

Transversal competences and skills in geology and prehistoric archaeology

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Abstract

This study develops a specific proposal for addressing some of the educational goals of the EHEA such as transversality, teamwork and the need to increase practical knowledge. The perspective from which the study was conducted was interdisciplinary cooperation among university professors who work in two quite different fields of science: geology and prehistoric archaeology.

A pedagogical tool was developed in which students can develop skills and abilities such as the ones mentioned above by pursuing a specific case study: the description and provenance of stone elements used to build the megalithic sepulchre in Puigseslloses (Osona). The proposal is based on students' following and participating in the entire research process: posing the historical-archaeological problem, defining the specific avenues of study, conducting the study, getting the results and holding an interdisciplinary discussion of these results.

General area of interest of this innovation

The proposal is addressed to students in Bachelor's degree programmes related to geology, the earth sciences in general, archaeology, history and the humanities. On a secondary level, given its cross-disciplinary nature, it might also interest teachers or future teachers of either primary or secondary school, in that they may adapt the proposal to use it for subjects that include the issues and knowledge from the different disciplines involved in this project.

1. Objectives

The project presents a transversal geology and archaeology course that was developed by the faculty and researchers linked to both disciplines from the Universitat Autònoma de Barcelona, plus at given points in the project from the Centre National de Recherches Scientifiques of Lyon, and from the Universidad Complutense de Madrid.

The goals of this project were:

1. To propose a transversal course that involves different areas of knowledge, poses an interdisciplinary research project, and sets the avenues of research needed to address it.
2. To experiment with a more practical and applied teaching methodology while historically and geologically discovering a specific zone.
3. To foster teamwork among the teachers and students involved.
4. To use the new technologies in the teaching of these disciplines.

2. Description of the project and methodology

At first the project consisted specifically of formulating a proposal for restructuring an undergraduate course. Implementing a course of this sort requires adaptation to the new curricula, which obviously exceeds any of our individual competences as it affects two Bachelor's degree that must both be willing to tackle this challenge. Therefore, here we only present the course itself, leaving the issue of its inclusion in the future curriculum to the corresponding bodies.

This project would not be so successful if the UAB had not given us the chance to teach an elective university subject. The proposal was submitted in February 2007, and the course was taught during the first term of academic year 2007-08.

This is a six-credit course called: *Geology and the Megalithic: From Theory to Practice*. Based on the experience of having taught it, we shall explain the results of the project.

2.1. Organisation of the project

The cornerstone around which the proposed subject revolves is a specific case study: the research process to determine the provenance of small stones used to build the megalithic sepulchre of Puigseslloses (Folgueroles, Osona).

For this reason, the project was approached in two different yet logically indissoluble parts:

1. Conducting the research
2. Drawing up a congruent course similar to the research process that provides the elements needed for students to resolve the problem posed.

2.2. The research

The research process was divided into several different parts, namely:

1. General description of the megalithic sepulchre of Puigseslloses, surveying and integrating studies that were already published.
2. Study and individual description of the slabs making up the sepulchre.
3. Geological cartography of the area in the county of Osona that includes materials that might have been from the area that was the source of the slabs.
4. Development of the general stratigraphic column of the mapped materials and detailed columns on the zones where there are outcroppings of materials similar to that of the slabs.
5. A petrologic study of the material of the slabs using the permit by the heads of the restoration of the monument which has been underway while this project was being developed.
6. A petrologic study of the materials in the outcroppings identified as possible source areas and a comparative study with those from the monument (Arribas et al., 2006).

The teamwork among the two groups of professors, archaeologists and geologists, enabled us to witness two different ways of approaching a problem and two kinds of language, as well as the complementarity and opportunity to match these two visions from different vantage points. However, this same situation also arose, writ large, among the students, as in elective courses students come from a wide variety of fields. In our case, students from three different curricular tracks registered in the course.

2.3. Organisation of the subject

The structure and development of the research served to achieve the goals sets:

2.3.1. To propose a transversal course

The course is a basic introduction to both certain historical-archaeological problems related to the use of geological resources by prehistoric communities, and especially the techniques needed to resolve these problems. The aspects that were dealt with were a transversal way of framing questions, such as the discovery of a territory and its resources (in this case, mainly geological) and how they have been used by human communities at some point in history.

In order to achieve this goal, and with the intention of avoiding theoretical discourse as much as possible, the course was organised around a specific focal point or, if you

will, around a specific historical and geo-archaeological problem that needs a specific research strategy to be developed: determining the stone materials used to build the large megalithic sepulchre of Puigseslloses (Folgueroles, Osona) and determining their source-areas of provenance.

