

DIGITAL APPLICATIONS IN ARCHAEOLOGICAL EDUCATION AND EXCAVATION TRAINING: THE DELTA COURSE

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Abstract

Despite the fact that over the last two decades there has been a considerable increase in the adoption of digital applications in archaeological excavations, the application of digital educational tools in the excavation training of Archaeology, students has not made commensurate progress. As a consequence, it is still difficult to integrate in Archaeology curricula the physical space of an archaeological excavation with that of the university classroom. The impact of the limited use of digital educational tools became even more apparent during the recent COVID-19 pandemic, which created serious problems in conducting face-to-face excavation training in both the classroom and the excavation site. Within this context, the integration of these two physical spaces through the digital “space” of online training is the main objective of project DELTA (Digital Excavation through Learning and Training in Archaeology), a transnational project funded in the context of Erasmus+/KA2 EU programme. Through the DELTA project, students of Archaeology will be able to improve their subject knowledge and develop digital and 21st century skills.

This paper presents the results of the first phase of the DELTA project, during which we conducted extensive desk and field research aiming at recording the existing situation in the three countries regarding: (1) the use of digital applications in archaeological excavations, (2) current courses on excavation practices, methods and techniques and (3) the use of digital educational tools in such courses. By analysing the results from Internet search and a survey using online questionnaires, we present (a) the most recent trends in the university curricula of Archaeology, (b) the current level of digital skills and expertise of students and professionals and (c) the needs and expectations of students and professors regarding the use of digital applications in excavation and Archaeology education. The results of this research were particularly revealing, especially when comparing the situation between the three countries, but also when contrasting the existing digital skills and the aspirations of the various categories of responders (e.g. educational level, current position etc.).

This research provided us with the necessary evidence for the design and development of a blended training course that combines the use of an online platform with face to face and on-site learning in a joint excavation; the ADDIE model was adapted in the course design. In addition, the online piloting of the course allowed participating Universities to discuss the level of integration of digital applications in Archaeology education and make suggestions for future actions, particularly within the context of the recent pandemic and the problems it created in students' excavation training.

Keywords: EU project, digital skills, digital excavation, students, higher education, digital archaeology

1 INTRODUCTION

Europe 2020 strategy establishes Information and Communication Technologies (ICTs) as a core element for five of the seven flagship initiatives to promote growth in the European Union: the European Platform against Poverty and Social Exclusion, An Agenda for New Skills and Jobs, Youth on The Move, and the Digital Agenda for Europe, and the Innovation Union. Europe 2020 Strategy and related Flagships promote the use of ICTs to tackle social inclusion, from young people using ICTs to improve life chances, through raising the skills and working conditions for workers in general and to build industry capable of delivering solutions for the challenges of health and demographic change. The digital literacy of the workforce remains one of the key challenges for the adoption of technology within cultural organisations [1]. Digital competence is one of the eight key competences for lifelong learning identified by the European Union and DELTA project develops a modular blended course on digital competences and 21st century skills, up-skilling the students of Archaeology.

DELTA (Digital Excavation through Learning and Training in Archaeology) is a transnational project that brings together 4 partners from 3 European countries: from Greece, Hellenic Open University, DAISSy research group (project coordinator), Department of History and Archaeology –National and Kapodistrian University of Athens, from Italy, University of Basilicata, Department of Archaeology and Museology and from Czech Republic, Masaryk University. Project DELTA designed and developed a course that combines the physical space of an archaeological excavation with the digital space of online learning. DELTA integrates the excavation site as an instructional tool in the classroom-based instruction of Archaeologists using digital means. The course was delivered via blended learning using an online platform, as well as sessions with tutors and on-site learning [2]. The project focuses on the development of digital competences so that young and future archaeologists maximize the Academic return on investment (ROI of education), become more resilient, increase their creativity and efficiency and acquire career adaptive competences.

In accordance to the European policies, a further integration and cooperation is needed between the Universities across Europe, so as to improve both the quality and effectiveness of their curricula and methods of excavation, as well as the introduction of new technologies in the archaeological sector. The Higher Education Institutions that participate in the project will be able to enhance their offer to young archaeologists, as University students, enabling them to cope with a massive introduction of technology in this sector.

