AUGMENTED REALITY AND LEARNING: THE PATH TO EDUTAINMENT, ADVANCED SOLUTIONS IN INSTRUCTIONAL DESIGN

Paolo Francescone, Università degli Studi Guglielmo Marconi, Italy

For learning mediated by new technologies, the response to the likelihood of technological overexposure, with consequent cognitive overload, is inherent in the good practice of design thinking and storytelling applied to instructional design, or in the complex techniques and methods of narratives that provoke knowledge transfer.

Introduction

The ever-increasing virtualization of environments and learning processes draws the attention to two fundamental and complementary issues: on one side the correct and strict technical-didactic design and implementation, on the other the set of new abilities and cognitive skills which need to be developed by the end-users of systems, services and contents of technology-mediated learning. Immersive laboratories and virtual classrooms, complex simulations and serious games, immersive learning in three-dimensional environments: the boundary between actual learning needs and the use of virtual environments, which is necessary to compensate for the presence/absence paradox facing the typical user of distance learning, crumbles and gets more complex.

The answer to the risk of technological overexposure with resulting cognitive overload is to be found in design thinking and creative storytelling applied to instructional design, that is to say in that set of storytelling techniques and methods aimed at transferring knowledge and skills, particularly as regards learning mediated by new technologies.

Those who design distance learning paths are required to keep a number of elements into consideration: the end-user’s real need of “things to be known”; his/her level of familiarity with immersive, interactive and multimedia technologies; his/her ability in selecting and sorting out the pure learning content from the expository and visual representation; his/her ability in properly combining the formal and informal aspects of learning; his/her
willingness to be emotionally involved; the overall usefulness of the learning path that has been implemented. In conclusion, if reality is “augmented” through the use of ever more complex technologies, also the cognitive and elaborating abilities of the learner must be greater. It is of paramount importance that instructional designers keep this in mind.

In this respect, a relevant example is the immersive multidisciplinary laboratory on Amedeo Modigliani, an immersive-learning multimedia and interactive environment recently made available by Università degli Studi Guglielmo Marconi to the students of the “Italian Arts, Music and History” course. It is a research project which, although radicalizing the learning experience through the use of advanced multimedia evocative storytelling techniques, successfully meets the contemporary challenge of learning from an “augmented reality”.

**Augmented reality between entertainment and edutainment**

The use of new technologies, which is unavoidable in several circumstances - at work, during free time activities, in education and training - more and more often implies that man’s sensory perception has to reckon with data and information which are electronically collected, selected, manipulated and transferred, in a way which cannot be achieved through the five senses. Mobile devices, smartphones, PCs equipped with webcams or other sensors, special stereoscopic 3D eye glasses, listening or manipulation devices “augment” reality through the addition of sensible information, based on a meta perception approach according to which reality can be, from time to time, adjusted and contextualized, made easier or more complex, clearer or multi-faceted, bigger or infinitely smaller, more useful or more enthralling.

Sometimes it happens that virtual worlds end up replacing natural perception, which normally enables man to experience reality through the use of the five senses; virtual worlds stir up sensations which cannot be felt in the real world. Augmented reality adds or removes information and data from physical reality through electronic or multimedia techniques which create the impression of immersiveness. It is a filtrated, computer-mediated, virtual reality which simulates a specific real situation enabling the user to
interact – often unintentionally – through unconventional, highly sophisticated interfaces. This filtering and mediation process takes place in real time, or rather in the real time that the user thinks he is living, but also in the past when this unconventional and sophisticated interaction was designed.

The implementation of the augmented reality principles is of great importance as regards molecular biology, nanotechnologies, military training and modelling of sophisticated systems. It is obvious that augmented reality is of great importance in the entertainment industry; in the movie industry, for example, 3D technologies have been very successful among the audience.

However, when applied to education and enlargement of knowledge, these technologies are to be used for edutainment rather than just for entertainment, that is to say, the ludic aspect has to be kept well separated from the educational one. Although taking advantage of the potential for emotional involvement, sensory pleasure and satisfaction provided by new technologies, one must not forget that these paths have, first of all, an educational and didactic purpose.

To be immersed in a virtual learning path or environment, within a so-called augmented reality, with an overload of stimuli and with the need of sorting out and interpreting new immaterial knowledge links, it does not necessarily mean that the user has to escape to another reality, as it happens with entertainment products; on the contrary, it means that the user can increase his/her participation and involvement in the reality he is studying through the use of new abilities and cognitive skills.

