

# Teaching new technological methodologies applied to ancient history: The profitable example of The Municipal Archaeological Museum and the primary school of Montelupo Fiorentino, Italy

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**Abstract:** The use of interactive devices, like multimedia blackboards, tablets, personal computers, is establishing itself as a fundamental teaching tool in primary and secondary schools. The contribution of new technologies turned out to be quite significant also in the study of topics like ancient history, where students can nicely supplement materials from textbooks with images, educational paths and games and virtual reconstructions of ancient civilizations environments. It is intended that the efficacy of such a mixed traditional and technological approach can be ensured by specialized personnel, able to complement (rather than substitute) the classical teaching methods with technologies to discover ancient history.

Since three years the MUSINT (Interactive Museum of Aegean and Cypriot Collections in Tuscany) project at the University of Florence started a collaboration with the Municipal Archaeological Museum and the Primary School of Montelupo Fiorentino, to introduce pupils to the Ancient Aegean Civilizations exploiting an interactive educational process including multimedia reconstructions, animated myths and legends, three-dimensional archaeological digitalized finds from Tuscan museums (including the municipal museum). Some of the finds of this latter small museum have actually been the protagonists to lead directly in the class room new educational paths with an active contribution by the pupils. For instance, using the technological tools, the pupils have attempted a virtual restoration of some vases, choosing the products to use and deciding how to integrate the missing parts. The project, supported by Regione Toscana, Comune and School of Montelupo, has been very successful and appears as a pilote project to be further developed and expanded for the following basic reasons:

- the pupils have actively and have enthusiastically participated to the program;
- the pupils not only gained a good acquaintance with widespread technological devices but also could perceive the ancient history under a more attractive and concrete perspective;
- the project also gave to pupils a direct access and knowledge of the regional cultural heritage.

**Keywords:** MUSINT, Aegean Civilisations, Primary School, Educational

## Introduction

In recent years, primary schools have increasingly developed an interest in archaeology to teach and disclose ancient history to children. Pupils, in fact, if actively involved in learning, are very passionate about historical materials. Introducing children to archaeology while explaining the job of the archaeologist helps them to better understand the past and become interested in it.

Ancient history sounds like an abstract discipline for pupils because they do not have the concept of time and hardly understand the reasons behind the line-up of historical events and processes. Therefore, it may be

essential to introduce topics in the most appropriate way to facilitate pupils to assimilate any relevant information. In this respect, archaeology is a great resource since it is equipped to provide actual knowledge of the historical events as an alternative to schematic or boring learning offered by textbooks.

In recent years, following the widespread use of digital technologies applied to cultural heritage, many schools have taken advantage of innovative educational proposals to support learning of history and facilitate understanding through games and active involvement based on "to do to understand" rationale. Named "*edutainment*" and aimed to teach and amuse at the same time, this teaching method has increasing capabilities to allow children to approach the historical facts by engaging tools including drawings, animated reconstructions, interactive games and 3D archaeological digitalized artifacts.

However, specialized personnel is requested for this approach owing to the fact that teachers lack, in most cases, a professional training in archaeological knowledge. Therefore, archaeologists are now motivated to teach children new fascinating things and provide basic knowledge as introductory to subsequent "*edutainment*" technologies. Without an appropriate theoretical framework, in fact, no interactive educational process can ensure a constructive, long-lasting learning.

Virtual technologies applied to cultural heritage are now widely popular and share concepts which constitute a cultural market in continuous expansion. Unfortunately, because of this increasing availability, the risk of trivializing these new opportunities is very high. On these grounds, plans for proper educational paths and application methods are called for.

This paper has a twofold purposes. On one side some technological details are presented from the tools needed to create a virtual museum and from the necessary elaboration to present these novel data to pupils of the primary school; on the other side an illustration of the practical use of these interactive opportunities is offered.

[G.D.]

### **The interactive museum as an archaeological medium (for an e-learning at primary and advanced levels of education)**

A prerequisite in using archaeology to teach ancient history is to follow a methodological model instead of relying on separate examples related to various aspects of prehistoric, protohistoric and classical history: such examples may be useful but risk remaining sporadic, although attractive, knowledges, and are subject to be forgotten during the time. If, on the contrary, we find some new ways to allow the inclusion of history learning in a stimulating experience, recognized at the same time as a cultural enterprise and as an active play, it is easier for the student to recall in the future a clear memory of such an educational tool.

