

Understanding and Accessibility of Pre-and Proto-Historical Research Issues: Sites, Museums and Communication Strategies

edited by

Daide Delfino and Valentino Nizzo



Understanding and Accessibility of Pre-and Proto-Historical Research Issues: Sites, Museums and Communication Strategies

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Session XXXV-1

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Cover image: Frame of the video- fast motion 'Tik & Tuk' as part of a path of universal accessibility in the Samnite Museum of Campobasso (Italy) 'Smart Cultural Heritage 4all' in the context of the project Molise M.A.C.R.O. Coordination: Regional Direction of the State Museums of Molise (S. Ialenti; V. Carbonara; D. Delfino), Development University of Molise (F. Ferrucci; G. Maddalena), Execution Heritage s.r.l. (E. Bruno; P. Tosco) and artist Gabriele Rocchietta' Courtesy of Ministry of Cultural Heritage, Activities and Tourism- Regional Direction of Museums of Molise.

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Foreword to the XVIII UISPP Congress Proceedings

UISPP has a long history, originating in 1865 in the International Congress of Prehistoric Anthropology and Archaeology (CIAAP). This organisation ran until 1931 when UISPP was founded in Bern. In 1955, UISPP became a member of the International Council of Philosophy and Human Sciences, a non-governmental organisation within UNESCO.

UISPP has a structure of more than thirty scientific commissions which form a very representative network of worldwide specialists in prehistory and protohistory. The commissions cover all archaeological specialisms: historiography; archaeological methods and theory; material culture by period (Palaeolithic, Neolithic, Bronze Age, Iron Age) and by continents (Europe, Asia, Africa, Pacific, America); palaeoenvironment and palaeoclimatology; archaeology in specific environments (mountain, desert, steppe, tropical); archaeometry; art and culture; technology and economy; biological anthropology; funerary archaeology; archaeology and society.

The UISPP XVIII World Congress of 2018 was hosted in Paris by the University Paris 1 Panthéon-Sorbonne with the strong support of all French institutions related to archaeology. It featured 122 sessions, and over 1800 papers were delivered by scientists from almost 60 countries and from all continents.

The proceedings published in this series, but also in issues of specialised scientific journals, will remain as the most important legacy of the congress.

L'UISPP a une longue histoire, à partir de 1865, avec le Congrès International d'Anthropologie et d'Archéologie Préhistorique (C.I.A.A.P.), jusqu'en 1931, date de la Fondation à Berne de l'UISPP. En 1955, l'UISPP est devenu membre du Conseil International de philosophie et de Sciences humaines, associée à l'UNESCO. L'UISPP repose sur plus de trente commissions scientifiques qui représentent un réseau représentatif des spécialistes mondiaux de la préhistoire et de la protohistoire, couvrant toutes les spécialités de l'archéologie : historiographie, théorie et méthodes de l'archéologie ; Culture matérielle par période (Paléolithique, néolithique, âge du bronze, âge du fer) et par continents (Europe, Asie, Afrique, Pacifique, Amérique), paléoenvironnement et paléoclimatologie ; Archéologie dans des environnements spécifiques (montagne, désert, steppes, zone tropicale), archéométrie ; Art et culture ; Technologie et économie ; anthropologie biologique ; archéologie funéraire ; archéologie et sociétés.

Le XVIII^e Congrès mondial de l'UISPP en 2018, accueilli à Paris en France par l'université Paris 1 Panthéon-Sorbonne et avec le soutien de toutes les institutions françaises liées à l'archéologie, comportait 122 sessions, plus de 1800 communications de scientifiques venus de près de 60 pays et de tous les continents.

Les actes du congrès, édités par l'UISPP comme dans des numéros spéciaux de revues scientifiques spécialisées, constitueront un des résultats les plus importants du Congrès.

Marta Azarello
Secretary-General /
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Education, dissemination and new technological approaches for a museum opened behind closed doors: the University Museum of Paleontology and Prehistory 'P. Leonardi'