The project operational objectives are:

- a) the co-design by Universities of new (or improved) training modules to fill the gap in the curriculum of initial and continuing training for Archaeology with regards to the management, documentation and preservation of cultural heritage;
- b) The training of professors and students in order enable them to make use of the new technology;
- c) The evaluation of the online tools/trainings with University students in order to fine-tune the products, methodology and delivery capacity of trainers.

In the field of culture, changes and, furthermore, developments in Information and Communication Technologies (ICT) have brought about new dilemmas and challenges for practitioners. Old and new professionals are now required to have ICT skills and the ability to be creative, flexible and able to manage digital knowledge [3].

The archaeologists like other cultural professionals need to up skill and be trained in new methods and tools in order to manage, document, preserve and promote the findings during and after the excavation field. The nature of the rapidly changing labour market landscape means that archaeologists as cultural professionals must embrace the practice of up skilling throughout their careers. The project DELTA is seeking to respond to crucial questions such as: Which are the needs of archaeologists? In what way these young professionals of the cultural sector are able to encounter the digital challenges in the digital era? How important is the digital literacy? Are current University curricula competent enough so as to result to a digitally confident professional?

The research findings and the course modules produced by the project partners will be discussed in the following sections.

2 METHODOLOGY AND OUTCOMES

DELTA project aims at designing and developing an innovative, open, blended course that combines the physical space of the excavation in the field with the digital space (virtual excavation, online learning) with the aid of new technologies, in order to train students in digital competences and the use of new technologies in Archaeology.

Intellectual Output 1 is the first of the two project outputs, and concerns the design of the course after taking into consideration (a) the skills needed for new archaeologists and (b) the syllabus of training courses that are already available at Archaeological departments. For this reason, before designing the course it was considered essential to carry out an extensive Desk and Field Research with the following aims:

- 1) To record the existing situation mainly in the three participating countries concerning:
 - (a) Higher education courses on excavation methods and techniques;
 - (b) The use of digital applications in archaeological excavations;
 - (c) The use of digital educational tools in courses about excavation practice.

2) To explore, assess and understand the expectations and desires of students and professionals of archaeology concerning the use of digital tools and applications in:

- (a) Archaeological excavations;
- (b) Courses on excavation practices, methods and techniques.

The Desk Research that took place from January to March 2020 explored the trends in the curricula of the 3 countries (Greece, Italy and Czech Republic) regarding the use of digital tools and applications in excavation and teaching. The Desk Research Questionnaire collected three major groups of data:

- Group A. General Institution Data: University/Department, Program of studies, Teaching Methodology, Courses on Archaeology, ECTS, Employment opportunities.
- Group B. Courses on Field Techniques: Description of course and excavation, Duration, ECTS, digital tools used in excavation.
- Group C. Digital tools and skills: (a) Digital tools used in the Excavation, (b) Digital skills provided to students. The form was composed in English and filled in by the partners with evidence and data found in the website of universities and institutions.

2.1.1 Desk Research: the results for archaeology courses in Greece

In Greece, there are 9 BA, 17 MA and 9 PhD Programs of Study related to Archaeology, offered by 9 different Universities (Universities of Athens, Thessaloniki, Ioannina, Crete, Thessaly, Peloponnese, Aegean). The Ionian University and University of Thrace do not lead to Archaeology degree but offer archaeology courses. All 9 BA Programs have a duration of 8 semesters (4 years) and require 240 ECTS for accreditation. The method of study combines lectures in class, seminars, practical and visits to archaeological sites and museums, and all are taught in Greek. The basic method of assessment for the overwhelming majority of the courses is written and oral exams, but also essays and presentations. All curricula provide also the opportunity for an internship in Institutions related to Archaeology, such as the Greek Archaeological Authority, Museums, Research Institutes and Cultural Organizations.

The employment opportunities related to Archaeology include the Greek Archaeological Authority, Research Institutes, Museums, Secondary and Higher Education, Tour-guides in archaeological sites and museums. In the NKU of Athens (DELTA project partner), students have to practice in a specific excavation, the Departmental Excavation at Plasi Marathon, which takes place every May, during the spring semester. When information is provided, the number of days of practice varies between 10 to 30 days. Concerning the use of digital tools in the excavation, information is provided in 5 cases. The digital applications include (1) Digital Notebooks composed in situ and after the excavation, (2) use of Drone, (3) Digital Photos, (4) Digital Drawings, (5) Photogrammetry, (6) 3D graphics, (7) Virtual Reconstruction and (8) GIS.