This is just the aim of our interactive museum(s), starting from which we may go into the details of the history teaching. The most evident goal of an interactive museum, according to our interpretation of this notion, is to create a series of files related to single objects (archaeological pieces as vases, seals, idols, jewellery, etc.) which are collected in different museums and whose visibility is difficult for various reasons (e.g. they are not exhibited to the public, they are in localities very far one from the other, also in different countries, etc.). The files are themselves interactive instruments, as we will see in the following, because each object may be seen as a 3-dimensional model and the visitor may move it at his pleasure. But, during the route which brings to the

file, a series of pathways may be followed, according to the interest and the level of knowledge of the visitor. First of all, the files of interest must be considered not as single items, but included in a historical itinerary which is explained through stories and drawings, from an academic level to a primary one. These itineraries are themselves interactive, because the visitor may ask information, which enlarge their knowledge on the subject (e.g., for advanced students a large and sectoral bibliography is furnished; primary students, which may follow easier historical tales, have at their disposal drawings to be coloured and reconstructed). Further information is offered on the history of the Museums and the Collections, and a particular interest is focused on the archaeological excavations during which the objects were found. Unfortunately, this last information is not always possible, because some pieces arrived to the Museum from the antiquity market. But, when possible, it may be of interest for the visitor, especially for the young visitor, to know, e.g., the complete story about a vase, when it was found in a tomb, it was in many small pieces and was reconstructed (restored), was given to a museum, and finally is displayed with other objects in a showcase. Also, in this last phases of our MUSINT, the interactivity is offered: we present simulations of some disrupted objects and the visitor tries to reconstruct them.

This is a simplified description of our already activated (MUSINT) and partially under construction (MUSINT II) innovative project of interactive museums. We want only to add that an analogous experiment is forthcoming, starting from already in use databases, on writing symbols and their supports, concerning the three major scripts of the Aegean world: Cretan Hieroglyphic, Minoan Linear A and Mycenaean Linear B.

[A.M.J.]

### **Technical details of the interactive museum**

From a technical point of view MUSINT is a dynamic website. In fact, it can be continuously updated through the interaction with the users and it can potentially appear different every time it is opened. Such a functionality is made possible by an appropriate programming languages, in particular HTML5 (PILGRIM 2010) and JavaScript (FLANAGAN 2011). These approaches allow the dynamic generation of the pages of the website on the basis of a prearranged model installed on the server.

The structure of the interactive museum consists of three main components:

- a) *Application server*. This element is realized according to the Ruby programming language and fully encompasses the application logic of the website (concerning both the visualization of the files and of the 3D models and of the contents and their operativeness);
- b) *Database*. The database includes all the materials of the site, including the 3D models. The 3D digitalizations of the artefacts of MUSINT were realized using two different techniques, the photogrammetric system and the 3D laser scanning acquisition. The choice between one solution and the other is done according to the level of details, the richness of the texture, the features of the surface, the elements go to the process best fitting their characteristics. The former furnished metrical information on three-dimensional objects through measurements and interpretation of photographic images (MENCI ET AL. 2011), the latter used a table laser scanner and was used by the GECO laboratory of the University of Florence (Geomatic laboratory for the environment and Cultural Heritage conservation) allowed the virtual monitoring of artifacts through the *Multistripe Laser Triangulation* technology (TUCCI ET AL. 2011). The running of the digital

reproduction of the artefacts was carried with the auxiliary *three.js* (<https://github.com/mrdoob/three.js>). This is a JavaScript library for the rendering of 3D models in a WebGL canvas (NUNZIATI 2011).

c) *Web client*. This element allows the access of the users to the site. The fruition of the site materials was arranged according to space (geographical coordinates) and temporal (chronological periods) concepts. This has been realized through four main navigation instruments accessible from the homepage:

- the geographical location of the provenance territory of the artefacts;
- the availability of icons based on the production of the artifacts contained in the interactive museum;
- images, photographs, drawings giving a full picture of the history and geography of the contents;
- the visualization of historical in-depth analyses.

[A.M.J.]

### The primary school of Montelupo Fiorentino

Since 2013, the primary school (fourth and fifth grade) of Montelupo Fiorentino, a small town near Florence, started a collaboration with the Municipal Archaeological Museum and the Laboratory of Aegean Civilizations of the University of Florence – coordinated by Professor Anna Margherita Jasink – where was started and nearly completed an on-line project called 'MUSINT Project', in this new case developed properly for the primary school ('MUSINT Educational Project ') (Fig. 1).