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Abstract

The Museum of Paleontology and Prehistory 'P. Leonardi' was founded in the mid-60s by Professor Piero Leonardi, who aimed to create an exhibition dedicated to university teaching. Over the years, the continuous and growing demand led to a reconfiguration of the Museum for an open enjoyment to a wider and more diversified public. Unfortunately, in 2012 the Museum was damaged by the earthquake that struck the Emilia Romagna region; since then, the Museum cannot be visited while awaiting for the renovation work. Accessibility, involvement and identification are the elements necessary for the museum experience to be fully lived. Traditionally, access problems have been mainly associated with architectural barriers, while only recently the general attention was more carefully focused on immaterial types of barriers, such as sensorial and cognitive or cultural and technological ones. Thus, communication in the museum context is of primary attention, as far as it places the visitor at the core of the communicative process instead of the Museum exhibition, facilitating the visitor during a process of personal experiential growth. But what happens when the Museum is no longer available? Is it possible to get out of the physical limits of the Museum itself and to make the heritage available again? In order to respond to different fruition needs an integrated enhancement project has been developed, involving the digitization of the collections by new technologies; this attempt to create a virtual and dynamic environment has the dual purpose of allowing consultation to researchers and students and to set up virtual paths for non-academic users. Furthermore, the demand for educational workshops for schools of all levels was granted thanks to a Student Association comprised of several students enrolled in the Master's Degree, and which aim is to disseminate and communicate the contents of the Museum in the light of the latest scientific discoveries. Finally, the staging of temporary exhibitions allowed the heritage to be brought out of the Museum and to be available to the general public with the possibility of creating new thematic routes, which in future will implement the original path of the Museum itself.

Keywords: university museum, education, dissemination, new technologies, virtual reality, high resolution images



1. Introduction

According to the ICOM definition, 'A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and assets the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment'. Thus, a museum collects and preserves the heritage, and must guarantee for their conservation, promote the concerning research, and also has to educate and entertain an audience of visitors. Museums are places of learning and leisure, but above all of communication. The audience often does not perceived University Museums as a showcase for the University institution itself, but experienced as places of study and research avoiding any perception of their precious role, as they bond the educational and instructive values represented by both the Museum and the University (Ghiara and Gianoli 2011). In 1999, the former Ministry of University and Scientific and Technological Research (MURST) and the Conference of Italian University Rectors (CRUI) created a program aimed at the enhancement and enjoyment of the wide patrimony of documents and testimonies of the scientific and educational tradition of the Universities.

In this complex panorama of enhancement projects, Universities were asked to organize University Centers and Systems for the purpose of promoting scientific culture and researches aimed to preserve the heritage, to teach museum-related disciplines, scheduling temporary exhibitions or other cultural events and taking care of the conservation, the cure and the increase of the collections.

To this purpose, in 2006 the University of Ferrara established the Scientific and Naturalistic Museology Center, which became the Museum System in 2012. Aim of the Center was to enhance those initiatives concerning research and education which were intended as part of a strategy of development and integration of the University in the territory of Ferrara. The University Museum System is composed of the Paleontology and Prehistory Museum, the 'Giovanni Tumiatì' Anatomical Museum, the Botanical Garden and Herbarium, the Premiata Farmacia Bragliani-Navarra, the Historical Archive, the Instrumentaria Collection of Physical Sciences and other collections of historical interest located in the various Departments.

The 'Piero Leonardi' Paleontology and Prehistory Museum, dedicated to its founder, has been an important place for the University education since its foundation in 1964. Its wide audience exponentially grew through the years until 2012, when an earthquake struck the Emilia area and damaged Turchi di Bagno palace, which hosts the Museum.

Aim of this contribution is to analyze all the different strategies carried out to keep alive a 'temporary closed' museum, which is not accessible to the audience since 2012.

1.1. The Museum

The Paleontology and Prehistory University Museum is located at palace Turchi di Bagno (Ferrara, northern Italy) (Figure 1). The building is part of the Quadrivio degli Angeli, designed by the architect Biagio Rossetti in 1492; its collocation among the Erculean Addition was decided by Ercole I d'Este. After the restoration at the end of the Second World War, the palace became the seat of the Botanic Garden and subsequently of the Geology and Mineralogy Institute of the University of Ferrara. Nowadays, beside the museums, the building hosts several sections of the Humanities, Biomedical and Surgical Specialties Sciences and Life Sciences and Biotechnology Departments, the University Institute of Higher Studies and the Prevention Center.

The Museum of the Department of Earth Sciences of the University of Ferrara (now called the 'P. Leonardi' Paleontology and Prehistory University Museum) was created in 1964 by the geologist,





Figure 1. Location of the 'P. Leonardi' Paleontology and Prehistory Museum in Italy (A) and in Ferrara (B). View of the Quadrivio degli Angeli and location of Palace Turchi di Bagno (C). Palazzo Turchi di Bagno (D). Vertebrate Paleontology (E) and Prehistory (F) rooms.

paleontologist and naturalist Professor Piero Leonardi, who founded the Museum 15 years after moving from the University of Padova to the Ferrara University in order to occupy the first Geology chair in 1949. Keen of museology, Prof. Leonardi noticed how the geological and paleontological assets could be seen as indispensable tools to be implied in the Earth Sciences and Paleontology education.

