not desirable" passive, in which the visitor undergoes this communication; the other "desirable", which provides an active learning and that promotes interaction and exchange.

In order to consider the museum as a place of education, learning and discovery, it is essential to move away from the conception that regards it as the place where we keep and store "old" and "dusty" objects. In this sense the museum would have the only task of conservation, cataloging and exhibition of collections; according to this perspective, the museum would only be a place where objects are layered and artifacts according to their historical times; on the contrary, the museum is a place where history comes to life, the place where we build our memory, we discover our roots, we know ourselves.

Regarded in this sense, museums become instruments of cultural growth of society and spread among the younger generations the importance of the protection of heritage.

According to this meaning, the museum can become a real “alternative school”. Inside it, the interest in the preservation of the collective memory, a decisive factor for the development of society, appears as a constant in the history of mankind. In fact, deprived of it, the man would not perceive his identity, would not have self-awareness, would not have awareness of his personal and collective history (Pagano, 2000).

The museum is a real "time machine" inside which you can travel with your eyes and your mind and, through this experience, accompanied by thought and critical reflection, you can find the roots with which strengthen yourself in the present.

2. Simulation-based learning

Simulation is "an act of imitating the behavior of a physical or abstract system, such as an event, situation or process that does or could exist" (Baek, 2009, p.27). The term comes from the Latin "simulo", which means "to imitate", connected to the term "similis", ie similar.

Webster's Dictionary defines it as "the imitative representation of the functioning of one system or process by means of the functioning of another" (www.merriam-webster.com). Therefore, an important feature of the simulation is the reproduction of some aspects of reality. It is not, however, a static but a dynamic reality, or, better yet, an interactive reality.

Landriscina (2009) in fact proposes an operational definition of the term simulation:

"simulation is an interactive representation of reality based on building a model of a system to which you want to understand how it works" (p.18).

Simulation is not a new learning or training methodology. The experiments conducted in controlled environments, role-playing games, the staging of situations designed to highlight some critical elements, and the virtual reality environment of a flight or a race simulator all represent important types of simulations.

> "Two major factors are contributing to the proliferation of simulation technologies on our campuses. First is the increasing availability of quality simulation resources, available via the Internet or through new devices and systems. Inexpensive, commodity-based products such as computers, sensors, haptic devices, immersive virtual reality displays, and so forth, together with increasing network bandwidth, are helping to make sophisticated simulation technologies affordable and far more accessible. Second is the growing focus on outcomes in education and the push not simply to transfer knowledge or have students pass courses but to teach and assess broader competencies more rigorously" (Damassa et al., 2010, p.2).

Simulations can be used to provide a fertile learning environment for students. The use of simulated activities in education is widely becoming recognized as an important tool in schools.

The simulation provides an interface to a model of the system we want to analyze (which could be anything from model of sports training, to an organizational model of business, to a procedural model of equipment operation, to a scientific model of a bio-system, or an organism, ect.): the interaction with the model usually takes the form of manipulating a selection of parameters to set the result. The full complexity of the underlying model remains hidden, and the instructional focus is to help students to see the relationship between the selected parameters.

> "Simulation environments used in education are designed to provide a supported and simulated experience of scientific inquiry, deploying existing dataset, visualizations of the data, and problems for the student to solve" (Laurillard, 2012, p.177).

A positive outcome of the simulation is the possibility for the students to observe the consequences of their choices, but in a simulated environment. Having the chance to see their mistakes in advance, they can make substantial changes to their actions and this can only result in a positive outcome of the quality of their experiences.

According to Landriscina (2009), the main uses of the simulation are as follows:

understanding; a simulated environment can show the student how the process takes place and, therefore, the student can understand what happens; this is the main purpose of scientific applications of simulation;

anticipation; the aim is to have a reliable pattern of what will happen in the future more or less distant; examples of this use of the simulation are in the design and construction of demographic, scientific, meteorological models;

support for decisions; the purpose is to enhance decision-making abilities of a person or a team through the ability to analyze the role of the variables involved in different possible scenarios;

training; the purpose is to teach the knowledge and to improve the skills;

entertainment; the aim is to involve intellectually and emotionally for curiosity, for fun or for competition.

