Themata 3
E-learning Archaeology, Theory and Practice

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Arkeonet: an e-learning pilot programme in science and technology applied to archaeology

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Introduction

The present paper aims to describe *Arkeonet*, an e-learning programme in archaeology that the Aranzadi Science Society has conducted for the last three academic years. First, we shall introduce Aranzadi as an archaeological organization and the context in which this e-learning programme arose, as well as its objectives. Secondly, we shall go through a description of how the programme is organized (materials, classes, evaluation, final paper). Thirdly, a detailed description of the content itself will be presented, explaining the most important activities that students carry out in each module. Finally, we shall end this article by presenting the conclusions drawn from the experience of the last three years.

Origins and objectives

The Aranzadi Science Society was founded in 1947 as a not-for-profit association, and has retained this legal status to the present day. The society's stated aims include pure and applied scientific and technical research into problems and issues related to the natural and human environment; dissemination of this knowledge and of the results of the research conducted; and protection and conservation of archaeological, ethnographic and natural heritage. Among its 13 Departments, Prehistoric and Historical Archaeology, together with Physical Anthropology are the three directly involved in the above-mentioned e-learning pilot programme.

The current activity of the archaeology departments is linked to the historical and cultural context in which Aranzadi mainly carries out its

activities (Autonomous Communities of the Basque Country and Navarra). Thus, the Prehistoric Archaeology Department is highly specialized in Palaeolithic and Iron Age sites; the Historical Archaeology Department works mainly with castles, old farms and urban plots; and as for the Anthropology Department, it has traditionally dealt with human remains and necropoli in the region. However, since 2000 its main activity has been exhuming mass graves from the period of the Spanish Civil War using archaeological methods.

Although Aranzadi's experience in archaeological excavations and research goes back more than 60 years, the members currently involved are fully aware of the developments which have taken place in archaeology in recent decades. On the one hand, the material evidence which is unearthed is considered not as a mere tool for dating the culture under study, but as a means of understanding the values and thoughts of those who used and produced it. On the other hand, the archaeological method traditionally applied to prehistory and ancient history has also been used in Mediaeval, modern or industrial contexts. Thus archaeology has become a science with its own method, able to create a historical interpretation from material evidence.

These two points, together with the current application of leading-edge technologies in archaeological research, increase the need for the archaeologist to be competent in different areas of knowledge, and also to introduce an interdisciplinary approach into his or her studies.

The underlying educational structure is another important factor which has been taken into account in designing the programme content. In the Spanish university system there is no degree in archaeology. Most professionals and researchers working in the field of archaeology have a Master's degree in history. Depending upon the university, they may have a 'mention' or 'specialization' in prehistory or ancient history, having taken some courses in archaeology. However, as stated above, this is not enough to become a fully competent archaeologist nowadays.

In the case of the Basque Country, two universities offer a Master's degree in history. One of them, Deusto University, includes one single subject in the field of archaeology. Meanwhile, the University of the Basque Country provides a more thorough education in this field, including in its curriculum thirteen archaeology related subjects, eight of them being specific for prehistory: Methodologies and research techniques (both in archaeology and history), Historiographical trends (both in archaeology and prehistory), Archaeology in historical times, Archaeology in classical cultures, Archaeology of architecture, Typology, Prehistoric art, Prehistory of the Iberian Peninsula, Stratigraphy, Environmental archaeology and Graphic support for research in prehistory.[1]

Hence Arkeonet's aim is to respond to archaeology's development into a more complex science and the essential use of new technologies which – in the Spanish system at least – has so far not been reflected in university curricula. The aim is to provide students with a general overview of the methods and leading-edge technologies being used in today's archaeological projects. The target groups are both students wishing to follow a career in archaeology and professionals who wish to be brought up to date with the new trends and approaches.

Organization and functioning of the training programme

Arkeonet is organized jointly by the Aranzadi Science Society and the Asmoz Foundation, with Aranzadi being responsible for the teaching aspects of the programme (selection of topics, design of content, selection of tutors etc.) and Asmoz providing the e-learning platform. Other organizations such as research centres, archaeological associations and companies from the region provide support for the organizers by receiving students for field work in their excavations.

The programme has a duration of 350 hours: 250 hours devoted to theoretical and practical content (from October to June) and 100 hours to archaeological excavations (from June to September). Although initially it was compulsory to attend classes once weekly, currently the programme may also be taken wholly online. However, this latter option is available only for students outside the region, since we consider the practical classes to be a key part of the training process.