 <b>MUSINT Educational Project</b>  	
<b>Keywords</b>	MUSINT (Interactive museum), Aegean Civilisation, primary school, edutainment, classical methods and new technologies applied to ancient history
<b>Content</b>	Minoan and Mycenaean world: palatial structures, religion, artefacts, pottery, traditional and virtual restoration
<b>Multimedia devices</b>	Multimedia blackboards, tablets, personal computers Educational paths and games, virtual reconstructions
<b>Users</b>	Students: the case of the primary school of Montelupo Fiorentino
<b>Projects goal</b>	To introduce the pupils to the Ancient Aegean Civilisations exploiting an interactive educational process including multimedia reconstructions, animated myths and legends, tridimensional archaeological digitalized finds from Tuscany museums (including the municipal Museum of Montelupo).

Fig. 1 – Structure and purposes of the "MUSINT Educational Project"

In fact, the MUSINT project included the implementation of a navigation path specifically devised for teaching purposes to allow young pupils to visit the contents with the help of a dedicated guide able to furnish appropriate suggestions and indications, in the form of mythical personages, as described in more details later. The project presented at the primary school of Montelupo Fiorentino focuses on the historical and archaeological contents stored in this educational trail.

The aim of the project is to introduce children to the discovery of ancient Minoan and Mycenaean civilizations through an interactive educational path comprising myths and legends, simplified explanatory texts, games and three-dimensional archaeological digitalized finds from Tuscan museums (including the municipal museum of Montelupo).

Starting from the internet site, a learning process was developed which makes use both of a series of historical basic information (like some curious facts about the daily life of ancient populations) and of more specific archaeological information (for example, the knowledge of the ancient ceramics techniques or how to carry the restoration of archaeological finds). This first theoretical teaching is done by the archaeologist in the classroom, with the aid of specific power-point presentations containing drawings, images and animated videos.

Direct interaction between students and the archaeologist is adopted during the lessons: the expert introduces pupils to history, helping them familiarize with time and space concepts. Children are always encouraged to ask questions and reflect upon what they listen to.

Once these basic concepts are explained and assimilated, the project makes use of multimedia and interactive contents to consolidate the information gained through games and fun.

The MUSINT project contains a number of interactive activities related to *edutainment* (a neologism that comes from a combination of the words *education* and *entertainment*) (GUIDO 2006) which are here outlined and explained in detail.

### **The tour of the Museum**

For the primary school the historical itinerary which introduces the different files is limited to Minoan and Mycenaean tales: the educational path of MUSINT started with two animated figures (Fig. 2), Agamemnon (for Mainland Greece) and Minotaur (for Crete). They introduce the children to the discovery of these ancient civilizations, with a particular care addressed to the Trojan war and to the Cretan labyrinth, but keeping in mind that they represent a connection among myth, history and archaeology. These characters, indeed, guide the children to the reading of two simplified historical tales that are linked to the above mentioned myths (DIONISIO 2011). New characters are under construction, for the other geographical areas (e.g., a young fisherman travelling around Cyclades islands, or Aphrodite and her assumed mythical birth on the western coasts of Cyprus).