Thus, the target of the first exposition was the University education, although by the end of the '70s the increased interest in naturalistic disciplines in compulsory education led to a continuous and growing request from a non-university audience. The organization of guided tours for elementary and middle schools annually involved thousands of students, while at the same time an updating of the whole exposition program began, in order for the finds to be more intelligible. Educational activities continued during the '80s until 2012, also through the organization of refresher trainings and educational experimental activities addressed

to compulsory education teachers in collaboration with the Board of Education, the Natural History Civic Museum and the Public Education, the Culture and the Tourist Departments of the Municipality of Ferrara.

The museum hosts four different sections: Vertebrate Paleontology, Prehistory, Invertebrate Paleontology, and Historical Geology. Each section comprehends an expository and a conservative sections.

At first, these sections were hosted in two wide rooms at the first floor and two other large spaces at the second floor of palace Turchi di Bagno, covering a total area of 440 mq. The need for educational spaces such as classrooms and laboratories due to the increased number of University students and teachers led to a reduction of the Museum spaces; the Prehistory room became a classroom as well, while sections located at the first floor (Invertebrate Paleontology and Historical Geology) were moved in two small rooms located at the second floor. This relocation negatively affected the availability of these two sections.

1.1.1. The Vertebrates Paleontology section

The Vertebrates Paleontology section is composed of ten showcases, five of them displayed along the walls and the other five in the central area of the room.

The first showcase holds several fish, amphibian and reptile fossils (both casts and original findings); these assets are sorted following the systematic criteria and illustrate the evolutionary history of the Vertebrate subphylum. A group of fish fossils from the 'Pesciaia' area in Bolca are considered to be of particular concern; this famous Tertiary deposit located in the Lessini mountains (Verona, Northern Italy) is known from the XVth Century for its extraordinary abundance of fish fossils.

Skull, mandible and cervical vertebrae belonging to a large sea crocodile are visible on two large wall-mounted marble slabs (red ammonitic marble, Jurassic, Veneto). Once determined as *Metriorhynchus* sp. (Leonardi 1956), the fossil has been recently re-examined and classified as a member of a new species, *Neptunidraco ammoniticus* (Cau and Fanti 2011), which lived in the Tethyan Ocean during the Middle Jurassic Era, about 100 Million years before the dinosaur extinction; thanks to its numerous teeth, measuring over 5 cm each, this large reptile probably fed on shellfish, ammonites, fishes and small sea reptiles.

The second wall showcase shows the reptile-mammals and reptile-birds evolutionary steps. Extremely important are the two original *Lystrosaurus* skulls from the South African Lower Triassic Era, which might be the only specimens in Italy (Posenato and Broglio 2011).

In the third showcase several osteological findings are exposed, both casts and original specimens. These findings belong to four different mammal orders, Carnivores, Proboscidea, Perissodactyla and Artiodactyla. Among the Carnivores group there is a fossil *Smilodon californicus* skull, coming from the well-known Californian Quaternary deposit of Rancho la Brea. Among the Proboscidea group the skeleton of an *Elephas falconeri*, also known as the dwarf elephant from Sicily (southern Italy) are very important specimen.

The Perissodactyla group is particularly interesting because of two *Brontotherium* skulls from the North-American Oligocene, which are currently the only specimens in Italy. The section ends with three small wall showcases exhibiting the evolutionary history of the Equidae and the Rhinocerotidae families; especially, this last showcase displays the original skull of a *Trigonias*, a primitive rhino from the north-American Oligocene, and of *Coelodonta antiquitatis* from the Siberian Pleistocene.

1.1.2. The Invertebrate Paleontology and Geology section

The section is composed of six showcases holding fossils, casts and pictures related to the Invertebrate subphylum from Protozoa to Echinoderms and disposed according to the taxonomic system, and illustrates morphology, evolution and paleoecology of the most common fossil groups. This section had a main role in the University education, above all as a support to paleontological disciplines. Several findings were collected by the Geology Department research groups during expeditions on the Venetian Dolomites.