The e-learning platform is based on Moodle, which is provided and supported by the Asmoz Foundation, the joint organizer of the programme. It allows for the storage of materials and for interaction between tutor and students, amongst the students themselves and between students and organizers. All training-related contact between tutor and students is to go through the platform, so that all students may benefit from discussions and explanations. Other features of the platform which have proved really useful for the programme are the possibility of organizing discussion forums, at news section and communication tools. The theoretical part is divided into 27 modules, each consisting of the following elements: contents,

Monday	Tutor uploads the teaching content and complementary materials.
Tuesday	Students go through the contents and if necessary, ask questions or request further explanations.
Wednesday **Thursday**	They answer the comprehension question.
Friday	Practical class (4 hours). Students are provided with the evaluation exercise.

complementary materials (maps, examples of reports, pictures…), links, bibliography, a comprehension question, the practical class, and an evaluation exercise. Each tutor decides on the most relevant contents to include in his/her module, as well as the materials students may use to study the subject in depth. While the materials provided are mainly an overview of the subject, the classes always have a practical focus, stressing the potential of the particular discipline / technology for solving research problems, as well as its methodological limitations.

As for the actual organization, the tutors upload the contents, complementary material and links to the e-learning platform prior to the practical class. So, students have time to familiarize themselves with the subject-matter, ask for further explanations and answer the comprehension question, which will enable the tutor to assess the depth of the students' understanding prior to the practical class. This latter is held on Aranzadi's premises every Friday afternoon and has a duration of 4 hours. In some cases visits to laboratories (e.g. a conservation laboratory) or research centres are organized. The functioning as described above is arranged on a weekly basis, according to the schedule above (Figure 1).

The evaluation exercises are a means of putting the knowledge acquired in each module into practice. They consist mainly of solving a problem related to the technology, scientific discipline or area of knowledge explained in each case, such as may arise in a real archaeological excavation or actual research. The aim of these exercises is not to repeat the theoretical contents in which each module is framed, but that the students should apply the tools presented in each module to real cases. For instance, an evaluation exercise may ask students to prepare a working methodology or proposed technological application, to analyse actual laboratory results or to work with certain software. This weekly assignment allows the tutor to assess the learning process on a regular basis. Students are required to successfully complete at least 80% of the exercises set. However, the final evaluation will be completed with 100 hours (two weeks) of practical work in an excavation. The objective is to perform a specific task set by the director of the excavation, which will be written up in as a final essay.

Figure 1 Weekly organization of the training programme.

Content

Over and above the e-learning programme, which is in itself an innovation in the training of archaeologists, Arkeonet is not traditional training, in that it aims not only to provide specific and theoretical knowledge, but also to familiarize students with the new methods of modern archaeology, always taking an interdisciplinary approach. The areas of knowledge chosen are the disciplines, technologies or topics currently used in, or related to, archaeological research, in both field and laboratory work. Some of them (e.g. Ground Penetration Radar) are rarely used in small or 'rescue excavations',[2] so the programme provides an opportunity for the students to become familiar with them, while others (e.g. Prevention of Risks at Work) are prevalent in archaeological work but generally ignored by the educational system. We may say that most of them are not included in academic curricula, and the few that are (e.g. palaeobotany) are approached solely from a theoretical point of view, neglecting the practical and methodological aspects. With all events, we emphasize that every topic is presented in a very practical way, showing the students devices or materials whenever possible and getting them to reproduce laboratory work.

In order to gain a more complete overview of the contents included in the programme curriculum, we have grouped them into four categories: Legal and Management Issues; Research Methodologies; Auxiliary Sciences; Technologies Applied to Archaeology and Conservation. Below we present a short description of each of the topics included in Arkeonet, including specific explanations of the teaching approach and content.

Legal and Management Issues

Under this point we have included those topics that are essential when

organizing an excavation or research project, but are not directly linked to archaeology as such:

> Archaeological Legislation and Regulations: Aims to explain the procedures laid down by cultural heritage law. It deals mainly with how to obtain an excavating license, applying models for excavating or research grants, storage of materials and access to past reports and excavation logs;
> Prevention of Risks at Work: This module presents the Spanish law on the Prevention of Risks at Work as it applies to archaeological works (excavations, prospecting, etc.) The aim is to make students aware of the importance of having a Risk Prevention Plan in any excavation, as well as adopting safety measures during field work;
> Intellectual Property Rights: Both the researcher and the archaeologist are continuously generating material protected by property rights (reports, essays, papers, photographs, etc.) The aim of this part is that students should know the property law applicable in each case according to the labour relationship and the material produced, so that they may protect their copyright.

Research Methodologies

Under this section we have included different areas of knowledge that complement and support archaeological research in its different stages.