Instructional design and storytelling techniques, which are essential for the creation of advanced and effective learning objects, are used to control and supervise the process leading to the dematerialization of knowledge and of the place where learning takes place, as well as its almost unlimited extension within virtual realities and the resulting cognitive overload. Instructional design takes care of the cognitive risks that may arise from the immersion of the users into augmented reality where they are exposed to an overload of sensory inputs and a seemingly chaotic and confusing variety of reflection cues, data, information and knowledge. The seeming confusion of these augmented realities is turned into the order which is typical of knowledge and learning through the use of specific content selection techniques, of storytelling and of instructional design.

Thus, a creative approach to the initial design gives rise to a creative...
approach in learning: the original and unconventional designing of spaces, contents, branches of learning, time and story plots provides the end-user with the opportunity of developing a unique and creative approach to learning; he can then use the knowledge so acquired to create and expand knowledge in unprecedented ways.

**Augmented reality planning: design thinking and creative storytelling**

*Design thinking* is the method used for the creation of paths and objects which are educationally effective and technologically advanced and which ensure the quality of the educational contents provided as well as a high level of technological complexity and innovation. This design tool can be used in several environments and is particularly suitable for *instructional design*.

Generally speaking, *design thinking* is nothing but a strategy that improves the effectiveness of the process leading to the formulation and rising of new ideas; in short, it is a strategy aimed at fostering creative thinking. It is a way to increase the so-called “variance” within a logical design path, to facilitate the process by which man behaves as if an experience is new even though he has already lived it many times. In other words, it is something very much similar to “lateral thinking” or “divergent thinking”; these are all methods that help to analyze a problem from a different perspective with the aim of working out a number of possible ways to solve the problem through the use of diversified knowledge and information instead of giving just one solution.

This approach to design is particularly suitable for the management of working teams involved in the development of multimedia learning objects. The exchange of ideas in a team of professors, instructional designers specialized in the development of solutions for technology-mediated learning, software developers, programmers and designers is the ideal background for creative brainstorming, for the development of alternative mental maps and for the creation of innovative learning paths as regards both contents and technological aspects.

While designing the learning object, *design thinking* is useful to:

- collect, study, select and relate sources using an innovative and unconventional approach;
• work out multi- and interdisciplinary knowledge links and interrelationships which could not otherwise be identified and transferred to the end-user;
• visualize and communicate complex and innovative story concepts;
• choose the technologies best suited for the story to be told;
• provide the end-user with the opportunity of making his/her own experiments within a pre-defined learning path;
• foster the creativity of each end-user during the learning process leading to a personal definition of knowledge;
• improve the ability of end-users to participate actively in the creation of knowledge;
• favour the development of new meanings of knowledge and the creation of innovative environments.

The initial macro-design activity ends with the drawing up of a paper detailing the learning contents and the technical specifications. It is a storyboard which includes and optimizes all the information ranging from the overall design concept and the graphic and visual representation techniques to the details of the development tool to be used for its implementation.

The storytelling strategy most suited to achieve the required objectives is actually implemented at this stage. The creative storytelling techniques used in the distance teaching/learning process include the following aspects:

• clear statement of the learning objectives;
• originality of story contents;
• a good level of interconnection of story contents;
• involvement of the user and appeal of the story;
• storytelling as an invitation to the free exploration and free building of knowledge;
• enhancement of the aspects relating to expansion of space, time and sensory experiences.
Implementation of augmented reality: feasibility and selection of the most suitable technology

Technology has become an essential element of our life style, of our consumer habits, of the way in which we approach knowledge and learning; in some cases they have been changed drastically by technology due to its visual and multimedia appeal, to the fact that it is becoming more and more user friendly and thanks to the large number of utilities it can offer. In an increasingly advanced, complex and diversified technological environment, within which the end-users themselves often show what the trends in tastes, preferences and personal acceptance are, those who design learning paths are faced with the issue of selecting the development tools best suited to achieve the most effective learning objectives.

Questions to be asked are numerous. Is the use of the most advanced technological solution always an added value? Which is the most suitable technology for a multimedia storytelling aimed at boosting knowledge? Or is technology just a tool that does not add anything to knowledge and the learning objectives which are being pursued? How many times have new technologies been used more for entertainment than for edutainment?

The modern technical-didactic models suggest that programming and multimedia development tools are to be used with great care and the right sense of proportion.

