

# Restoration in Archaeological University Courses: A Practical Ceramic Conservation Laboratory in the Graduate School in Archaeology – UNIFI

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University courses on conservation are often mainly theoretical, and it is often impossible to act directly on artifacts owing to the lack of suitable conservation products and working spaces as well as the scarcity of archaeological materials. However, the archaeologist's work is mainly carried out in the field and, in most cases, requires direct conservation procedures on archaeological finds to allow their study and documentation. As such, the lack of practical restoration laboratories within university curricula represents a serious gap in the training of future professional archaeologists. In 2016 a practical laboratory of ceramic conservation was established for the first time within the Graduate School of Archaeology of the University of Florence. The goal was to give students the opportunity to put into practice the theoretical conservation lessons received in the classroom. Trainees were put to work directly on both ancient and modern pottery, in order to learn which materials to use and how to carry out all the relevant steps for the cultural heritage conservation (cleaning, gluing and integration of missing parts). All the operations carried out during the course followed the same procedures currently required for the conservation of archaeological ceramics by the Superintendency for Archaeological Heritage of Tuscany. All the steps taken in the laboratory are similar to those implemented on a Mycenaean stirrup jar reported here as an example.

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## Keywords:

Restoration courses, ceramics, university curriculum, archeology, fieldwork

## SDH Reference:

Giulia Dionisio and Daniela Puzio. Restoration in Archaeological University Courses: A Practical Ceramic Conservation Laboratory in the Graduate School in Archaeology – UNIFI. SDH, 1, 2, 682-691.

DOI: 10.14434/sdh.v1i2.23191

## 1. INTRODUCTION

Today, archaeological restoration is a discipline typically learned in vocational training courses lasting three to five years. This is particularly the case with the conservation of ceramic artifacts. Educational programs in restoration are found at accredited public or private restoration schools. In

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Italy, these institutions are few and severely limited by economic and bureaucratic problems, while such disciplines are not formally part of the normal university curriculum in archaeology. Therefore, the archaeologist who wants to learn some practical aspects of ceramic restoration is compelled to embark on an additional training course at the end of a traditional degree program.

Italian archaeology students, despite their specialized studies and their opportunity to participate in archaeological fieldwork, bring many limitations to the restoration of ceramics owing to their unique archaeological experience. They learn how to produce a pottery catalogue and the relevant photographic and digital documentation, but they have no knowledge of the techniques and technologies of ceramic production and are not able to recognize degradation phenomena.

Currently, at the University of Florence there is no theoretical and practical course on archaeological ceramic manufacture and restoration. This gap is very limiting, since during archaeological excavations the young undergraduate and graduate students need to interact with ancient artifacts about whose production they generally have no understanding. An improper use of brushes and scalpels during excavation procedures can cause irreversible surface damage (often in the form of grooves and scratches) as well as the loss of decorative designs and coatings. It is, therefore, easy to understand how during fieldwork it is important to implement proper restoration methods that can ensure the correct removal of any deteriorating elements and the conservation of all artifacts brought to light, while at the same time improving the quality of essential documentation.

Restoration expertise makes it possible to view the morphological and decorative features of the objects and thus to provide more accurate archaeological records. In most cases, ancient ceramics require a series of precautionary procedures aimed at improving their state of preservation. These steps are needed to allow the proper development of cataloguing procedures (graphic and photographic documentation). Presently, young archaeologists must necessarily refer to the conservator (when available) to acquire knowledge of and information about ancient artifacts.

## **2. THE INNOVATION OF THE CERAMIC LAB AT THE GRADUATE SCHOOL IN ARCHAEOLOGY - UNIFI**

How is it possible to overcome these serious shortcomings in the university education of specialists? The Graduate School in Archaeology of the University of Florence has as its purpose the education of specialists with a specific professional profile in protection, enhancement, knowledge and management of cultural heritage. Until 2015, no practical course focusing on the restoration and conservation of archaeological ceramics had been included in the teaching plan. Therefore, students lacked any practical knowledge regarding field interventions during excavation campaigns. Today, in Italian university courses there is not a program of studies that allows students to learn both archaeological disciplines and practical heritage conservation; the structured curricula are separated, one in archaeology and the other in heritage conservation. None had developed a complete course integrating these two disciplines.