The evolution of life on earth and the main geological events happened in the southern Alps area are displayed in six showcases by stratigraphic columns, index fossils, stone specimens, and environmental and paleogeographic reconstructions.

1.1.3. The Paleoanthropology and Prehistory section

The room displays the biological, behavioral and cultural evolution of humankind from its birth to the beginning of historical eras; the exposition is set in chronological order and follows the steps of the human evolution and the hominization process. The exhibition then shows the diffusion of humankind in the various African, Asian and European areas, by associating several skull casts to the corresponding lithic artifacts.

The showcase dedicated to the first Modern Humans sequentially displays findings testifying the human presence in Africa and in the Near East at about 100 ky (Skhul site) and Neanderthal findings. Casts of the most significant findings about the latter are displayed (Neanderthal, La Chapelle, La Ferrassie and Circeo sites) and specimens of Mousterian lithic industries.

Findings representing Upper Paleolithic technologies and other cultural aspects are shown in the showcase dedicated to the rise of Modern Humans in Europe. Next to lithic and bone artefacts, several pictures are exposed, showing graphic reconstructions of settlements, ornaments and decorated items, burials and artistic production. Following, on display we find pictures representing the last European hunter-gatherers and evidences of the rise of agricultural and pastoral activity in the Near East and their diffusion in Europe. A view of the European Neolithic pottery is then shown, sorted by chronological and geographical order (Middle Europe, Po Valley, Italian peninsula).

The last showcases are dedicated to the Eneolithic, the Bronze and the Iron Age and exhibit pottery, metal artefacts and characteristic artwork.

2. Enhancement activities

2.1. Education

The temporary closure of the Museum led us to question us about what could be the best strategy for continuing the activities of education, dissemination and fruition of the collections. Our first step was to focus on communication using the mail tool for a remote fruition, websites. In 2012, after the creation of the University Museum System, a restyling of the website began, after with the Ferrara University website restyling. The new website was selectedly developed and has a dual function in well-characterized areas. On one hand, it provides a 'static' information about the history of the Museum and its organization, collections, initiatives, such as temporary exhibitions, conferences and publications; on the other hand it allows a 'dynamic' communication, proposing in a special section an in-depth analysis of some of the assets, providing the most extensive documentation, including photographic and iconographic. In order to enlarge the website catchment area, social media accounts were also activated (Facebook, Instagram, Twitter and Google+).

An important opportunity to restart activities of education, dissemination and fruition occurred in 2012, when the Leonardi Museum joined the first Italian University Museum network; this was possible thanks to a project funded according to law 6/2000 relating to the diffusion of scientific culture between twelve different universities coordinated by Modena and Reggio Emilia (Corradini 2017). The project was titled ‘Computer technology and the new reality for knowledge, networking and promotion of cultural scientific heritage: the role of the network of university museums’ (website 1) and involved computer technologies for the enhancement of heritages conserved in University museums. Over 28.000 museum heritages were catalogued thanks to the Catalogue Informative System on web-SIGECweb. Findings were contextualized both by historical and territorial perspective, so that four thematic routes were created (Environments, Landscapes, History of Scientific Instrumentation and Histories) (Corradini, 2017). The aim of the project was to address the interest of students towards the scientific method by using assets from Museum collections, by promoting through Museum routes an integration between territory and scientific culture, which is still suffering in our Country.

Thanks to this project, it was possible to catalogue 2000 findings stored in the ‘P. Leonardi’ Paleontology and Prehistory Museum, and to create three routes dedicated to three different fields: Histories, Landscapes and Environments. The first one is dedicated to Prof. Leonardi, founder of the Museum; the second is related to the osteological collections from Grotta del Broion (Vicenza, northern Italy); the third one is referred to the paleontological findings from the Late Glacial fossil deposit of Settepolesini di Bondeno (Ferrara, Northern Italy). Museum paths so far created were a stimulus to study the exposed findings and to give visibility also to those collections which are still not exposed.