The simulation in teaching has many advantages: for example, the simulations are often cheaper than real systems: to set up a flight or a race simulator, for example, is probably cheaper than buying a plane or a car to practice flying or driving; and, of course, is even more safe; any incident, when simulated, is without risk to the learner.

A process simulation can also be paused, to better analyze the events that are taking place and, therefore, highlight the critical elements (which, of course, is not possible in reality).

A simulated environment can finally be realized in order to investigate the effects of variation of individual parameters (rather than the whole system which, in fact, often are not separable).

The simulated activities that promote learning tend to recreate situations "almost real" (so that there is, therefore, little difference between the simulated environment and the real one): in doing so, they simulate reality so well that it achieves the same type learning experience that would occur in reality; moreover, this experience takes place in an engaging, so that students are not only observers of the phenomena but that they become active participants in the process (the reason is that students learn best from experience that they live in first person rather than those mediated). The involvement of students in activities is so deep that develops interest in knowing more and more things: it follows that the simulated process motivates learning and encourage students to improve the activity by contributing their own ideas.

The simulations also can be designed specifically for each learner, and may take into account the level of development of each student's learning and help develop the skills of each of them through the development of problem solving tools.

The most critical element in the design of the simulation environment is given by how to realize the feedback in such a way as to allow that all the potential described above can actually occur.

The goal, using a simulation environment, is to foster an active exploratory learning that allows students to improve their understanding by using high-level cognitive abilities to explore, analyze, interpret and solve problems and, in so doing, to improve such skills. It is an ambitious purpose, but it is equally clear how the experience inspire learning.

> "When learning with simulations, learners interact with the model through an interface that enables them to change values of input variables and observe the effects of these changes on output variables. Simulation programs can be used as the basis for training of knowledge or skills (or a combination of both). In the case of learning practical skills, transfer to real situations is crucial, so high fidelity is often preferred. High fidelity means that the model in the simulation must be realistic and also that the interface (for both input and output) needs to be close to the real situation (Hays & Singer, 1989). […] In summary, and as a very general conclusion, large-scale evaluations of carefully designed simulation-based learning environments show advantages of simulations over traditional forms of expository learning and over laboratory classes. These results may become slightly more nuanced when we look at the different types of learning outcomes" (de Jong, T., 2011, pp.446-47).

2.1 Serious Games and Immersive Environments

Interactive immersive entertainment, or videogame playing, has emerged as a major entertainment and educational medium. Players' understandings are developed through cycles of performance within the gameworlds, which instantiate particular theories of the world (ideological worlds). Players develop new identities both through game play and through the gaming communities in which these identities are enacted (Squire, 2006).

A serious game is a game designed for a primary purpose other than pure entertainment. Game technology and design are used to develop user experiences to, at the same time, engage, educate and entertain the learners. Serious games are simulation environments in the real world or events or processes designed in order to solve a problem or for the purpose of educating through learning experiences.

Although serious games can be entertaining, their main purpose is to train or educate users, though it may have other purposes, such as marketing or advertisement. Because their primary purpose is other, sometimes serious game will deliberately sacrifice fun and entertainment in order to achieve a desired progress by the player. Serious games represent, therefore, a category of games with different purposes including educational games of various kinds. Game-based learning force the user to take an active approach to learning with rapid feedback and clear consequences leading to higher engagement and improved learning.

> "There is a strong argument for the value of games in education because of their affinity with "learning by doing", or even "being" in the context of role-play games (Gee, 2003; Squire, 2006; Van Eck, 2006). By combining "play with "interactivity" (Roussou, 2004), they provide a kind of intensive, motivated concentration of cognitive activity that is precisely what we hope for learning (Prensky, 2003)" (Laurillard, 2012, p.182).