The Graduate School in Archaeology of the University of Florence now for the first time in Italy provides a structured course on the conservation of archaeological ceramics based both on the practice of restoration and also theoretical lessons. The Practical Laboratory for Archaeological

Ceramics Restoration was established in 2016 by the chair in Aegean Civilization in order to provide students with practical knowledge. The exact parameters used were articulated into three main training steps, which have been developed on the basis of what is explicitly required by students:

- A series of theoretical lessons aimed at the recognition of degradation features on archaeological finds. Particular attention has been paid to the distinction of chemical and physical degradation phenomena. This step is crucial, since this distinction is not addressed in any specialization school in Italy (the theoretical lectures, in fact, are limited to explaining the restoration phases and their implementation, without knowledge of the phenomena that make restoration necessary). As a serious gap in scholars' formation, the lack of training in ceramic damage can lead to the further damage of archaeological pottery. Lessons have also dealt with the knowledge of the materials currently used in restoration by the Superintendency for Archaeological Finds.
- Introductory lectures on virtual restoration techniques (digital models obtained by laser scanners and photogrammetry) and information on the use of specific software packages for digital reconstruction.
- A practical laboratory in which all operations aimed at the conservation of archaeological artifacts have been implemented (cleaning, consolidation, gluing and integration of missing parts).

At the end of the course students wrote a final report about what they learned. They also prepared conservation documentation on some Aegean archaeological ceramic fragments to be restored.

In what follows, we provide more detail about the three steps.

## 2.1 Theoretical lectures

This course included a series of theoretical lectures addressing the technical characteristics of ceramic bodies. The lectures were followed by a series of practical lessons aimed at putting into practice what the students had learned. The first theoretical lectures concerned the study of fabrics and the ancient ceramic production process; the fabric properties and the processing steps were illustrated in a detailed manner with a special focus on the modeling techniques, the surface treatments and the ways of firing. Particular attention was paid to the first intervention procedures to be implemented on ceramics that come from an archaeological dig.

The subsequent theoretical lessons were devoted to conservation issues proper, especially the types of degradation that may affect the archaeological ceramics. The state of preservation of the artifacts varies considerably according to the area in which they were discovered, and it is mainly affected by the various uses of the vessels during antiquity (i.e., use wear) and the different geochemical characteristics of the soil across the site. Learning about these phenomena is very important as a prerequisite for working on the artifacts with the right products and with the right conservation procedures. The theoretical course also included the study of the archaeological restoration history.

## 2.2 Practical lectures

When the students had completed the first part of the course, they began the series of practical lessons (Fig. 1).



Figure 1. Students working during the practical lessons

### 2.2.1 Cleaning

Cleaning operations were carried out on some ceramic fragments of the Aegean area stored at the University of Florence [Bombardieri and Jasink 2014]. These fragments were characterized by earthy alterations and calcareous deposits. After recognizing the degradation phenomena, students removed them with cotton swabs soaked in different solvents (water or acetic acid or ethyl alcohol) depending on the alteration consistency. After this operation, cleaning was completed with a mechanical scalpel, carefully choosing the suitable blades to use (Figs 2 and 3).