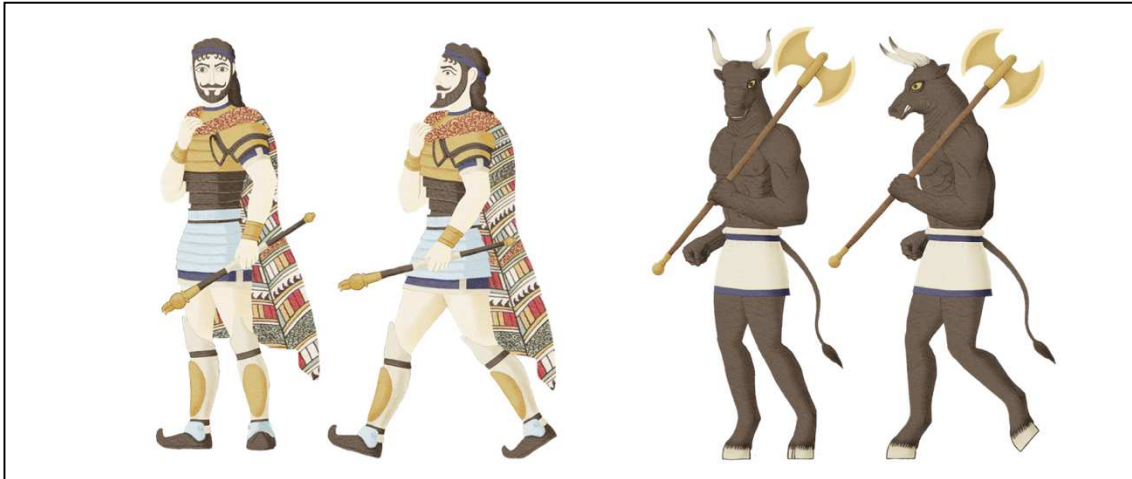


Fig. 2 – Digital representation of Agamemnon and the Minotaur, they are the guides for the Museum tour (drawings and digital transposition by P. Kruklidis)

### Drawings with the graphic tablets

The graphic tablet is a device that allows to enter a manual drawing inside the computer. This technological device, composed by a pen and an LCD support, is widely used for photo editing and freehand drawing. All reconstructions, characters (also Agamemnon and the Minotaur) and scenes contained inside the learning process of MUSINT were made through this innovative methodology starting from a pencil sketch.

During the class, pupils were able to directly test this technology and they were fascinated: drawing and seeing in real time a fantasy motif “come to life” on a computer screen is an innovation that entertains and involves (Fig. 3). Use of the graphic tablet requires a double skill, primarily of hand drawing which is later enhanced by the computer support. For further information on the drawing tablet use and implementation stages see the KRUKLIDIS lesson (*‘Communicating archaeology and architecture: multimedia reconstructions’*) in DBAS (DataBases about Aegean Subject: <http://www.sagas.unifi.it/vp-377-dbas-project.html>) – Educational section.