In the case of Geology and the Megalithic: From Theory to Practice, the course was for six credits, 1.5 for were theory and 4.5 for practice.

Professors from the Bachelor's in Geology and Archaeology helped to teach this course.

The syllabus (topics and associated workshops) was designed to give students the knowledge and skills they needed to resolve the problem posed. It is shown in Table 1.

Table 1. Syllabus broken down into topics and workshops

TOPICS	WORKSHOPS
Topic 1. Introduction to geo-archaeology	
Topic 2. The use of mineral resources in prehistory and studying them	
Topic 3. The supply of raw materials to build megalithic sepulchres. Introduction to the case study: Puigseslloses (Folgueroles)	
Topic 4. Rocks	Rock recognition workshop
Topic 5. Sedimentary rocks	Workshop on recognising sedimentary rocks
Topic 6. The topographical map	Workshop on topographical maps
Topic 7. The geological map	Workshop on geological maps
Topic 8. Aerial photography	Workshop on interpreting aerial photographs
Topic 9. Forms of managing other mineral resources in prehistory: Ceramics	Ceramics workshop
Topic 10. Forms of managing other mineral resources in prehistory: The stone industry	Stone industry workshop
Topic 11. Anthropology	
Topic 12. Physical properties and the alteration of materials in monuments. Conserving stone monuments.	
Topic 13. Final discussion. Analysis of the results	

The sequence of topics has changed and can change according to the location of the field trip.

The contents that were taught went from more general to more specific and necessary for resolving the problem posed. For example, a theoretical vision of all types of rocks was supplied, stressing the ones that primitive humans mainly used in their activities (siliceous rocks, quartzite, argillaceous, etc.). After this, we moved on to a more specific explanation of sedimentary rocks, which are the ones used to make the dolmen, although the students taking the course are not yet aware of this.

The transversality of this course is clear not just from the diversity of the topics but also from the relationship between geology and archaeology.

2.3.2. To experiment with a more practical, applied methodology

The choice of a specific topic around which the course should revolve constantly led us to deal with a real problem which students need a set of theoretical but also, more importantly, practical knowledge to resolve. It is not enough to have theoretical knowledge of rocks, rather students who might come from different degree programmes also have to touch them and know how to visually recognise them. What is more, this section of the course also includes a study of a thin slice of rocks via a polarised light microscope.

The students have to acquire the abilities and skills that enable them to manipulate the information learned in the theoretical classes. For this reason, the course has a higher number of hours devoted to practical work (4.5 credits versus 1.5 credits for the theory).

Along these lines, we thought it was coherent and necessary, given the fact that both the theoretical and practical sessions revolve around a specific monument located relatively close to campus, that a visit to this monument would be conducted during the course (Figures 1 and 2) in order to discover its geological setting, learn about other possible sites of archaeological interest nearby, etc. In this way, both students and professors could see and discuss the work underway and the working hypotheses formulated *in situ*.

Figures 1 and 2. Field trip: students work at the monument and one of the outcroppings



In order to conduct the fieldwork, a dossier or field guide was drawn up that indicates the stops along the way. At the start of each stop, the goals to be achieved are set forth and then a series of explanations and questions are given to help students achieve the goals.

We should also stress the close relationship between the field and laboratory practices. In this case, the most obvious example is with the topics related to geological mapping: topographical maps, geological maps and the interpretation of aerial photographs. Before the field trip, students were taught the theoretical notions of orientation and topographical maps, and they even got glimpses of the zone of interest via aerial photographs that gave them a stereoscopic vision of it. In the field, GPS was used. Each student carried a topographical map of the zone where they had to pinpoint all the stops and where they started to draw up an incipient map of the materials found in the outcroppings at each stop. Once back in the lab, they continued to complete the geological maps with the aid of the aerial photograph.

The third type of practical task included in the proposal focused on a practical study that the students must conduct. With the help and guidance of the faculty, and at a basic level, they must submit a study on a megalithic monument that is located near them (near their family home, where they live now, etc.). To do this, they are given a sheet with the main points that they must fill in.

If the schedule permits, it is a good idea for them to present their studies to their classmates.

2.3.3. To foster teamwork

We should bear in mind that the students registered in the course come from different fields of study, which at first might seem like an obstacle. Plus, breaking the ice can be difficult at first if there are larger groups from the same field.

We got around these problems in the following ways:

1. By trying to ensure that the students who had prior knowledge on certain topics shared it with the other students who did not have this knowledge. This was captured in the practical laboratory work.
2. By trying to ensure the field trip to had a positive influence on creating closer relationships by car-sharing, lunch time, etc.
3. The proposal of a practical study in which the students chose the monument and had to describe its geological setting required them to try to group together with people from other disciplines

2.3.4. To include new technologies in this study

The course has a website : <http://geoarq.uab.cat>

The homepage contains the following:

1. Introduction:

Projects: The projects based on which the proposal for this transversal subject got underway are listed, as well as the people who participated in developing the project.