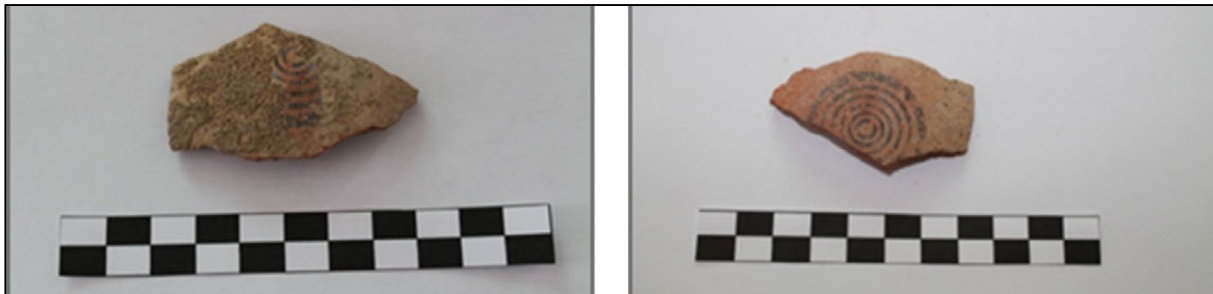


Figure 2. A fragment of Cyprus ceramic before and after cleaning

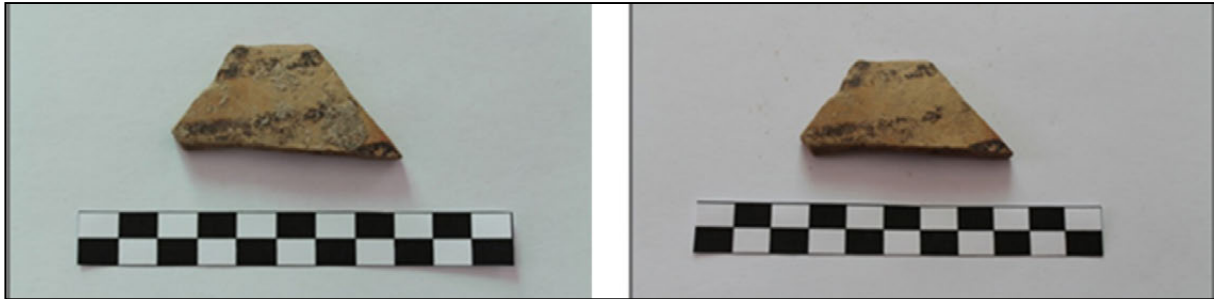


Figure 3. A fragment of Mycenaean ceramic before and after cleaning

### 2.2.2 Gluing

Once the cleaning process was completed, the next step, in the case of fragmentary artifacts, was to recompose them. Owing to the lack of mendable vessels, gluing operations (Fig. 4) were carried out by students on specially broken modern ceramics (small flower pots). Students put in place a preliminary reconstruction of the fragments using masking tape. This practical technique is useful for understanding the shape of the ceramic vessel, the size and the presence or absence of missing pieces. This method is also helpful in planning the final mending, because it shows which fragments can be glued all together and where it is best to start.



Figure 4. Some small flower pots ready for gluing

Then the students proceeded to the actual gluing; the adhesive used was Polyvinyl Acetate, a thermoplastic vinyl resin. This adhesive is applied hot and is particularly suitable for recomposing archaeological ceramics since it ensures a strong and effective bond in an extremely short time, while being totally reversible. In fact, should mistakes be made during mending, this adhesive can be removed completely with acetone and re-applied to the broken fragments (Fig. 5).



Figure 5. The preliminary reconstruction of the fragment with the masking tape and the actual gluing with the Polyvinyl Acetate adhesive

### 2.2.3 Integration of missing pieces

In every ceramic vessel on which students worked two or more fragments had been removed. The reconstruction of missing pieces is the lengthiest stage in the entire conservation process and requires the greatest patience and inventiveness with regard to the spaces and materials available in the operating environment. Dental wax sheets were used as counterforms to help support the integrated material. The edges of the gaps were screened with masking tape to delimit the area that required work. The gaps were integrated with Polyfilla Interior, a gypsum and cellulose based filler stucco. This stucco can be poured, colored and modelled like plaster, but, unlike plaster, it takes advantage of the fact that it can be modelled plastically, while also allowing a longer processing time. After drying, the reconstructed parts were finished off with special tools (spatulas and rasps) and smoothed with various types of grained abrasive paper so as to match the rest of the pot (Fig. 6).