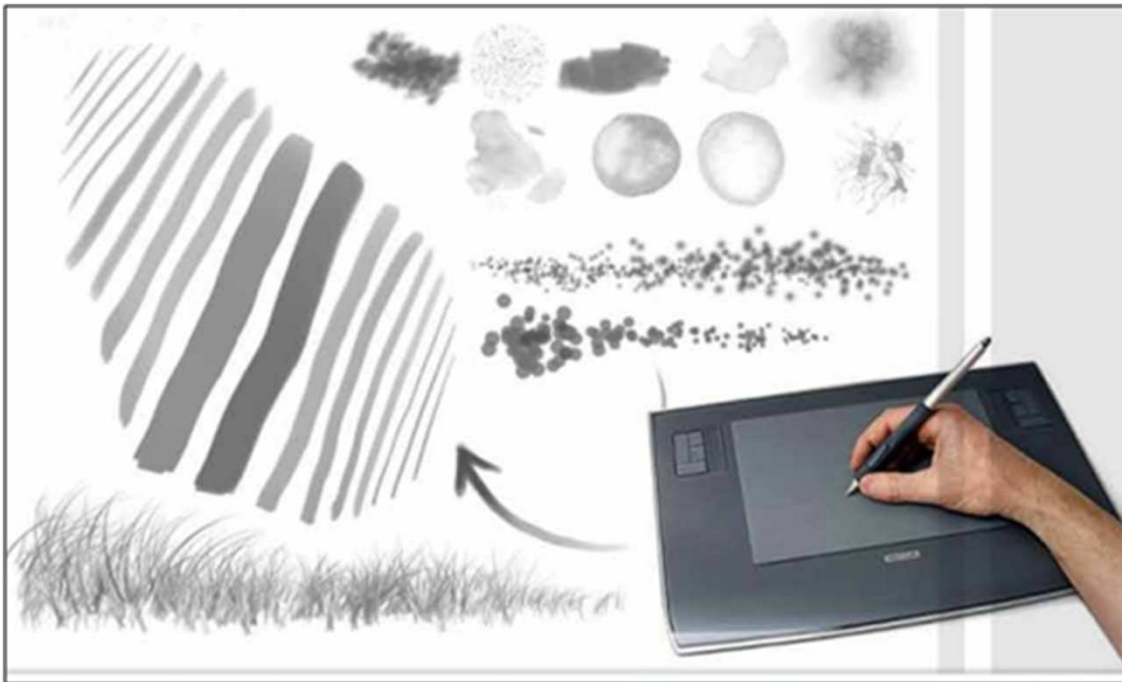


Fig. 3 – Working with the graphic tablet

### 3D archaeological digitalized artefacts

The opportunity to virtually interact with some of the artifacts stored inside the museum was one of the highlights from the first year of this project application. Three-dimensional vessels have been obtained following two main procedures (Fig. 4), carried out in the presence of a pilot class: one of the procedures is the 3D laser scanning acquisition (TUCCI ET AL. 2011; ALBERTINI ET AL. 2014), the other obtains 3D models from the photogrammetric system (MENCI ET AL. 2011). These digitalized models can be rotated, flipped and magnified through the mouse by the single users. This peculiarity has excited and involved children so that they feel closer to antiques. This sort of display is dynamic and engaging and encourages children to explore and observe all objects.

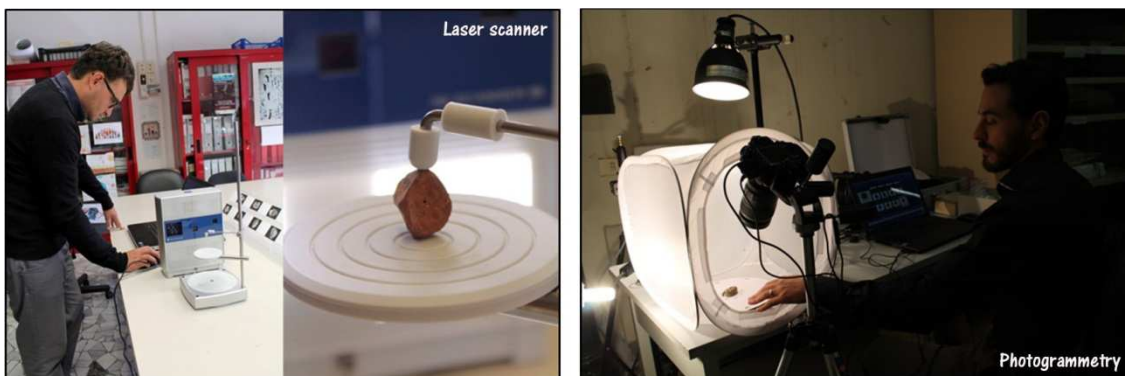


Fig. 4 – 3D Laser scanner (Next Engine Unit) and photogrammetry equipments for 3D modeling

### **Virtual restoration and Puzzle reconstruction of an ancient vessel**

In 2014, the interactive applications of MUSINT were expanded according to children's demands and interests. Pupils were very interested in the restoration procedures because this is a very new topic for them, not yet covered by traditional teaching.

Archaeological restoration is a practical activity that stimulates the desire to "prove" and the assimilation of historical concepts such as the archaeology of ancient materials production.

For these reasons, two virtual applications (virtual restoration and the puzzle reconstruction of an ancient vessel), developed by the DREAMSLab Laboratory (Dedicated Research Environment for Advanced Modeling and Simulations) - Scuola Normale Superiore of Pisa together with our @egeanLab (Aegean Civilizations Laboratory) - Università di Firenze, were presented to children.

The technical process provided the initial use of a number of photographic images of Mycenaean pottery. Through the game development platform Unity 3d (<https://unity3d.com>) it was possible to program a software for the management and creation of puzzles to create them directly from the images, providing a suitable image with no need of an additional picture editing software.

Basically, within the project are inserted images using internal algorithms which are divided into different parts. Then through the interface it is possible to interact with just the specifically generated parts.

The application dedicated to the virtual restoration has been designed on the basis of some virtual restorations, made in recent years by the institutions above mentioned (DreamsLab and @egean Lab) , on some Etruscan silvery-like ceramics (DIONISIO-LICARI 2014) and on two Mycenaean stirrup jars (DIONISIO ET AL. 2015).

The application designed for the younger generation allows to choose the products to be used and to decide how to integrate the missing parts. Children may, in fact, choose among different materials for gluing and reassembling the fragments, and for integrating the missing parts. Some of the proposed materials are not appropriate and it is an useful exercise for the pupil to recognize the suitable ones (Fig. 5). Artifacts chosen were selected from those set out in the small municipal archaeological museum of Montelupo: pupils know very well this museum thanks to visits made with their teachers during the school year. Being able to virtually restore a vessel that children saw directly inside the museum is a stimulating factor that helps pupils become aware of the archaeological heritage preserved in the territory where they live.