The development of multi-sensory environments, interactive and participatory, which combine the physical world with the virtual world, is derived from the constant needs of the games industry for users to make the gaming experience more exciting. The result was specialized theme parks and various other leisure and entertainment centers worldwide that are offering users interactive activities through the creation of immersive environments within which they can act directly in the first person. This is not a trend limited to the entertainment domain; informal learning environments for children are also following this path, backed up by a theoretical notion of play as a main activity in the intellectual development of the child. And interactivity is the key word that ties, on the one hand, the game as the primary learning activity for the child and, on the other hand, the idea of creating immersive environments within which they can live in the first person learning experiences. The interactivity, then, is in connection with learning, as with the game, as with the narration, and, by its nature, as with all the intrinsic characteristics of virtual reality, such as immersion, presence, and the creation of illusion (Roussou 2004).

Supporters of "serious games" reasonably argue that they have the potential to foster the development of knowledge and high level skills. The leisure and entertainment industry is healthy and growing and will continue to be able to invest heavily in the development of game environments incredibly realistic and computationally complex. But companies never take seriously the declination of such products for educational purpose and the world of education cannot afford the level of investment needed to emulate these games. There are some areas of the market that have courageously addressed to immersive environments such as games for educational purposes but they are very far from making reference to the theories of learning that may drive their design or issues that would fit well with the educational curricula.

There is the inevitable risk of confusion between immersive virtual games for leisure and "serious games" educational. The proponents the use of games for learning focus their attention on the motivational effects that the intense concentration typical of virtual games can have on the world of education. But the games become immersive, not simply because of the still primitive graphics is realistic, but because the narrative development of the game has been cleverly designed to instill a continuous interaction between the expectation due to user input and the response to this input: this is to drive the narrative process. The games are highly interactive and interactivity is important for learning, so it is expected that the formats of the game should be used for education (Laurillard 2012).

3. The Augmented Reality

Technological advances in the field of Information and Communication Technologies (ICTs) enable a variety of innovative ways to mediate knowledge. Among them, Augmented Reality (AR) becomes increasingly a field of interest.

What's Augmented Reality (AR)? In what the AR differs from virtual reality?

About to begin, we refer to QR Codes. How many times, during a visit to a museum or queuing in a public office or doing shopping, we happened to see those blacks and white squares (QR Codes) through which we can access the information that we care? What is it?

QR code is an object created to be linked to digital resources: when we scan it by the QR reader on our digital device, we will connected and the resources will be downloaded and

opened on our device. So, the QR codes act as hyperlinks to data and other resources for use by students, parents, etc.

Is it Augmented Reality?

When we talk about Virtual Reality we refer to a situation that is completely generated by the computer: it may also represent an experience very close to the reality (i.e. realistic) but it will not be the reality. Virtual Reality is an "other place" that exists only in the digital space.

Thus, augmented reality is a particular extension of virtual reality that is to overlap the reality perceived by the subject with another reality generated by the computer. The user's perception of the world is "augmented" by virtual objects that provide additional information on the real environment.

So that we can talk about AR, three things must happen: first, you have to put together a virtual object and a real object; then, the user must be able to interact in real time with the virtual object; finally, the virtual object must be placed in a three dimensional space.

Augmented reality is not a different reality from what we expect, but it is a different point of view that allows us to see reality for what we want it to be. It gives us the opportunity to see work in progress, stimulating our creativity and imagination.

Augmented Reality, how we use it today, has its roots deep in the concept of Virtual Reality: by Real and Virtual interaction, in some way, we are deceiving our senses with appropriate technological instruments, and, in this way, we are creating a new reality, an augmented one. However, this Reality requires a radical change in both technical and philosophical way. The specific properties of Augmented Reality undeniably challenging the perception of space, which is traditionally based on the use of what surrounds us. The Augmented Reality Technologies (ARTs) are among the first to virtually expand our perception of three-dimensional space, by its own nature, classic and abstract.

