

## Digital technologies for the first network of the Italian University Museums

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### Introduction

A specific program agreement approved and financed by the Ministry of the University and Research in 2013 (into the law 6/2000 for the diffusion of the scientific culture), has enabled museums, museum centers and systems of twelve historical Italian Universities (Bari, Cagliari, Chieti-Pescara, Ferrara, Florence, Modena and Reggio Emilia, Parma, Perugia, Rome "La Sapienza", Salento, Siena, Tuscia) to take part in a national project, coordinated by the University of Modena and Reggio Emilia. This project aims to create a national system of fifty University Museums, fourteen collections, and seven Botanical Gardens.

The creation of this first national network is a fundamental tool to create multiscale management models and integrated project designs both at a national and international level. These concern not only scientific research but also multidisciplinary museum education and integrated museum communication, so that the public value of cultural historical scientific and naturalistic heritage preserved in museums can be perceived.

The project aims to offer a relevant contribution to the scientific education on different levels using innovative tools that do not need huge structural investments, and that directly involve and connect University Museums located on the whole national territory.

The tool of the Italian University Museums network will be a bilingual web portal realized on purpose for the project. It will rationalize their presence on the web, in order to strengthen and standardize the presentation of their quality contents on the web, as suggested by the guidelines of European project Minerva ([www.minervaeurope.org](http://www.minervaeurope.org)). Its innovative perspective will take into consideration the peculiar features of the collections as well as the experiences of each University Museum, their interdisciplinarity and their possible uses in the present-day historical, social and cultural context. It will design a new image of the museums and their ability to activate national and international synergies to plan lifelong learning activities for a wide and diversified audience, from research structures to schools of any kind and level.

### The catalog of the collections

The first objective of the project has been to monitor the most significant objects of the University Museums network. The museums are cataloguing more than 25.000 objects chosen from their most significant collections contributing to the national catalog of cultural heritage *into the SIGEC web*, the General Informative System of Catalog issued by the Central Institute for Cataloguing and Documentation (ICCD) of the Ministry of the Culture and Tourism. The museums are using the different catalog cards issued by the same ICCD for different kinds of cultural goods, according to the various disciplines, in particularly the card for the naturalistic scientific cultural heritage recently realized with the

contribution of the CRUI – Museums, a special committee of the Conference of Italian Universities dedicated to University Museums.

### **The Italian University Museums network web portal**

According to the peculiarity of the disciplines to which the catalogued objects belong – i. e. Physics, Anatomy, Archeology, Botany, Chemistry, Mineralogy, Paleontology, Physics and Zoology – four thematic itineraries will be created into the Italian University Museums web portal: stories, history of scientific instruments, landscape, environment. Through them, the web portal aims to activate and promote a wider audience's interest and involvement.

This web portal has been designed not to be a mirror of what concretely exists in the collections. On the contrary, it should be a tool at the service of the University Museums themselves, close but different: in a word, a medium between Museums professionals and different audiences. The interaction with the users and the constant inclusion of new contents on such digital space allow that spreading of knowledge and improving of services that University Museums, as public services, are supposed to do.

The proliferation of web and social networking technologies has enabled culture promoters and museum professionals to communicate, exchange, and produce new digital assets at a phenomenal rate. The adaptation of database technologies and the web leads to an increasing volume of digitized or born-digital objects that not only help streamline daily operations and services, but also shape our socio-cultural experience and identity.

Moreover, social media may provide, through the computational social sciences, a compelling opportunity for the researches about the involvement of people in museums, also if it does not necessarily provide a representative demographic of society at large.

Although some open ethical questions exists about the use of the public's social media for research such as this, particularly related to informed consent (GERARD, O'BRIEN & JACKSONS 2014).

### **Digital technologies for the Italian University Museums web portal**

Joining the University Museums in a network and creating a dedicated bilingual web portal will activate synergies, thus to share both mission and multidisciplinary contents. It will stop the disunion and the variety of web proposals: dedicated portals, complex websites, and webpages within the University website. It will instead promote more services than at present: services for the knowledge, the learning, and the users, and it will as well share resources with other sites.

It is therefore fundamental to create an interactive environment, specialized in conveying information, knowledge and culture, which clearly identify its promoting institution and mission, as well as, not least, vowed to quality.

Digitization means that information can be shared, cross-referenced, and repurposed like never before. This revolution is not just about information access and archiving but creating and harvesting knowledge to drive economic and technological progress, and in the museum context, a richer learning experience that meets visitors' interests and needs: expectations for civic and social engagement are profoundly changing museum' scope, reach, and relationship. Moreover visitors and staff expect a seamless experience across devices, more and more people expect to be able to work, learn, study, and connect with their social networks wherever and whenever they want and the need for data literacy is increasing in all museum-related fields (KELLY 2014).