> Accessing bibliographical resources: This is an introduction to documentary research, providing an overview of the arrangement of libraries and archives, as well as currently available online resources. It focuses on strategies and tools for searching the Internet;
> Methodology of archaeological prospecting: The aim of this module is to introduce archaeological prospecting as an element in archaeological research. The information gathered during prospecting needs to be arranged systematically so that it may be used in subsequent research or excavations in a methodologically sound way;
> Types of archaeological deposit: The main objective of this module is to present the varieties of archaeological deposit, as well as their specific problems and the research strategies to be applied in each case.
> Dating systems: Although this topic is usually covered in academic curricula, the purpose of its inclusion in the programme is to provide an understanding of the foundations of chronology as applied to archaeology. It aims to show the capabilities and limitations of the most commonly used dating systems, and to compare the ones that are most useful in common cases. Finally, students are trained in the critical interpretation of figures and diagrams for geo-chronology;
> Stratigraphic series: This introduction to sediment analysis aims to show all the information that may be extracted from a thorough analysis of the sediment in which the archaeological elements are embedded. In addition students carry out real analysis in a laboratory, performing the process from collecting samples through to interpreting the results of the analysis.

Auxiliary Sciences

The inclusion of these sciences and their application to archaeological research underscores the interdisciplinary approach that Arkeonet intends to promote amongst students. The approach remains mainly practical, although the theoretical framework is a must. Students will be provided with reports and studies conducted for actual archaeological research, as the best way of showing how other disciplines contribute to archaeology.

> Geological context: This includes a short presentation of the geological history of the region along with explanations and examples of the information that geologist may bring to archaeological research (identifying materials used, geographical origin, etc.);
> Palaeobotany: An introduction to the science of palaeobotany and how it helps the archaeologist to describe environmental conditions. The content includes analysing botanical remains, methodology and an interpretation of pollen diagrams;
> Palaeontology: An approach to the methodology and objectives of this auxiliary science, essential as it is to archaeology. The aim is to show heuristic potential with regard to animal evidence along with capabilities and limitations of faunal analysis. It is divided into two modules: one for macro-fauna and the other for birds and micro-fauna. Apart from studying the theoretical framework of each area, students will handle actual animal remains, using Aranzadi's reference collections of macro-fauna and birds;
> Physical Anthropology: The aim is to present the working methodology of this discipline, as well as illustrating the kind of information that an anthropological analysis may furnish. This presentation is complemented by practical laboratory sessions in the Forensic Department of the Faculty of Medicine;

> Analysis of metal objects: This is a compendium of three disciplines: archaeometrics, palaeosiderurgy and archaeometallurgy, all of which are necessary for understanding and interpreting the analysis of metal objects. An overview of the features of metals and their combinations is followed up with an introduction to the methodologies and technologies most commonly used for this analysis.

Technologies

The list of technologies applied to archaeology aims to provide an overview of the major role that technology currently plays in archaeological research and excavations. In general the modules present methodological guidelines to take into account when using and applying such technologies so as to ensure the validity of the results in the framework of a scientific research project.

> Cartographic Information Systems: This module is intended to provide students with a general overview of the main foundations of cartography, as well as existing digital tools for obtaining cartographic information. Another main objective is to familiarize students with questions to consider when making a map (a fairly common task for an archaeologist: for including in reports, papers, presentations, exhibitions, etc.);
> Geographical Positioning Systems (GPSS): This module aims to show how GPSS work and present the possibility of processing the recorded information with appropriate software as well as GPS applications in archaeology;
> Topography and total station: Together with an explanation of the working methodology, and the features and capabilities of the technology, students undertake practice sessions with a station, taking measurements and making a map with the data obtained;
> Laser topography and 3D scanning: The aim of this module is to show existing systems for digitizing archaeological objects. The presentation covers aero-spatial detection systems, digitization with laser technologies and 3D scanning. These technologies are seldom used in ordinary excavations, so it is an opportunity for students to see actual results obtained with them in the field of archaeology;
> Digital photography and computer-aided design: Photography and planimetry are presented as key tools for recording the archaeological features. Together with working methodology, software and tools are presented, in addition to an introduction to photogrammetry;
> Ground Penetration Radar (GPR): The fundamentals of how GPR works are explained, as well as how to interpret the diagrams generated by the device. Students have an opportunity to handle a GPR, learn the limitations of its use and check actual reports on the advantages of this detection system when used within a correct methodological framework;
> Photography applied to archaeology: A practical guide to how to optimize the use of photography as a key working tool for the archaeologist. The module provides information and recommendations about the best way of carrying out field work as well as organizing and preserving the documentation. The aim is to enhance the quality of the material generated and the organization of working archives;
> Video-making applied to archaeology: Nowadays it is relatively easy to get the equipment necessary for producing quality audiovisual media that record the site, its environment, the tools used, the methodology, the people participating, their impressions, etc. The aim is to teach the skills necessary for recording and editing an 'audiovisual report' (documentary) about an excavation;
> Databases: The process of designing, implementing and using databases presents an additional difficulty in the archaeological context, due to the large volume of information generated and the lack of a specific standard application for it. This module aims to provide solutions to the problems that most commonly arise during the life-cycle of the database applications used in archaeology.