> "Johnson, et al. (2010) stated, "AR has strong potential to provide both powerful contextual, on-site learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world" (p.21). AR has been experimentally applied to both school and business environments, although not as much as classic methods of education and training during the last two decades. In addition to that, now that the technologies that make AR possible are much more powerful than ever before and compact enough to deliver AR experiences to not only corporate settings but also academic venues through personal computers and mobile devices, several educational approaches with AR technology are more feasible. Also, wireless mobile devices, such as smart phones, tablet PCs, and other electronic innovations, are increasingly ushering AR into the mobile space where applications offer a great deal of promise, especially in education and training. […]It is highly likely that AR can make educational environments more productive, pleasurable, and interactive than ever before. AR not only has the power to engage a learner in a variety of interactive ways that have never been possible before but also can provide each individual with one's unique discovery path with rich content from computer-generated three dimensional environments and models" (Kangdon, 2012, p.14 and p.19)

At the same time, ARTs enabling potentially endless opportunities to reformulate the surrounding space through mobile devices (which now have screens bigger and bigger), but augmentative features can predicts a research area also in the temporal sense: the new reality, in fact, may prefigure possible futures or may show hypothetical past: therefore, through controlled simulation, we have ways to construct realities as we would like, or as we think it is really beyond the appearance, or as we think it was.

4. The Toy Museum of Naples

The Toy Museum of Naples is born from the encounter between one of the main centers of Study and Research in the field of education and childhood, that is the University Suor Orsola Benincasa of Naples, and one of the finest collections of toys, both ancient and modern, on the Italian territory, that of Vincenzo Capuano, Professor of History of Toys at the Faculty of Educational Sciences of the University.

The city of Naples while presenting, on the one hand, a large museum tradition "classic" (think of the National Museum which is the largest archaeological museum in Italy) and, secondly, a museum tradition linked to specific native productions (think about the splendid collection of nativity arts of Museum of San Martino), not being in the past a significant site of toy factories, which, on the contrary, have found their place in the majority of cases in the industrialized north of Italy, over the years has remained on the margins of both the market that the world of collecting toys and hosts a few cultural events in this field.

However, the city has always been fertile ground for the expression and research in the field of play and imagination; these elements, out of the ordinary, can be recognized as essential elements in the character of the people of Naples and inexhaustible resource expressive of it.

The Toy Museum of Naples, located within the University Suor Orsola Benincasa Citadel, has the opportunity to achieve a double objective and fill in some gaps. First, it makes available to the public the rich collection and endows the city of Naples, as well as large Italian and European cities, a museum dedicated to one of the most important minor arts: the toy, in fact, is at the same time, an instrument of raising the artistic, historical memory, testimony of costume, craft and industrial progress.

Secondly, because of its location within a center for research and training in the field of education and childhood, the toy museum achieves the intent to initiate direct contact with the object of observation (the toy) and to initiate, therefore, a reflection on the great educational contribution of the toys as it has developed over the centuries, on the values and models that the toy has forwarded childhood over time, with inevitable relapse even on selection and use critical and responsible in the present (Università degli Studi Suor Orsola Benincasa - Museo del Giocattolo di Napoli. http://museodelgiocattolodinapoli.it/).

The Technological Laboratory of the Toy Museum was founded with the aim of creating advanced technology solutions to realize an interactive tour of the museum collection. With the use of mobile devices, visitors have the opportunity to get more information (including multimedia) on toys and can "interact" with them via dedicated applications.

A first app, called "Things of dolls", allows the visitor to replace the dolls' clothes, digitalizing a recreational experience that we often find in childhood. The game follows the history and traditions: it allows the visitor to dress a vintage doll with the clothes of a modern Barbie or vice versa, highlighting such as clothing is strongly related to the specific historical era of the toy.

Another application is called " Once upon a time a piece of wood": the title recalls the opening words of the novel by Carlo Collodi, Pinocchio. As it is known, Collodi's masterpiece begins with a detailed description of the birth of Pinocchio just from a piece of wood. The experience that the visitor live through the app allows the user to digitally revive the steps of modeling the timber according to the story that lead to the birth of the puppet Pinocchio. This application becomes even more significant if intended for use by persons with weakened sphere of communication (autism, aphasia, pervasive and/or specific learning diseases) for which, as we know, the transposition of text written in visual text increases the possibilities for enjoyment and understanding, implementing, at the same time, verbal communication itself.