In 2014, Leonardi Museum joined a new project in collaboration with the Italian University Museum network. The project highlighted the importance of University Museums and reconsidered their role in orientation towards the scientific culture. Aim of the project was to promote scientific culture in upper secondary school, also through a better use of scientific workshops and multimedia tools; thus, students were involved through initiatives useful to foster communication with the worlds of research and scientific production, increasing a widespread awareness of the importance of science and technology in everyday life and for the sustainable development of society (Corradini and Endrighi 2019). In order to integrate and innovate standard formal education techniques, 56 educational pathways of formal and non-formal education were organized; taking also into account the National Plan for Education in Cultural Heritage of the Ministry of Cultural Heritage and Activities and Tourism, these educational paths make use of computer technology to better stimulate and accompany students’ active learning processes. Educational pathways are dedicated to three thematic macroareas: biodiversity and agrobiodiversity (9 paths), color (20 paths) and time (27 paths). Educational pathways are characterized by the use of real objects, findings or tools in several educational activities, on which scientific observational experiences are built, beside other cultural practices involving readings and insights allowing the application of the experimental method. Two different pathways have been realized, one dedicated to the role of color in art, the other one concerning human evolution. The first educational pathway focused on the communication of the evolution of art during Prehistory through the exhibition of findings and recent scientific discoveries, by studying raw materials and applying original prehistoric techniques. Aim of the second pathway is to give students an awareness of the fundamental role of evolution in the transformation of living organism to adapt themselves to environments and available resources, by observing human and zoological osteological specimens from the Museum collections. Activities show how the relationship between animals and Humans changed through time, leading humankind in partially replacing natural evolutionary processes with the domestication process.

Surely these pathways increased the interest of young students in scientific culture, although they left an important question open; not only University museums, but also scientific Museums



generally should ponder how to improve approaches towards students of the last two High School grades in order to increase their interest in scientific studies.

2.2. Dissemination

Starting from 2016, educational and dissemination activities addressed to elementary school and extra-scholastic audience have been restarted, thanks to the collaboration of 'PreHistorica' Student Association. The association is mainly composed of 'Quaternary, Prehistory and Archaeology' Masters students, PhD students and research fellows of the University of Ferrara, and was founded in 2016 with the dual aim of approach and extra-scholastic audience to Prehistory (usually, summarily treated in scholastic Italian programs) and promoting the collections of the 'P. Leonardi' Paleontology and Prehistory Museum.

The first concrete goals of the cooperation between the Association and the Museum was to provide an engaging and creative teaching experience through experimental archaeology, educational activities for elementary schools and orientation activities for secondary schools and Bachelor's degrees students. Educational workshops designed by the Association focused on several themes concerning Prehistory, such as Human Evolution, Paleontology, Vertebrates evolution, Prehistoric art and technology and Archaeological excavation (Figure 2). Target of the activities were children aged between 6 and 11 years; workshops were designed so as to combine educational communication with the more suitable storytelling techniques. Communication techniques were adapted depending on the audience, although a high scientific level of contents was always maintained. This choice led to an excellent level of learning by participants despite the complexity of the covered topics. Workshops were always structured with a frontal theoretical and multimedia lesson and two or three game activities; this structure provided a high learning level avoiding any kind of passive approach through a multisensorial experience where touch, vision and other factors involved in the learning process and game activities were successfully combined. The most successful workshops were those dedicated to Vertebrate and Human Evolution; using osteological casts from the Museum's educational collection, the main differences between the various species of hominins and those between herbivores (artiodactyla and perissodactyla), carnivores and rodents were explained. At the end of the activities, teachers and students were asked to fill out a brief questionnaire, in order to obtain a feedback regarding the effectiveness of the workshop



Figure 2. Pictures from educational and dissemination workshops concerning Paleontology, Anthropology and Prehistoric Archaeology.

itself. It was possible to ascertain how apparently complex themes such as human or vertebrate evolution, are actually well received by elementary school audiences, when methodically and scientifically approached, as well as with a high degree of creativity and participation.