The programme is supplemented by presenting basics of conservation and preservation of the archaeological substance. These comprise:

> Conservation treatment for archaeological objects and materials: The theoretical framework of this module aims firstly, to provide general guidelines on how to preserve archaeological elements during excavation and field work; and secondly, to explain how these materials need to be treated in order to be stored in the best possible conditions for their conservation. There is one class for presenting the theoretical framework and another one held in a specialist conservation and restoration laboratory for archaeological materials;
> Restoration and consolidation of structures: This module is an introduction to restoration criteria, explaining the specific problems of different materials used for cultural heritage structures, namely stone and wood.

Technologies and approaches to dealing with each case are presented;

> Conservation of architectural elements: The contents are divided in two parts, one consisting of technical problems and solutions (foundations, movements of structures, stabilization, etc.), and the other one focussing on conservation criteria from a historical point of view: reconstructing, removing or adding elements, reversible actions, use of the building, etc. Students assess and discuss different buildings restored or reconstructed for different uses.

The fact that the Aranzadi Science Society is itself an interdisciplinary organization is the reason why it has been possible to include such a complete range of topics. The connections between different disciplines and areas of knowledge are one of its specialties. We may point out that all the experts participating in Arkeonet are linked in some way to Aranzadi.

The teaching staff includes university lecturers (e.g. in Palaeobotany, Anthropology), archaeologists (e.g. Prospecting, Computer-Aided Design), experts in different technologies who collaborate regularly on Aranzadi's projects (e.g. GPR, Video), public authority staff responsible for cultural heritage (e.g. Legislation, Conservation of archaeological elements) and finally, active members of the Aranzadi Science Society (e.g. palaeontologists, stratigraphists). To have a teaching staff with such diverse backgrounds and experience in an archaeological programme is in itself innovative. This, together with the selection of topics that make up the programme, ensures that the archaeological work is conducted from a theoretical, management and technical point of view. This triple perspective is a must for any archaeologist nowadays.

Conclusions

Over the last three years, around 40 persons have taken part in the Arkeonet programme. They have come from diverse backgrounds: students, working archaeologists, cultural managers or just people interested in archaeology with some amateur experience.

According to their feedback, the interdisciplinary approach has been implemented successfully and the relevance of new technologies applied to archaeology has also been made clear. The programme's participants have become aware of the wide range of disciplines and technologies involved in archaeological research and hence of the need to have an overview of all the existing possibilities in order to solve a problem or question within an excavation or research project.

As for the delivery of the programme by e-learning, it has become apparent that this is one of its major strengths, thanks to the flexibility and the independence to organize themselves freely students enjoy this method of delivery. The practical classes, held every Friday, were regarded as necessary and very useful, especially in the modules related to applied technologies or auxiliary sciences.

Another factor appreciated by the students was the tutors. In general, they considered that the tutors were well qualified in their respective areas of expertise. The materials provided (teaching modules, reports, links, bibliography, etc.) were also positively assessed. The tutors were regarded as willing to share their knowledge and generally available to resolve questions or provide further information.

When asked about possible improvements, students suggested including other topics and areas of knowledge such as submarine archaeology, specific methodological tools for excavating (e.g. the Harris matrix) and an introduction to project management.

In conclusion, we may say that the pilot programme has been a success and has highlighted the need for this kind of training. Over the coming years, the challenge will be to adapt the programme structure to the new educational curricula that will be issued from the Bologna Process, paying special attention to a Master's degree in archaeology. Looking now to the future, we believe that the teaching experience gained over the last few years has laid the foundation for offering other e-learning programmes, both those with a different structure and organization (shorter and more specialized programmes in particular areas of knowledge) and those with new archaeology-related content (e.g. archaeological heritage management).

Notes

1 This overview of degrees and curricula existing in the field of archaeology will doubtless change with the application of the Bologna Process to both undergraduate and postgraduate studies.

2 By 'rescue excavations' we mean the compulsory analysis and excavation of every piece of archaeological evidence that emerges during any civil engineering or building work, as provided by Spanish law.