The choice of the graphics and of the visual representation tools to be used in didactic storytelling poses a rather serious problem. Besides the usual requirements of accessibility and usability, which are typical of graphically developed environments, and of traceability vis-à-vis the platforms in which they are implemented, special attention must be paid to the selection of visual representation criteria and standards. Both static graphic representations (icons, pictures, graphs) and motion graphics are nothing but one of the possible “ingredients” in a multimedia “kitchen”. Despite all the concessions that can be made to the contemporary image culture, in which we are all irreversibly immersed, it is necessary to know that the graphic representation elements have to be adjusted to a learning-aimed storytelling. Being one of the elements available for instructional design, graphics must always be functional to the overall balance of storytelling and not just an aesthetic embellishment.

The same is true as regards programming technologies and
languages for the development of complex multimedia objects: the choice between PHP rather than C#, between Action Script rather than Silverlight, between audio/video editing in After Effects or rendering in 3D Max may substantially affect the usability of the object itself, its compatibility with SCORM requirements typical of distance learning platforms, its usability through different devices (PC, smartphone, TV, etc.), the possibility of surfing through the most used browsers.

The technical and didactic design should focus on the end-user, his/her needs and requirements for accessibility and usability, that is to say the student that, in order to learn, uses the technology that has been selected for him. This must be kept in mind even when the objective is to immerse the student in learning environments where reality has been "augmented".

A sample case: augmented reality and immersive learning in the virtual laboratory “3D Perspectives – Amedeo Modigliani”

Designed and developed by the “Multimedia Educational and Creative Production” Department of Università degli Studi Guglielmo Marconi for the “Italian Arts, Music and History” course, the multidisciplinary immersive laboratory “3D Perspectives – Amedeo Modigliani” is a three-dimensional multimedia and interactive environment within which the student can look in depth at the most important events of the life of the artist and of the man. The access logic is free, customizable and deeply involving. Among the other things, the laboratory is an open graphic-functional case which is available for new progressive implementations. During the initial designing stage we have had the opportunity to experiment with the use of 3D technologies for learning purposes. Since we wanted to give the opportunity of studying Amedeo Modigliani’s carving technique in an unconventional way, we have used a 3D digital mapping of one of his sculptures in order to highlight its plasticity. The entire project for a multidisciplinary immersive laboratory was developed around this technical-didactic focus, called the “Sculpture” path. The effort, therefore, has been to build a sound and consistent multidisciplinary story plot around the 3D object called “sculpture” leading to the creation of a technologically
advanced, content-complete learning object. Let us look in detail at the functional and multimedia characteristics of this object, its learning contents, and how the design decisions have been implemented.

The student can interact with an usable and intuitive interface and he can freely decide which path to follow and which audio-visual areas to access.

The “music room” offers a selection of classical music pieces that evoke the musical mood of the period and reflect Modigliani’s personal preferences as far as music is concerned. The pieces are: “Le tombeau de Couperin” by Maurice Ravel (piece composed between 1914 and 1917), “Arabesque” by Claude Debussy (1888-91) and “The Rite of Spring” by Igor Stravinsky (1912-13). From available biographic sources it seems that Modigliani had a strong partiality for Ravel’s music. Germaine Survage, who posed for a portrait in Nice, says: “Modigliani settled down in a small room where I had a piano and, looking at me, made me play Ravel’s music for a long time […] The portrait was drawn in a few hours and he never stopped, not even for a minute.” (Augias, 1999). During the years he spent in Paris, Modigliani breathed the innovation and experimentation of musical impressionism, current led by Debussy, who is regarded, after Wagner, as the “father” of modern music. Stravinsky, on
the contrary, arrived in Paris in 1910 with the “Russian Ballets” company. In Paris, which had become the meeting point of artists coming from all over the world, the musician started to frequent Montparnasse. Here he met Modigliani, who, a few years later, portrayed him in a few pencil sketches.
Once you have selected the piece that will accompany you through your virtual tour, you can start experiencing immersive study. There are a number of macro-routes dealing with Modigliani’s artistic experience. Based on a multidisciplinary approach, news, information and knowledge have been collected and linked together around these routes.

The first macro-route is “Women”; it deals with the women that played a major role in Modigliani’s life. “ Modi-maudit”, the damned dissolute artist, the unrecognized genius that sought refuge in cheap wine and absinth, met many women in his life, but only a few of them deeply inspired the artist and loved the man: Beatrice Hastings, Simone Thiroux, Jeanne Hébuterne. The Russian poetess Anna Achmatova deserves to be mentioned by herself. Besides sharing her love for poetry, Modigliani appreciated her “inborn ability to guess the thoughts, to see the dreams of the others”. Amedeo could communicate with her: “Probably he and I understood a basic thing: all that happened was the beginnings of our life: his very short, mine very long.” (Achmatova, 2004).