2.3. Cataloguing and ICT new technologies

During the cataloguing of the Leonardi Museum's assets, we began testing the use of 3D photogrammetry and high-resolution images (GIGAPIXEL) for the digitization of artifacts. We specifically focused on the development of the latter for the fossils preserved at the Museum, since this technique allows to highly enhance details of even very small objects. 'Gigapixel' images are composite shots that can be enlarged several times to examine each part of the object. The process of creating a gigapixel image is quite simple: it is necessary to take several photos of the object that sharing at least 60% of their surface; images are then merged in a single image with high resolution details using specific softwares (Figure 3A). This technique is mainly used by landscape photographers, but its application in the field of cultural heritage makes possible to obtain a double result: on the one hand, it allows the user to view the object in detail and, on the other, to obtain a digital archive accessible to researchers and scholars who can remotely analyze the object in detail. Digitization was started by considering the first showcase placed before the Vertebrate room as it is particularly rich in fish, amphibians and reptile fossils on flat supports. Four fossils were chosen: two fishes, an amphibian and a reptile. The two selected fishes are Rhacolepis Agassiz 1841 and Leptolepis Agassiz, 1843, the amphibian is Pelosaurus laticeps Credner, 1882 and the reptile is Ichtyosauria De Blainville, 1835. The chosen ones are all fossils placed in slabs, allowing a more shooting accuracy; also, photographs would have completely immortalized the entire fossil, which thing could not be possible with a three-dimensional finding. To create a Gigapixel photo of a finding a Canon Eos 600D professional camera with a macro lens was used, along with a stand and a green cloth necessary to give the background of the photo a very high color contrast. More than 20 photographs for each finding were shot and uploaded to Adobe Photoshop®; through the Photomerge function a very high-resolution composite photograph has been developed (Figure 3A). The software re-elaborates the photographs and creates an image composed of different levels that can later be merged into one. The last level will be elaborated in order to cut out the background from the fossil and insert a white, black or transparent one (depending by user's choice) and adjusting any brightness errors or due to the fusion process. The final image can be saved in different formats; it was decided to save results in three formats, JPG, TIFF and PNG, since they are the most common and simple formats for all purposes. JPG format provides the lowest quality, but also the lightest one; consequently, its loading on the web is faster. Differently, TIFF and PNG files are heavier, but with a higher resolution and quality (the best files for this case, ie high resolution). After saving the image, it was necessary to load it on www.easyzoom.com to make it accessible to the public audience. The four Gigapixel images and other pictures of the finds from the first showcase of the Museum have been uploaded on the web application cospaces.io where the museum of Paleontology and Prehistory was virtually recreated (Figure 3B). Cospaces is a recently born application with a great potential, mainly used in the scholastic context; it is essentially a 3D graphic editor supported by any browser where the user can create a simple graphic content thanks to a vast library of backgrounds, objects and characters. The editor supports the loading of sounds, personal images, videos, 3D models, animations, characters and offers several objects and backgrounds to use and customize. In addition to the editor, a console to be programmed in CoBlock or Javascript is present, in order to access to more advanced features (for example, to create interactive objects with links that refer, as in our case, to films or photos in gigapixel). CoBlock is a very easy to use visual programming environment that allows even the most uninformed user to take the first steps in the world of programming. The content can be displayed through cardboard viewers suitable for Smartphone, Gear VR, Google Daydream or simply via PC and Applications specially designed for iOS and Android phones and tablets.