On the basis of the previous application, a puzzle formed by pieces of Mycenaean vases in fragments mixed together was also created. The goal of this game is to choose the fragments relevant to each other and rebuild the whole vessel. In this way children can learn how to recognize the morphology of an ancient ceramic product and the decorative motifs it is characterized by. In Fig. 6 the class is working, choosing the fragments belonging to one of the vases, and the final reconstruction is shown.

The opportunity to distinguish between different fragments stimulates learning and forces pupils to focus on details they otherwise wouldn't notice.



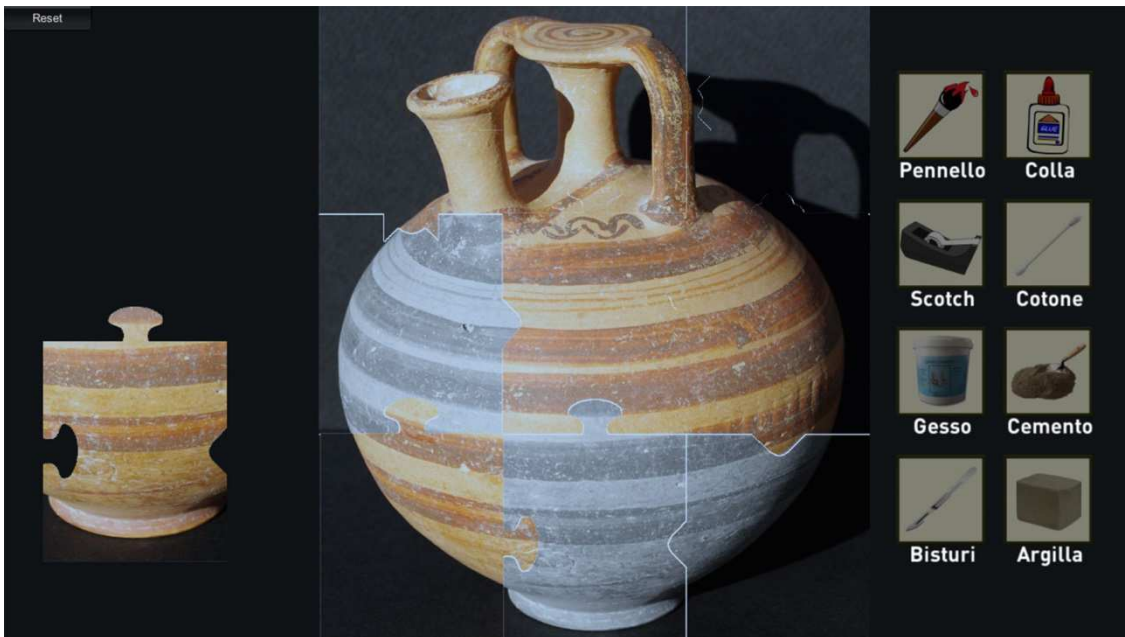


Fig. 5 – The site for the virtual restoration of pottery

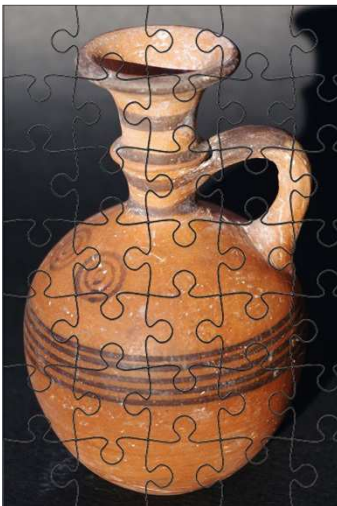


Fig. 6 – Pupils at work for the puzzle reconstruction

[G.D.]

## Conclusions

The experience of our University team of Aegean Lab in teaching some aspects of Aegean Archaeology and history using the methodology of "MUSINT Project" has been very satisfactory both for us and for the pupils. It represents a work *in itinere* and every year will be enlarged with new aspects according to choices by mutual consent between the University, from one side, and teachers, pupils, pupils' parents, the local government (the mayor) and the archeological Museum of Montelupo, from the other. This synergy may be employed also to enlarge our horizons both in research and teaching. As to the research, new tools employed in our daily work at the University are useful only if used starting from advanced studies, and must never be applied to superficial models without solid bases deriving from specific "traditional" researches. As to the teaching methods, the same caution may be adopted, and the enthusiasm for new technological tools must be

guided by an expert researcher, and not only by a technician (both figures may also work side by side). It is important to stress this point, because it is very dangerous for new students (from primary school to University) to forget the historical and, in general, traditional knowledge, becoming enthusiastic about new tools, which must remain only tools, to be applied to true realities.