Once the student has selected the macro-route called “Women”, he can choose among three additional micro-routes: “Paintings”, “Literature” and “Sculpture”; they are focused on the artist’s representation of a woman’s world and on his love affairs.
The “Painting” route enables the student to view portraits of the most important women in Modigliani’s life. Documents, photographs, the possibility of zooming in on any detail of the works and an audioguide allow the student to study each painting in detail.
The “Literature” route focuses on the intense relationship that Modigliani had with Anna Achmatova, the Russian poetess he met during his stay in Paris. Their relationship is told through drawings and sketches that Modigliani made for her, photographs of that period and a poem in which the poetess seals with tender words their love affair.
Even though most of Modigliani’s works are portraits, the artist tested himself also against sculpture when he moved to Paris in 1909. His favourite subjects were: woman’s heads and women posing as caryatids. In June 2010 one of the few sculptures of the artist from Livorno was sold at an auction for 43.18 million Euros. The sculpture, known as “Tete De Caryatide”, is a 65 cm high calcareous stone showing Modigliani’s signature on its base; it was first exhibited at the Salon d’Automne. Modigliani made it in Paris between 1909 and 1914; it is one of the famous set of Caryatids.
known as “Goddesses of Beauty”.
The “Sculpture” route enables the student to study this work in depth. The 3D 360° visualization and a photo gallery showing details of the sculpture make it possible to appreciate the technical ability, the plasticity as well as a feeling of mystery and beauty.

In a virtual environment, through the use of multimedia and 3D technology, i.e. in a multisensory and immersive environment, the student can enter a micro world of knowledge, skills and
experiences that he could not have otherwise experienced. Thus, studying thus becomes a personal and innovative experience of discovery and learning.

References

Martín Abadi, Cardelli Luca (1996), A Theory of Objects, New York, NY, USA, Springer-Verlag

Anna Achmatova (2004), Amedeo Modigliani e altri scritti, SE


Corrado Augias (a cura di) (1999), Modigliani, l’ultimo romantico, Segrate (Milano), I, Mondadori


Tim Brown, Change by Design (2009), New York (NY), USA, Harper Collins

Thomas M. Duffy, Cunningham Donald J. (1996), Constructivism: Implications for the design and delivery of instruction, in Jonassen David (ed.), Handbook of research for educational communications and technology, New York, NY, USA, Macmillan Library Reference

Jerry A. Fodor (1968), Psychological explanation: an introduction to the philosophy of psychology, New York, NY, USA, Random House

Mark S. Fox (1979), On Inheritance in Knowledge Representation, Proceedings of the 6th International Joint Conference on Artificial Intelligence, 20-23 August 1979, Tokyo, Japan


Herman Maurer, Marianne Sapper (2001), *E-Learning Has to be Seen as Part of General Knowledge Management*, Proceedings of EDMEDIA: World Conference on Educational Multimedia, Hypermedia and Telecommunications, Charlottesville, USA, pp. 1249-1253


Yufeng Mo, Yisong Xu (2010), An E-learning System Based on Subsumption Architecture, Proceedings of International Conference on E-Business and E-Government (ICEE), 7-9 May 2010, Guangzhou, China


Wayne Piekarski, Bruce Thomas (2002), ARQuake: the outdoor augmented reality gaming system, in “Communications of the ACM - Internet abuse in the workplace and Game engines in scientific research”, V. 45, n. 1, pp. 36 - 38


Suzanne Ross (1980), Holistic Concerns, “Human Systems Management”, V. 1

Meryle Secrest, Carla Lazzari, Modigliani (2011), Segrate (MI), I, Mondadori

Meryle Secrest, Modigliani: A Life (2012), New York (NY), USA, Knopf Doubleday Publishing Group

la creatività e l’innovazione nell’ambiente di lavoro, Roma, I, Elliot

David Weinberger (2012), La stanza intelligente, Torino, I, Codice Edizioni

David Weinberger (2010), Elogio del disordine, Milano, I, BUR

David Weinberger (2002), Arcipelago Web, Milano, I, Sperling&Kupfer

Yorick Wilks (1974), More on Fodor’s Distinction Between Strong and Weak Simulations, “Philosophy of Science”, V. 41, n. 4, pp. 408-411