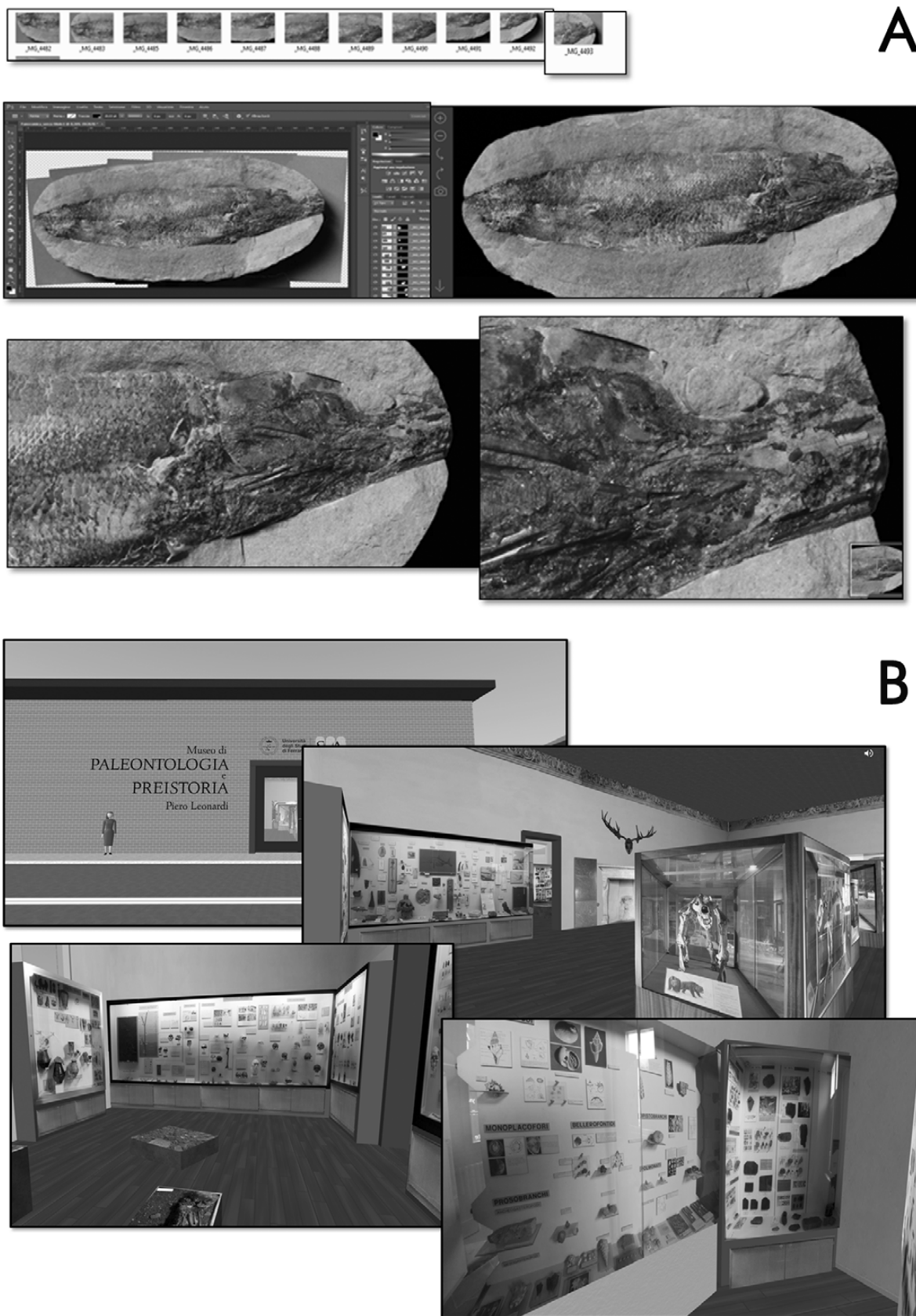


Figure 3. Elaboration of a Gigapixel image and final result (A). Pictures from the virtual tour of the 'P. Leonardi' Paleontology and Prehistory Museum realized via cospaces (B).

3. Discussion and perspectives

The numerous activities launched since 2012 had the dual purpose of opening the doors of a closed museum and undertaking new itineraries useful for a future reopening. Collaborations and projects have been of fundamental importance to guarantee the fruition of the Museum's collections and the partial restarting of educational and dissemination activities.

An extremely interesting topic and which future developments could be very useful for the dejection of the physical barriers of the Museum (until it won't be re-opened) is the digitalization of the collections contents, particularly if accompanied by high-resolution images and three-dimensional models. Museums are proving to be among the most interesting fields to implement digitization, virtual and augmented reality solutions. The continuous development of digital acquisition technologies and three-dimensional modeling is opening up new perspectives of application in the cultural sphere in recent years. Specifically, in the context of cultural heritage and museums, the production of high-resolution images (Marzi *et al.* 2016) and three-dimensional digital models (Russo *et al.* 2011) has become an indispensable practice for the integration of traditional systems of documentation, conservation and analysis of artifacts or findings (Remondino and Campana 2014). The broad accessibility to digital devices and the more and more frequent diffusion of low cost digitalization methodologies and applications giving the possibility to develop virtual tours and contents in augmented reality is surely another of the most interesting aspects that facilitated the diffusion of new technologies in the field of cultural heritage. The aim of setting up and testing an immersive reality experience to promote the museum through new information technologies is increasingly proving to be an interesting challenge that can provide better, faster and more democratic access by potentially interconnecting collections in real time to users all over the world and allowing museums to open up as never before to an ever-wider audience.

This work mainly produced two results:

- Gigapixel photographs provides a very detailed view of the museum assets. They allow to focus attention on details of a fossil, with the advantage of making details more visible, therefore allowing users to better interpret the characteristics of the find. This removes physical barriers (showcases) that normally distance the visitor from the details of the displayed object. Furthermore, the acquired pictures can be considered an alternative (digital) form of preservation of the finds. In the event of a possible restoration, photographs could be useful as a reference point.
- An immersive virtual reality allowing users to visit the museum through alternative routes; this is useful since it makes up for the impossibility of physically visiting the museum. Furthermore, the environment provides a different interaction compared to the classical museum visit. The layout of the objects and virtual captions could be useful to reorganize the layout of the museum showcases for its future reopening.