2.1.2 Desk Research: the results for archaeology courses in Czech Republic

In Czech Republic there are 21 BA, 15 MA and 8 PhD Programs of Study related to Archaeology, which are offered by 7 different universities (Brno, České Budějovice, Hradec Kralové, Olomouc, Opava, Pilsen, Prague). All these programs are offered by Departments or Institutes of Archaeology in those universities. Most of the BA Programs have a duration of 3 years and require between 67 and 180 ECTS for accreditation, while others have a duration of 2 years and require 180 ECTS. The method of study combines lectures in class, seminars and practical. 10 Programs are taught in English and Czech, and 11 in Czech. The methods of assessment include exams, essays and theses. The percentage of Archaeology courses and ECTS required for a BA in Archaeology is 100%.

All curricula also provide the opportunity for internship in National Institutions related to Archaeology, such as Cultural Heritage Organizations, Museums and Research Institutes.

The employment opportunities of the graduates of Archaeology include jobs in the Academia (University Departments and Institutes of Archaeology), the National Academy of Science, Museums, and Cultural Heritage Organizations. The majority of the courses on Excavation Techniques include compulsory practice in excavation or in the field. In most courses the duration is between 5 and 15 days, while in the Summer Practice of Brno it is 20-30. In all excavations it is reported the use of digital tools in the excavation practice, including Database, Photogrammetry and GIS.

2.1.3 Desk Research: the results for archaeology courses in Italy

Due to its size and long academic tradition in archaeology, Italy has a large number of universities offering programs of study on Archaeology and relevant disciplines. In central and south Italy where the

partner of the project (UNIBAS) is based, there are 21 BA, 26 MA, 8 Specialization and 17 PhD Programs of Study related to Archaeology, which are offered by 22 different Universities (Bari, Basilicata, Cagliari, Calabria, Catania, Chieti, Foggia, L'Aquila, Lecce, Macerata, Messina, Molise, Napoli-Benincasa, Napoli-Federico II, Napoli-L'Orientale, Napoli-Vanvitelli, Palermo, Roma-La Sapienza, Roma-Tre, Roma-Tor Vergata, Sassari, Urbino). The departments offering these courses vary considerably, comprising Departments of Humanities, Classics, Letters, Literature, Arts, Social Sciences, Tourism, Education, History, Cultural Heritage and Human Sciences.

All 21 BA Programs of Study have a duration of 6 semesters (3 years) and require 180 ECTS for accreditation. The method of study combines face-to-face lectures in classes, seminars, practical and e-learning distant methods, including MOOCs. All BA Programs are taught in Italian. The methods of assessment include written and oral exams, essays, a thesis and practical exercises. All curricula provide also the opportunity for internship in Superintendence's, Archaeological Parks, Museums, Archives, Libraries, and Organizations operating in the field of protection, conservation and enhancement of cultural heritage. The employment opportunities related to Archaeology include jobs as Archaeologist, Art historian; Researcher; Professor; Expert in conservation and enhancement of cultural heritage. The use of digital tools (Digital notebooks, Digital cards, and use of Drone, Digital photos, Digital drawings, Photogrammetry, 3D graphics and GIS) is reported in all excavation courses.

In the Italian educational system, after the MA Degree (Lauree magistrali), it is possible to apply and follow the post-graduate School of Specialization in Archaeology (3rd cycle, limited number of students), providing a Diploma of Specialization in Archaeology. Eight School of Specialization in Archaeology were recorded, all focusing on Archaeological and/or Cultural Heritage, of 2 years and require 120 ECTS for accreditation. Only the School of Specialization in Archaeology, University of Basilicata, includes course on excavation and field techniques. The use of digital tools is reported, and include Digital notebooks, Digital cards, Drone, Digital photos, Digital drawings, Photogrammetry, 3D graphics and GIS.