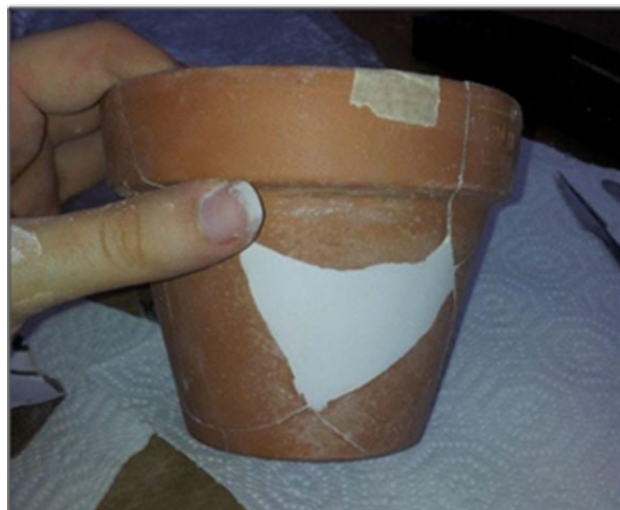


Figure 6. The integration of missing pieces of a small flower pot

### 3. CONSERVATIVE PROCEDURES CARRIED OUT ON SOME AEGEAN CERAMICS: COMPARISONS

The conservation methods used during the seminars on the pottery collection of the University were the same as those recommended by the restoration laboratories of the Superintendency for Archaeological Heritage of Tuscany. When transferring the conservation experience to the Aegean materials stored in the Archaeological Museum of Florence, the implementation of some special conservation procedures was necessary. The museum's ceramics are actually characterized by old restorations done with unsuitable materials, and they have gaps and surface deposits. As an example, we report here on the procedures performed in the restoration laboratories of the Superintendency on a Mycenaean stirrup jar from Rhodes [Dionisio 2016]. In this way, we can compare the previously implemented conservation techniques with those taught to the students.

Because in the Graduate School we did not have any special equipment, such as fume hoods, it was not possible to use wax for the integration of the missing parts, as applied in the present case. Therefore, for practical reasons, this the only material different from those used in the University lab.

#### 3.1 State of preservation

In the case of the stirrup jar n. inv. 198761 [Benzi 2009], the surface was covered by a thick layer of dust that had altered the colors of the decorations. Some inconsistent earthy alterations on the surface were also evident and the decorative pattern was abraded at many points. The artifact had considerable structural deficiencies of the body and half of the vessel was missing entirely. The preserved fragments had previously been reassembled during old restorations and minor gaps had been integrated with unsuitable and incompatible materials, which had been chosen according to the then-current views on products to be used in restoration (Fig. 7).



Figure 7. The Mycenaean stirrup jar before the actual restoration

#### 3.2 Removal of the old restoration and cleaning of fragments

The old restoration (gluing and integration of missing parts) was removed with localized applications of water along the fractures to dissolve the adhesive (probably a synthetic vinyl resin) and to remove the chalky material used as gap filling. The fragments were subsequently treated with cotton swabs

soaked in demineralized water to remove the dust layer on the surface and the residual traces of glue and plaster (Fig. 8).



Figure 8. The removal of the old restoration

### 3.3 Gluing of the fragments

The new gluing was carried out using a thermoplastic vinyl resin, Polyvinyl Acetate. As explained to students during the practical lab, this product is one of the most frequently used adhesives for the reconstruction of archaeological ceramics.

### 3.4 Integration of missing parts

The integration of the missing parts was partially carried out using I76, a product based on waxes and inert fillers. The integration was intended only to recover the object's readability and to ensure its structural stability. Integration must never prevail over the preserved portion of the object; as explained in the lab, in fact, we should always carefully consider what to rebuild and in what percentage.