New digital technologies, characterized by a good usability and accessibility level, will be applied (with reference to D. lgs. 4/2004- Code of cultural heritage and landscape and to

the recommendations of the WCAG 2.0) in the University Museums web portal. Among them, RFID-Radio Frequency Identification-Cross Media Content and architectural Interaction design, 3D reconstructions for immersive environments, streaming video and tools for real-time exploration of museum objects. Specific devices will reveal the four cultural itineraries (stories, history of scientific instruments, landscape, and environment) in the web portal. Characteristic of these technologies is their possible application both on-site within the exhibition paths and online within the web portal, websites, through mobile devices as well as for editorial initiatives. These technologies enable University Museums to create cultural communication programs involving emotional and sensorial spheres.

The spreading of computer and mobile devices for communication has been taken into consideration in designing and developing thematic paths as well as cultural itineraries on the territory. Actually, we are not only multitasking, we are multiscreening using tablets or smartphones. This means that it is not the device content to be critical: it is the device context that determines our behavior. When designing Museums learning experiences, it is imperative for Museums to consider the types of screens and devices they utilize in the physical and in the virtual space.

Rich learning experience across museums' digital and mobile spaces should encourage discovery and interaction, cater for the unexpected, provide many pathways to explore, give a taste for what happens behind the scenes, and be fun; provide content that is challenging, real, authoritative, and meaningful that encourages questions. If well organized and easy to navigate it involves staff that can relate to users and visitors and be respectful of their ideas and views, knowledgeable in their field, and easy to talk to – in the physical space, on line, or accessed via mobile devices. This can increase opportunities for social interactions – hanging out with friends, families, peers – learning together while building community, enhancing connections, and providing opportunities for collaboration (KELLY 2014).

The online content will be presented on the University Museums web portal using a responsive design in different ways depending on the device on which it is viewed: a museum's website may appear differently when it is being seen on a desktop versus a tablet versus a smartphone.

A responsive design codebase is one of the best examples of separating the presentation layer from the application system. Responsive design framework detect a device's screen resolution. Once the resolution is identified, all content on a site is presented within a grid system that are not new to the industry; it is both functional and well designed. There is a number of different Web destinations that need to accommodate the growing number of Web-enabled devices: a responsive design can satisfy the growing expectations of a contemporary audience. The flexibility of responsive design gives us an important opportunity to engage with and connect to visitors, regardless of where they are.

Responsive design enables museums to realize a more flexible and complex digital experience, to find creative and interesting ways to connect visitors to more relevant personalized and engaging content, to promote a production model and to create contents that is more accessible to its users (LUDDEN 2014).

The structured digital information used by means of software with rendering devices provides intuitive experiences of the objects through the immersive or virtual reality: it is helpful to add interpretative content to the enlarged view as a way to increase the learning potential.

Widespread expectation is nowadays for a further expand of the Web thus to incorporate immersive 3D environments.

The 3D immersive multi-user virtual worlds become increasingly accessible. At the same time, it offers an improved and engaging class experience. 3D digitization models of museum objects are a relevant step on the overall process to the complete reading of the objects, through multiple processes, in accordance with specific application requirements

due to complexity of the digitization needs. Different methods and technologies can be used to fulfill particular demands and needs of a specific digital recording: the main factors that influence the suitability and applicability of a method are the complexity in size and shape, the morphological complexity, the variety of materials (PAVLIDIS, KOUTSOUDIS, ARNAOTOGLOU, TSIUKAS & CHRISTODOULOS 2007).

The forms of objects can be acquired with the 3D modeling in an objective and non-invasive manner without any contact, in order to build a reconstruction of the morphology: they can also be completely reconstructed, with the contribution of experts, through integration of 3D acquisition techniques, using the CAD modeling (CHANE, MANSOURI, MARZANI & BOOCHS 2013). 3D digitization models, which may be linked to various kinds of multimedia information also with interactive models, contribute to provide more comprehensive descriptions as well as finds that can usefully be included in databases also to set catalog cards. The interactive visualization granted by 3D models is the closest representation tool to direct inspection. The following steps of storing, managing, searching and displaying 3D objects are still uneasy processes. Digital 3D models would let objects on a much wider scale than in real life, since they could have virtual access to objects located far away, without the limitations of museum operating hours or access rights. A crucial requirement for using digital models as replacements for printed material is the availability of the following enhanced searching over digital libraries, interactive visual analysis without compromising model, accuracy and quality, flexible tools for shape comparisons and improved shape reasoning capabilities.

3D reconstructions are also essential for the conservation status. They allow museums to monitor it as well as to schedule maintenance and restoration interventions in order to assess beforehand the impact that these interventions will have on the object, allowing the experts of different disciplines to optimize the various activities (KOLLER, TURITZIN, LEVOY, TARINI, CROCCIA, CIGNONI & R. SCOPIGNO 2004; ABATE, CIAVARELLA, FURINI, GUARNIERI, MIGLIORI & PIERATTINI 2011).

The technologies that enable presentation of interactive 3D contents on the web are fundamental to build virtual exhibitions. They allow museums to create both internal exhibitions accessible within the museums and remote on-line exhibitions accessible over the web. Remote access to 3D content allows users to experience distant virtual exhibitions in the same way as they can experience local 3D applications (FLOTYNSKY DALKOWSKI & WALCZACK 2012; PIERACCINI, GUIDI & ATZENI 2001).