The museum is completed, finally, by an own digital duplicate on the site www.museodelgiocattolodinapoli.it; this space, on the one hand, preserves the temporal objects themselves, placing them away from the natural physical degradation, and allows the use to those who are in other places; on the other hand, the site allows different visiting paths precluded by the physicality of the real museum.

The advanced search between the objects and the subsequent classification into subsets (real “rooms” of the virtual museum) is made through the selection of parameters that identify the characteristics of toys: categories, materials, ages, personalities, brands, mechanisms, types. The space of the museum is, therefore, continuously redefined and the visiting time is stretched (or compressed) according to the research carried out and the virtual room generated by it.

5. A proposal for an Augmented Toy Museum

The Toy Museum in Naples hosts workshops for primary schools students, once a week, for groups of 40-50 students.

Students are proposed social-anthropologically age-appropriate activities, in which children can understand the (spatial and temporal) distance with other previous cultures; on one hand, the cultures that preceded our culture in our local area and, on the other, those who preceded our culture at a national and international level.

In the laboratory, the children have to imagine how the toys were played with, how many players were involved, what was the "aim of the game", etc.; children have to find out of which "modern" toy these games are the ancestors; they have to understand the reason for its [technological] limits, constraints: the children’s answers are not always satisfactory and show their difficulty in envisioning the game in action.

Students were then given a questionnaire rating the museum’s activities and their answers confirmed their difficulties: in fact, what became evident is that toys, albeit "telling a story" (the story of their parents, grandparents, great-grandparents, etc.), are perceived by

children as something "distant", of which they do not always understand the function; toys are perceived as objects distant from the practices of play in our times.

Analysing this feedback, we decided to design a digital space (still under construction), which could extend the use of the museum and not only show the toy but also describe its use visually.

How to study the potential of Augmented Reality to support teaching, particularly in the case of museum education?

Consistently with what has been achieved within the Toy Museum of Naples, our proposal focuses on possibility of expanding the museum outside of the physical space that houses it, extending its usability to its visitors. Toy Museum of Naples, as we have seen, is already open to technological innovation and to the use of mobile applications that make its resources more usable. Even now, visitors of the museum will be given a digital device that has loaded an interactive guide of the museum. The digital device could be the "virtual portal" through which visitors can increase their museum experience.

Just starting from the discussions held on the importance that simulation environments may have on learning, particularly those immersive, the project aims to investigate how Augmented Reality can become a tool to better understand the informal educational spaces, in particular to know how it is possible to increase the educational resources of a museum.

And what better test-bench, what ideal experience for this experiment we could analyze if not the Toy Museum?

The characteristic of the toy, in fact, is that it is an object that comes to life in the hands of the child/teenager/adult that is playing, which customizes the toy through a subjective use; and thus the child/teenager/adult live through the toy his personal entertaining/learning experience.

> "In the game and using the toy, only apparently the child is reproducing lived experiences or the reality; however, he is creating a new reality, disposed and suitable to its needs or to his needs at that time. The game, therefore, is always a deeply creative activity, an activity that produces imagination and looks to the future. The toy in its simplicity and in its sophisticated processing, acts as a vehicle, as a facilitator, as an access key to enter in a space in which the subject creates a new reality, composing a world suitable and relevant to his needs" (Corbi, 2011).

When, on the contrary, such an object remains "closed" in the display case of a museum, it's like if this object lost a part of itself.

Each museum, by its nature, at the same time, in fact, preserves and protects the object, but in doing so, it also limits the enjoyment of the visitor, or, in the case of museum education, the student that from everything is kept in the museum would like to take a learning experience. Why, then, do not take life to objects stored in enclosed spaces such as museums?

And what, if not toys, they can at best represent an object that, by itself, does not exist except when it comes to life in the hands of the child who plays with them? How to overcome this contradiction?

Just the Augmented Reality can allow toys come to life.