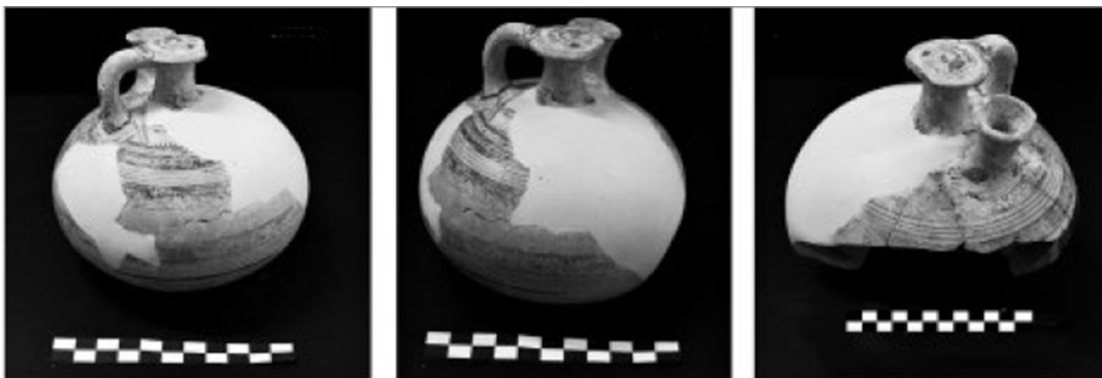


Figure 9. The Mycenaean stirrup jar at the end of actual restoration



The reconstruction of the missing parts is an invasive treatment that is likely to be subjective. Therefore, it is necessary to put it in place exclusively for structural reasons and not for aesthetic pleasure (Fig. 9).

#### 4. APPLICATIONS FOR VIRTUAL RESTORATION

In 2015, virtual restoration work was carried out for the first time at the University of Florence on some Aegean finds (two stirrup jars) from the Archaeological Museum of Florence. This first experiment included scans of original finds, digitization and subsequent 3D color printing. The operating method described here as an example will be applied in the future in the Practical Laboratory for Archaeological Ceramics Restoration of the Graduate School in Archaeology.

The first step for the virtual reconstruction of the jars was the acquisition phase. Considering the size, the material, the shape, the color and the surface of the objects, the artifacts' data were well suited to be acquired with a NextEngine 3D scanner and with photogrammetry techniques (photogrammetry was used for the geometric coverage of complex areas characterized by undercuts). The 3D models obtained were then imported into OS Blender, an open software used for 3D graphics and animation. In this way, the missing parts were molded. For the photogrammetry, a reflex Nikon D800 camera with the Nikon 60mm f/2.8 Micro-NIKKOR AF-D lens was used. Agisoft Photoscan software was then applied to the automatic generation of the 3D models.

The geometries were rebuilt by considering the acquired models (orthogonal projections, diameter, orientation and thickness), the morphological characteristics of the artifacts and the comparison with objects of the same typology.

Photoshop software was finally used for creating the textures, using an extremely accurate photographic documentation of the surface of the jars (Fig. 10) [Dionisio et al. 2015].



Figure 10. The virtual restoration of two Aegean stirrup jars

#### 5. CONCLUSIONS

The Practical Laboratory for Archaeological Ceramics Restoration of the Graduate School in Archaeology (University of Florence) was highly appreciated by the students and the course was very popular. Indeed, practical activity is generally carried out with great enthusiasm. Students who

attended this restoration training course showed great interest and active participation. We asked them their opinions about the lessons they attended and all said that it was just what was missing in an advanced archaeological course. The final reports presented by the students highlighted their willingness to participate in future courses. The reports emphasize a particular interest in the application of new virtual restoration technologies as well as great satisfaction with the new expertise acquired.

The next step to be taken during the next session of seminars, scheduled for the end of 2017, will be the introduction of new technologies. The applications of virtual ceramic conservation will be a new frontier for the restoration course at the Graduate School of the University of Florence, as the topics discussed in this first learning course were the starting points for structuring a more thorough course, based on the virtual restoration and 3D printing of archaeological ceramic artifacts. The new university course will focus mainly on the most commonly used techniques for the digital acquisition of artifacts (the use of laser scanners and photogrammetric techniques) and on their practical application. With the use of dedicated software packages, such as those described in the previous paragraph, students will be able to rebuild ancient ceramics without interacting directly with them.

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Received March 2017; revised July 2017; accepted August 2017.