The visual impact has a big relevance: virtual reality opens various opportunities for research, representation, teaching, valorization, dissemination, protection, fruition of the cultural heritage of the University Museums.

Virtual exhibitions enable presentation of countless artifacts that cannot be directly exhibited to the public due to their fragility, limited space, or the prohibitive cost of creating and managing appropriate displays. The increased computing power and the technical developments, allowing interaction visualization, have permitted the exploration of large data sets using visual presentations.

The use of new advanced and sophisticated techniques (currently applied to massive, heterogeneous, and dynamic datasets, such as those generated in studies of astrophysical, biological, and other complex processes) made possible the interactive manipulation of large visual data sets using visual presentations. Advanced computational methods with sophisticated graphics engines can tap the extraordinary ability of humans to see patterns and structure in even the most complex visual presentations and ultra-high-resolution displays allow zooming in to examine specific aspects of the renderings, or to navigate along interesting visual pathways.

Digitization can now cover artifacts ranging from the smallest (for example a small prehistoric stone tool) to the largest (a building or an entire historical city), aiding

researchers by providing much better resolution (as measured by number of samples and density of those samples on the measured surface) and improved accuracy.

A significant goal for the Italian University Museums network is to design a flexible and dynamic system with the following properties: a) it is based on a general data model able to include the common 3D objects in the web; b) it provides the definition of simple operations in order to easily build complex objects; c) it provides basic mechanisms for implementing content based 3D retrieval (AMATO, MAZZEO, MOSCATO & PICARIELLO 2012; ROGERS & EARNSHAW 1990).

A virtual environment tries to evoke a strong sense of reality in the user. This is achieved by the generation of artificial input to the user's visual, acoustic and haptic senses. By interfacing some of his/her articulations in the real world back into the virtual environment, the user can consciously interact with the environment (LOSCOS, TECCHIA, FRISOLI, CARROZZINO, RITTERWIDENFELD, SWAPP & M BERGAMASCO 2004; MOUSTAKAS & TZOVARAS 2010).

The generation of high-quality visual feedback from the virtual environment is often considered the most important aspect in generating a high degree of immersion. The desire to increase the degree of immersion led to the development of sophisticated image generators and display devices (CARROZZINO & BERGAMASCO 2010; LORENZO, SICILIA & SANCHEZ 2012).

## **The educational potential**

Digital technologies facilitate many kinds of collaboration – between University Museums and learners, between different institutions and among learners themselves – and facilitate personalization: the learning potential of a versatile and mobile information source under the learner's control is very big. The four thematic itineraries of the University Museum network web portal (stories, history of scientific instruments, landscape, and environment) with their underlying philosophies and their different approaches to learning could be an example of six possible types of learning enhanced with information technologies

- 1) distributive learning: the combination of growing access to distributed resources and the availability of media tools help with constructing and sharing interpretation of these resources;
- 2) authentic tasks and complex inquiry: the availability of large archives of online primary resources makes possible assignment that allow for authentic researches and the complex expression of research conclusions;
- 3) dialogic learning: interactive technologies allow for asynchronous and synchronous learning experiences and provide spaces for conversations and exposure to a wide array of viewpoints and varied positions;
- 4) constructive learning: the ability to create environments where it is possible to construct projects that involve interdisciplinary, intellectual connections through the use of digital media that are usable;
- 5) public accountability: the ease of transmission of digital media makes it easy to share work, raising the stakes of participation due to the possibility of public display;
- 6) reflective and critical thinking: in aggregate, learning as experienced within digital media now available to pedagogues contributes to the development of complex reflective and critical thinking that cultural mediators (KERAMIDAS 2014).

Creative applications with learner-created outcomes can reflect the views of the University Museums and include for example different types of activity: creative games, guided tours, interactive references, puzzle/mystery, role-play/stories, and simulations.

In particularly games, when or the educators wish to instill in the public or in the students (KERAMIDAS 2014) properly designed, motivate learners, improve learner retention and encourage students not typically academic to partake in the learning process. Learning now bridges the public world – when it is information based and shareable – and the personal and structured world of the individual.

The web portal of the Italian University Museums network can become a place where users of all ages and backgrounds can engage together with a topic; it is important to pay attention to the intergeneration of learning experiences: through different learning styles and levels of knowledge, the University Museums web portal can develop interest and motivate to learn more.

## **Conclusions**

The use of new digital technologies in the University Museums web portal together with interactive devices displays aims at stimulating the users. At the same time 3D reconstructions allow museums to create virtual visiting paths through various narrative registers for different kinds of audience.

Thanks to the collaboration of cultural associations and voluntary organizations it will be possible to realize common activities related to the collections of the University Museums aimed at social inclusion.

The web portal has been designed to allow a new image of the Italian University Museums network: laboratories to promote critical interdisciplinary dialogue, instruments for scientific and technological lifelong learning; places for intellectual meetings and social solidarity, to strengthen civil society and promote local virtual systems as well as national and international synergies, to plan lifelong learning activities for different audiences.

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