Like a scene from the movie "Toy Story", the toys through the screen of the mobile device can take lives and show themselves in all their beauty. In this way, they cease to be only static objects, memorabilia for collectors, something to "do not touch" (what might happen to the toys in fiction from the movie "Toy Story 2" if they will fly in Tokyo Toys Museum): on the contrary, they come to life in a virtual dimension, returning to their original function of toys: objects to "act", to be used, to be played thanks to Augmented Reality; thanks to it, it becomes possible to overcome the contradiction of a toy unusable because behind a bulletin board, accessible only visually, and it become possible to revive the excitement in the virtual reality of the toy in action.

Referencias bibliográficas

Abruzzese A. & Maragliano R. (Eds.) (2008), *Educare e comunicare, spazi e azioni dei media*, Mondadori Università: Milano.

Alessi S. (2000), *Building versus using simulations*, in Spector J.M. & Anderson T.M. (Eds.), *Integrated and holistic perspectives on learning, instruction and technology: Understanding complexity*, Kluwer: Dordrecht.

Ardizzone P. & Rivoltella P.C. (2008), *Media e tecnologie per la didattica*, Vita e Pensiero: Milano.

Azuma R.T. (1997), *A Survey of Augmented Reality*, in "Presence: Teleoperators and virtual Enviroments", *6* (4), pp.355-385.

Baek Y. (2009), *Digital Simulation in Teaching and Learning*, in Gibson D. and Baek Y. (Eds.), *Digital Simulations for Improving Education: Learning through Artificial Teaching Environments*, Information Science Reference [an imprint of IGI Global]: Hershey, PA, pp. 25-51.

Bertuglia C.S., Bertuglia F. & Magnaghi A. (1998), *Il museo tra reale e virtuale*, Editori Riuniti: Roma.

Buckingham D. (2003), *Media Education. Literacy, Learning and Contemporary Culture*, Polity Press: Cambridge, UK.

Calidoni M. (1999), *Verso un sistema italiano dei servizi educativi per il museo e il territorio. Materiali di lavoro della commissione ministeriale*, Aracne: Roma.

Calvani A. & Rotta M. (1999), *Comunicazione e apprendimento in internet*, Centro Studi Erickson: Trento.

Cambi F. & Gattini F. (2007), *La scienza nella scuola e nel museo,percorsi di sperimentazione in classe e al museo*, Armando Editore: Roma.

Castells M. (1996), *The Information Age: Economy, Society and Culture. The Rise of the Network Society*, Wiley-Blackwell: Oxford.

Cawood S. & Fiala M. (2007), *Augmented Reality. A Practical Guide*, The Pragmatic Bookshelf: Raleigh, NC/Dallas, TX.

Cecconi L. (1997), *Didattica museale e multimedialità*, in "CADMO", vol.13-14, pp. 25-34.

Comunication Strategies Lab (Eds.) (2012), *Realtà, esperienze, strategie e contenuti per l'Augmented* Reality, Apogeo: Roma.

Corbi E. (2011), *Il giocattolo come medium per lo sviluppo della creatività e dell'autonomia*, in AA.VV., *Museo del giocattolo di Napoli*, Alfatipografia: Napoli. Retrieved from: http://museodelgiocattolodinapoli.it/index.php?idPage=135&lang=it

Damassa D.A. & Sitko T.D. (2010), *Simulation Technologies in Higher Education: Uses, Trends, and Implications*, ECAR Research Bulletin (3): Boulder, CO.

de Jong, T. (2011). *Instruction based on computer simulations*, in Mayer R.E. & Alexander P.A. (Eds.), Handbook of research on learning and instruction, Routledge: New York, NY, pp.446-466.

Di Bari C. (2009), A passo di critica: il modello di media education nell'opera di Umberto Eco, Firenze University Press: Firenze.

Gee J.P. (2008), *Learning and Games*, in Salen K. (Ed.), *The Ecology of Games: Connecting Youth, Games, and Learning*, The MIT Press: Cambridge, MA.

Gee J.P. (2007), *Good Video Games + Good Learning: Collected Essays on Video Games, Learning and Literacy*, Peter Lang: New York, NY.