2.1.4 Field Research: major points

In January-February 2020 a special questionnaire form was composed in English and translated by the partners in the three national languages (Czech, Greek and Italian). A special invitation was sent via email to students, colleagues and professionals of archaeology. A more detailed analysis of the methodology and the research analysis is presented on the long version of the report in DELTA website [4]. A total number of 245 responses were collected through online survey.

The first point concerns the training of students in the use of digital tools in archaeology. There are sharp differences between the three countries, with Greece having the lowest percentage (17%), the Czech Republic the highest (59%) and Italy lying in between (39%). Nevertheless, even in the more digitally advanced countries, there is still a large percentage of archaeologists who feel digitally "illiterate", regarding the use of digital tools in archaeological projects.

The second point is the acknowledgment of the limited range of digital tools used in archaeological projects, and in which students of archaeology are trained. The analysis of the responses showed that students' training is confined to digital tools related to excavation recording, such as the use of Digital Notebooks/Cards, Digital Photos and Photogrammetry; in contrast, other tools related to post-excavation tasks, such as Public Engagement, Dissemination and Communication of archaeological knowledge, and Digital Presentation and Management of objects, archives and collections are rarely included in the syllabus of these courses.

The third point is related to the fact that digital educational tools have rarely been applied in courses of Excavation Methods and Techniques.

Finally, the fourth point, is that students and junior scholars (students in BA, MA, Specialization and PhD Programs) are eager and interested to learn as many digital skills as possible, covering almost every aspect of excavation and post-excavation work.

3 DESIGNING AND DEVELOPING THE DELTA BLENDED COURSE

The above points justify the main objectives of the DELTA project regarding the design and development of a special course which will train students and professionals of archaeology to the use of digital tools in archaeological projects. The design of this course should be made in a way, which will allow easy

and seamless incorporation in the existing archaeological curricula. The new course should include training in as many digital tools as possible. DELTA operated in the design and development of a blended course entitled “Digital Excavation” containing 4 modules:

- 1) Digital Tools for Archaeological Practice/ Excavation;
- 2) Documentation in situ and after excavation;
- 3) Digital Preservation of cultural heritage monuments and artifacts;
- 4) Open-Air Museums and Experimental Archaeology.

The DELTA blended course (online, face to face sessions with Tutors, the Intensive Study Programme at a joint excavation in Greece) was a total of 200 hours, providing 8 ECTS and targeted first and foremost students of Archaeology in the partners countries Universities. The face-to-face activities implemented online due to corona virus and were compulsory for students from Masaryk University (CZ), University of Basilicata (IT) and National and Kapodistrian University of Athens (GR); the participation of other students was voluntary.

A modular training approach was selected. Each module consists of units and each unit is realized with learning activities and learning outcomes. The design phase is the most essential and demanding one [5]. Adopting learning outcomes in the educational or training process serves the shift of the traditional approach oriented to the teachers towards an approach oriented to the learner [6]. The “learner-centered” model adopts an “outcome-based” approach, focusing on what the learners will learn, master and be able to do as they progress through the course [7] [8]. Writing learning outcomes with emphasis on correctness and quality requires the employment of particular techniques like the ABCD and SMART approaches. Additionally, the learning outcomes were identified based on the Bloom taxonomy and especially the Cognitive (knowledge-based) [10] domain. The methodology contextualized for the DELTA blended course, adopts the basic elements of the well-known ADDIE model (Analysis, Design, Development, Implementation and Evaluation) [11]. The ADDIE model illustrates an iterative and self-corrected training process of five phases of instructional design since it provides continuous assessment in every step. The delivery of the DELTA course was implemented through the online DELTA platform, designed and developed by the Hellenic Open University [12].

3.1 Module 1: Digital Tools for Archaeological Practice/Excavation

Module 1 focuses on the potential of using contemporary technology in archaeological fieldwork. Students acquire new skills with the potential to enrich their professional career in dealing with digital data, such as planning fieldwork using available digital tools and online resources, acquiring digital data from measuring devices (total station, GNSS receiver), managing spatial data and preparing digital maps, as well as applying 3D documentation methods during fieldwork. The module covers multiple phases of fieldwork and reflects the needs of professionals and stakeholders in effectively conducting an archaeological excavation in the digital era. The main advantage of the learners is training in the free and open-source software (e.g. QGIS, Meshroom), which is a cost-effective, usually cross-platform solution. Results gained through this software support cooperation between individuals and institutions. The module is divided into four units: “Before excavation” (unit 1), “Geodesy” (unit 2), “Geographic information systems” (unit 3) and “3D visualisation techniques” (unit 4). The interrelated topics were introduced in these units through the handbook, interactive presentations and additional study material (Table 1).