In the perspective of a future reopening of the museum, these results will be useful as a virtual counterpart to the physical visit itinerary, for example by signaling the access to alternative routes through QR codes; placing them in captions, visitors can access multimedia content via smartphone or tablet. Gigapixel pictures provide a very detailed visualization of the museum assets and allow to focus attention on the details of fossils. The Virtual Museum and the Gigapixel photographs can be considered an added value of the Museum itself; this will be also true when the museum will be reopened (Bertolini *et al.* 2017). In this way, the museum will boast a form of innovation that is still in an experimental phase but that in the future will become full part of cultural heritage. Future developments will focus on creating interactive three-dimensional models of the finds, thus creating a more engaging interaction for the visitor.

The experience with the Cospaces has therefore proved to be positive despite being in progress. Nevertheless, it could be a costless valid alternative for virtual exhibitions.

Author contributions

U.T.H. coordinated and designed the project, A.C.C. and C.C.C. managed and implemented the web-site; M.B., G.Po. and G.Pr. elaborated the Virtual Tour of the Museum Leonardi; A.P., A.T., C.M. and M.B. carried out the laboratory for Prehistorica; A.S., F.S. and M.B. elaborated the Giga pixel images; M.B., A.P. and U.T.H. wrote and edited the manuscript.

References

- Balke, M., Schmidt, S., Hausmann, A., Toussaint, E.F., Bergsten, J., Buffington, M., Häuser, C.L., Kroupa, A., Hagedorn, G., Riedel, A., Polaszek, A. 2013. Biodiversity into your hands – A call for a virtual global natural history ‘metacollection’, *Frontiers in Zoology*, 10: 55-63.
- Bertolini, M., Scali, F., Poletti, G., Guerreschi A., Fontana, F., Thun Hohenstein U. 2017. Virtual Portable Art, un percorso virtuale per le pietre incise di Riparo Tagliente, in Arzarello, A., Fontana, F., Peresani, M., Peretto, C., Thun Hohenstein, U. (eds), *Applicazioni tecnologiche allo studio di contesti paleolitici e mesolitici italiani*, *Museologia Scientifica e Naturalistica*, 13: 120-122;
- Blagoderov, V., Kitching, I.J., Livermore, L., Simonsen, T.J., Smith, V.S. 2012. No specimen left behind: industrial scale digitization of natural history collections. *Zookeys*, 146: 133-146;
- Cau, A., Fanti, F. 2011. The oldest known metriorhynchid crocodylian from the Middle Jurassic of North-eastern Italy: *Neptunidraco ammoniticus* gen. et sp. nov., *Gondwana Research*, 19 (2): 550-565.
- Corradini, E. 2017. Percorsi formativi della Rete dei Musei Universitari Italiani per l’orientamento permanente al metodo e alla cultura scientifica, *Museologia Scientifica Memorie*, 16: 43-47.
- Corradini, E., Endrighi, E. 2019. I nuovi percorsi educativi della Rete Italiana dei Musei Universitari, in Martellos, S., Celi, M. (eds) *I musei al tempo della crisi. Problemi, soluzioni, opportunità*, *Museologia Scientifica Memorie*, 18: 39-44.
- De Marzi, F., Riccarducci, G., Pinzari, M. 2019. Digital imaging di esemplari in collezioni museali di storia naturale: problematiche e prospettive in Martellos, S., Celi, M. (eds) *I musei al tempo della crisi. Problemi, soluzioni, opportunità*, *Museologia Scientifica Memorie*, 18: 96-100.
- Posenato, R., Broglio, A. 2001. Museo di paleontologia e Preistoria, in Loriga, C. (ed.), ‘*Verso un Museo delle Scienze. Orto Botanico, Musei e collezioni storico-scientifiche dell’Università di Ferrara*’, *Annali dell’Università di Ferrara*, special issue: 23-34.
- Remondino, F., Campana S. 2014. *3D recording and modelling in Archaeology and Cultural Heritage. Theory and Best Practice*. Archaeopress BAR Publication Series 2598.
- Russo, M., Remondino, F., Guidi, G. 2011. Principali tecniche e strumenti per il rilievo tridimensionale in ambito archeologico, *Archeologia e Calcolatori*, 22: 169-198.
- Scoble, M. 2010. Natural History collections digitization: rationale and value, *Biodiversity Informatics*, 7: 77-80.
- Vollmar, A., Macklin, J., Ford, L. 2010. Natural History specimen digitization: challenges and concerns. *Biodiversity Informatics*, 7: 93-112.

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