In fig. 7 three phases of our MUSINT are displayed, through the home pages shown at the beginning of our yearly lessons.

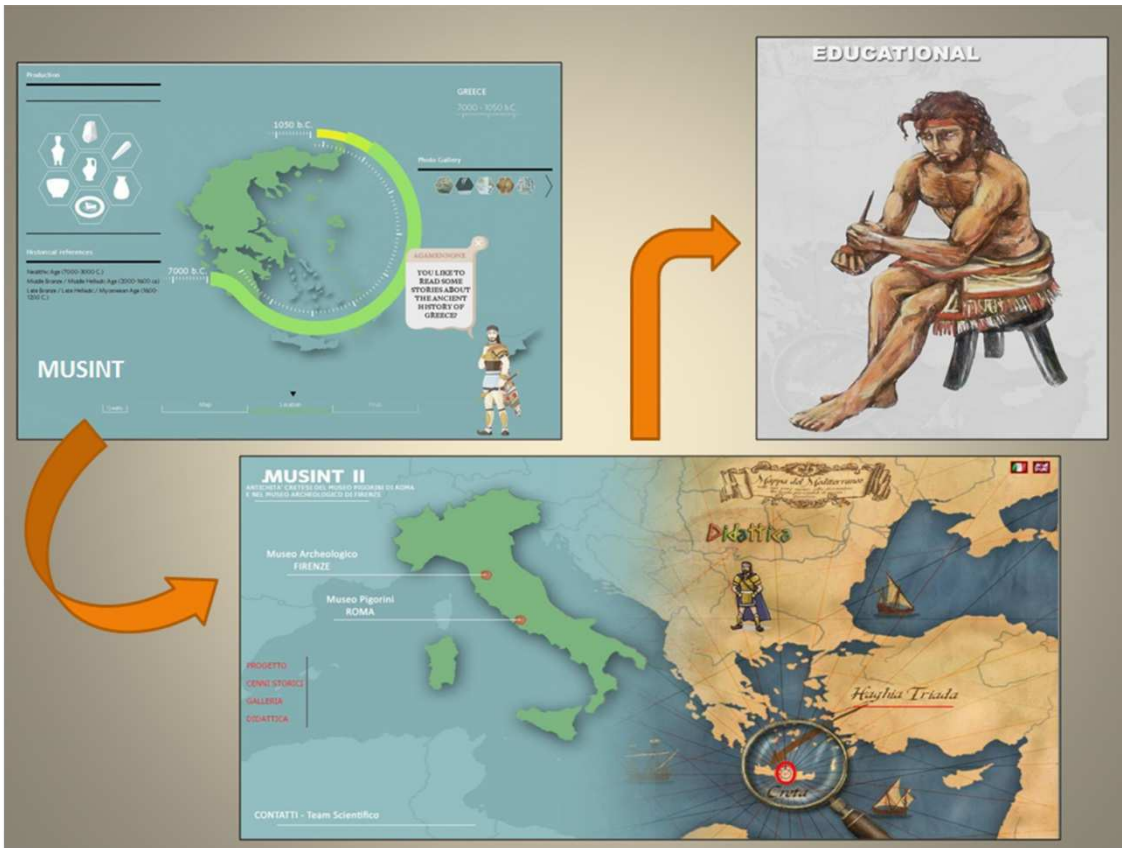


Fig.7 – Development of the "MUSINT Project" toward educational applications

The first image illustrates the geographical area of interest of our project (from Aegean to Cyprus), from which all the following applications derive. The second image privileges the connections between the Cretan area and the Italian Museums, where Haghia Triada findings are kept - apart from those which may be seen in the Iraklion museum in Crete -, as a consequence of the Italian archaeological expedition in Crete at the beginning of 1900. The third image introduces the part of the project devoted expressly to primary education and represents a Cretan craftsman working with clay.

We think that the above expressed concepts are very clear to the pupils of primary school of Montelupo, and we hope that their enthusiasm for the ancient history - learned through new interactive methodologies, but representing the central point of the their education - , remain an essential - and long reminded - experience in their future.

[A.M.J.]

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