	Unit 1	Unit 2	Unit 3	Unit 4
Handbook chapters	1	1	1	1
Learning objects	6	4	6	5
Introductory video [self - produced]	1	1	1	1
Learning outcomes	8	4	6	5
Additional	17	23	45	2

study materials				
Workload (hours)	10	10	10	10
Face-to-face activities (hours)	2	2	2	2

Table 1. The content of module 1 (*Digital Tools for Archaeological Practice/Excavation*).

3.2 Module 2: Documentation in situ and after excavation

Excavation, as an irreversible and destructive process, requires consistent, accurate and detailed documentation and recording. These are an essential part of any archaeological project because they allow the reconstruction of the excavation process and the archaeological interpretation afterwards. The objectives of Module 2 are to familiarize students with the basic principles and methods of documentation applied in situ and after excavation; how to use and operate tools for digital recording, namely tablets and the relevant software for filling digital notebooks and/or recording sheets, integrate varied types of digital information (texts, drawings, images, orthophotos) into a single digital archive; how to manage, analyse and visualize the digital data, which is kept in the form of databases, for the purposes of archaeological interpretation. The module is divided into four units: “The importance of archaeological documentation in situ and after excavation” (unit 1), “Digital documentation in situ” (unit 2), “Digital documentation after the excavation” (unit 3) and “Post-excavation analysis of digital archaeological data” (unit 4). The interrelated topics were introduced in these units through the handbook, interactive presentations and additional study material (Table 2).

	Unit 1	Unit 2	Unit 3	Unit 4
Handbook chapters	1	1	1	1
Introductory video [self - produced]	1	1	1	1
Learning objects	3	4	4	4
Learning outcomes	4	6	5	3
Self evaluation questions	20	20	20	20
Additional study materials	12	16	35	39
Workload (hours)	10	10	10	10
Face-to-face activities (hours)	2	2	2	2

Table 2. The content of module 2 (*Documentation in situ and after excavation*).

3.3 Module 3: Digital preservation and presentation of cultural heritage monuments and artefacts

Module 3 focuses on those techniques, which effectively enable archaeologists to produce, manage and visualize digital data for the preservation and presentation of cultural heritage, from the largest scale of entire buildings or archaeological sites and their surrounding landscape, down to the smallest scale of artefacts and ecofacts. Through Module 3, learners are able to produce and store digital documentation for the formal presentation of archaeological heritage (CAD software; Geographical Information System GIS Platform; GPS Data georeferencing, digital tools for artefacts drawings, Data Bases DB); practice a powerful combination of photogrammetric and measurement techniques in connection with 3D imaging and drone; select effective case studies for virtual restoration and conservation of ornamental surfaces of monuments and artefacts (3D restoration and 3D printing) and design a project of virtual restoration with practical application; be familiar with Virtual Reality (VR) and immersive VR, Augmented Reality (AR). The module is divided into four units: “Digital documentation for the formal presentation of post-excavation archaeological heritage” (unit 1), “Photogrammetric and measurement techniques in connection with 3D imaging and drone of post-excavation archaeological heritage” (unit 2), “Virtual restoration and conservation of ornamental surfaces of monuments and artefacts (3D restoration and 3D printing)” (unit 3) and “VR and immersive VR, AR Augmented Reality” (unit 4). The interrelated topics were introduced in these units through the handbook, interactive presentations and additional study material (Table 3).