Gee, J. P. (2003), *What Video Games Have to Teach Us About Learning and Literacy?*, Palgrave Macmillan: New York, NY.

Hays, R. T., & Singer, M. J. (1989), *Simulation fidelity in training system design*, Springer-Verlag: New York, NY.

Jessel J., *Processi sociali, culturali, cognitivi e nuove tecnologie nei contesti di apprendimento*, in Miglino O., Nigrelli M.L. & Sica L.G (Eds.) (2012), *Teaching, Teach, Technology. Videogiochi di ruolo, simulazioni al computer, robot e realtà aumentata come nuove tecnologie per l'apprendimento: una guida per insegnanti, educatori e formatori*, FEU: Napoli.

Johnson L., Levine A., Smith R. & Stone S. (2010), *Simple augmented reality*, in Johnson L., Levine A., Smith R., & Stone S., *The 2010 Horizon Report*, The New Media Consortium: Austin, TX, pp.21-24.

Kangdon L. (2012), *Augmented Reality in Education and Training*, in "TechTrends", *56* (2) March/April 2012, pp.13-21.

Landriscina F. (2009), *La simulazione nell'apprendimento, quando e come avvalersene*, Centro Studi Erickson: Trento.

Laurillard D. (2012), *Teaching as a Design Science. Building a pedagogical Patterns for Learning and Teaching*, Routledge: London/New York, NY.

Maragliano R. (2008), *Di cosa parla questo Manuale. E come ne parla*, in Maragliano R. & Abruzzese A., *Educare e comunicare, spazi e azioni dei media*, Mondadori Università: Milano, pp.1-34.

McLuhan, M. & Fiore Q. (1967), *The Medium is the Massage: An Inventory of Effects*, Bantam Books/Random House: New York, NY.

McLuhan, M. & Nevitt, B. (1972), *Take today: The executive as dropout*, Harcourt Brace Jovanovich: New York, NY.

Miglino O., Nigrelli M.L. & Sica L.G (Eds.) (2012), *Teaching, Teach, technology. Videogiochi di ruolo, simulazioni al computer, robot e realtà aumentata come nuove tecnologie per l'apprendimento: una guida per insegnanti, educatori e formatori*, FEU: Napoli.

Monaci S. (2005), *Il futuro nel museo. Come i nuovo media cambiano l'esperienza del pubblico*, Guerini, Milano.

Mottola Molfino A. (1998), *Il libro dei musei*, U. Allemandi & C.: Torino.

Pagano R. (2000), *Il sapere come memoria*, in Laneve C. (Ed.), *Per una pedagogia del sapere*, La Scuola: Brescia.

Ritzer G., Dean P. & Jurgenson N. (2012), *The Coming of Age of the Prosumer*, in "American Behavioral Scientist" 56(4), pp.379-98.

Rivoltella P.C. (2006), *Screen Generation. Gli adolescenti e le prospettive dell'educazione nell'età dei media digitali*, Vita & Pensiero: Milano.

Rivoltella P.C., Brichetto E. & Fiore F. (2012), *Media, Storia e cittadinanza*, La Scuola: Brescia.

Rivoltella P.C. & Ferrari S. (2010), *A scuola con i media digitali: problemi, didattiche, strumenti*, Vita & Pensiero: Milano.

Roussou M. (2004), *Learning by Doing and Learning through Play: an Exploration of Interactivity in Virtual Environments for Children*, in "ACM Computers in Entertainment (CiE)", *1* (2), pp.1-23.

Sefton-Green, J. (2006), *Report 7: Literature Review in Informal Learning with Technology Outside School*, FutureLab: Bristol, UK.

Squire K. (2006), *From Content to Context: Videogames as Designed Experience*, in "Educational Researcher", November, *35*, (8), pp.19-29.

Toffler, A. (1980), *The third wave*, William Morrow: New York, NY.

Van Eck R., *Digital Game-Based Learning: It's Not Just the Digital Natives Who Are Restless*, in "Educause Review", *41,* (2) (March/April 2006), pp.16–30.