	Unit 1	Unit 2	Unit 3	Unit 4
Handbook chapters	1	1	1	1
Introductory video [self - produced]	1	1	1	1
Learning objects	4	1	2	1
Learning outcomes	7	6	8	6
Self evaluation questions	20	20	20	20
Additional study materials	25	12	9	19
Workload (hours)	10	10	10	10
Face-to-face activities (hours)	2	2	2	2

Table 3. The content of module 3 (Digital preservation and presentation of cultural heritage monuments and artefacts)

3.4 Module 4: Open-Air Museums and Experimental Archaeology

Module 4 introduces the students of Archaeology to the value of archaeological open-air museums, their management and their visitors. Also, learners will understand how the practice of experimental archaeology is strongly connected growing craft experience. Through this module, learners will comprehend how to acquire 21st century skills related to audience engagement and storytelling techniques. Effective interpretation will allow them to make each visitor personally connect with a resource or place and to care about the sites. The public archaeology will help young researchers to better understand archaeological processes and allow audience to interact with archaeological

knowledge. The module is divided into five units: “What is an Open – air Museum?”(unit1), “The meaning and scope of Experimental Archaeology” (unit 2), “Live interpretation in AOMs” (unit 3), “How to best manage an open – air museum?”(unit 4), “Low-tech and High-tech Approaches in Archaeological Open-Air Museums” (unit 5). The interrelated topics were introduced in these units through the handbook, interactive presentations and additional study material (Table 4).

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Handbook chapters	1	1	1	1	1
Introductory video [self - produced]	1	1	1	1	1
Learning objects	2	1	1	1	1
Learning outcomes	7	2	3	3	2
Self – evaluation questions	20	20	20	20	20
Additional study materials	23	12	8	7	5
Workload (hours)	8	8	8	8	8
Face-to-face activities (hours)	1	1	2	2	2

Table 4. The content of module 4 (Open-Air Museums and Experimental Archaeology)

4 CONCLUSIONS

The analysis of the data deriving from the Desk and Field Research contributes valuable information for the design of an effective digital course on the application of digital tools in archaeology, which is the main objective of designing and developing the course of DELTA project. The blended course of DELTA project entitled “Digital Excavation” was organized from May to August 2021 and was developed and delivered by the consortium of “DELTA: Digital Excavation through Learning and Training in Archaeology”. The “Digital Excavation” was a 15-week blended course of 160 hours in total, with online self-study in DELTA platform and online sessions with tutors, providing 6 ECTS. The online part of the course was delivered through the DELTA platform, developed by DAISSy research group of the Hellenic Open University. The assessment of DELTA course was held through self – evaluation quizzes (multiple choice and True/ False questions) in each Module. The completion of DELTA is achieved when succeeding in at least the 80% of learning material and graded activities (quizzes). The aim of DELTA course was to enable students of Archaeology to update their knowledge and skills and develop digital and 21st century skills. The course included 4 modules, each one was developed and delivered by a project partner. The third part of the blended course includes a five days training of 40 hours (in total) in the field, a joint excavation for learners-students of Archaeology, selected by each partner of DELTA project.

The high demand for training in digital skills and no possibility to meet personally during the global coronavirus pandemic highlighted the importance of blended learning and DELTA course. The COVID-19 pandemic has caused serious problems in conducting traditional teaching. The search for new ways to prevent such unexpected situations has supported the importance and benefits of the DELTA project. The global response to COVID-19 has impacted every way of life, touching every continent and every

sector, including culture and education. It became evident, more than ever, that young professionals need digital skills and competences so as to cope with their excavation tasks. The COVID-19 crisis has resulted in a significant increase in online learning by adults. The training that had started as face-to-face in classroom environments has been pursued in online mode. Students are encouraged to use the time freed up by short-time work schemes to take up new training. As such, the crisis provides a powerful test of the potential of learning online. And the DELTA course enabled its target group (Archaeology students and their educators/tutors/professors) to be equipped with basic digital skills and new tools towards, documentation, preservation and communication of archaeological findings and fields.

A combination of the online course with face-to-face activities, conducted online, proved to be a great alternative solution:

1. It created an opportunity to exchange digital experience in archaeology not only between cooperating institutions. Thus, the DELTA project was not only an educational tool, but it integrated people studying and working at different institutions, providing an insight into the educational and scientific conditions.
2. The DELTA project might be an excellent opportunity for students to familiarize themselves with digital applications and integrate them into the field practice.
3. The DELTA project provided a platform for the interaction of students and tutors, thus creating an effective communication tool.

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