2. Course: Brief description of the course.
3. Faculty: The people who teach the course.
4. Syllabus: A list of the topics dealt with in the course.
5. Materials: In this section, students are given a user name and a password that enables them to enter this space, where the course materials are uploaded.
6. Classrooms and *Timetable: Information on where and when the course is taught.
7. Bibliography: General bibliographic citations are provided. This section also contains an exhaustive list of links with geo-archaeological references on the Web.

Likewise, the News section features information on congresses or activities being held related to the field of geochemistry.

2.4. Evaluation

We suggested ongoing assessments, where the following are taken into account:

1. Turning in the exercises assigned on time.
2. Turning in the exercises done in the laboratory.
3. Turning in a report on the field trip based on the observations and work they conducted during it.

Students who wish to raise their final grade also have the possibility of taking a final exam.

3. Results

Putting the proposed transversal course into practice during the first term of academic year 2007-08 enabled us to state that the students were capable of following and participating in the research process that led them to describe and establish the provenance of the stone elements used to build the megalithic sepulchre of Puigseslloses (Osona). The historical-archaeological problem was framed and the theoretical and primarily practical elements that were to serve as the basic tools for students to follow the research process were introduced from the very start.

The field trip served to illustrate the skills and abilities acquired by students in this course, as they were capable of:

1. Applying the contents from the different theoretical topics at each of the stops.
2. Orienting themselves.
3. Locating Puigseslloses on the topographical map.
4. Pinpointing where each of the stops was using the GPS.
5. Describing the architectural structure of the sepulchre.
6. Identifying and naming the conserved parts of the sepulchre.
7. Identifying the rocks that make up the megalithic sepulchre.
8. Remembering which archaeological materials were recovered from the sepulchre.

9. Drawing up a basic stratigraphic column.
10. Describing and identifying the different rocks observed at the different stops along the route.
11. Arguing at which part of the stratigraphic column they were at in each stop.
12. Describing the sedimentary and tectonic structures.
13. Deducing which type of loose blocks correspond to these structures and arguing what they might be used for.
14. Comparing the materials at the different stops with the ones used in the sepulchre.
15. Working in a group.

3.1. Survey

In order to objectively measure all the subjects dealt with, students were given a survey to evaluate them more precisely. The questions along with the percentages obtained are shown in Table 2.

With regard to the development of the course, students were asked to evaluate the sessions devoted to each topic as excessive, appropriate or too little. In this case, the results enable us to more finely tune the best number of sessions for each topic. The table only shows the results for the field trip.

4. Conclusions

With this proposal, a transversal course was organised between geology and prehistory. It was put into practice as an elective course.

It is a course which poses a specific problem, which students then resolve by developing and practically applying the different study and research methods that are most suitable.

The proposal therefore included a field trip, although it is true that with two field trips the course might be better rounded, despite the fact that the laboratory practices helped us to optimise the time spent on the field trip. In any event, the second proposed field trip would partly be used to get to know the Episcopal Museum of Vic, where the finds discovered during the excavations of the Puigseslloses sepulchre are on display.

The course had an extensive team of professors who did not just ensure that the explanations of the different methods and techniques used were thorough, but also enabled students to be exposed to a wide range of perspectives and proposals. Given the agreement among the professors participating in this experiment, this plurality entailed no difficulties when planning the contents of the workshops or evaluating the students.

Until now, the results have been highly satisfactory, as we believe that the students showed a high degree of involvement once they understood what they were being asked to do and what this entailed.

Table 2. The survey and its results

PROFESSORS				
The number of professors was	excessive	appropriate 88.9%	insufficient	blank 11.9%
The diversity of the professors was	excessive	appropriate 88.9%	insufficient	blank 11.9%
The coordination among the professors was	good 22.2%	appropriate 66.6%	poor	blank 11.1%
STUDENTS				
The different backgrounds of the students was an element that was	positive 88%	unimportant 12%	negative	
DEVELOPMENT OF THE COURSE				
In your opinion, including a field trip was	appropriate 100%	doesn't matter	unnecessary	
In your opinion, one day for the field trip was	excessive	appropriate 55.5%	too little 44.4%	
Your expectations of this course were	exceeded 78%	partly met 22%	not met	
During the course, your interest in the subject has	increased 87.5%	remained the same 12.5%	waned	
Do you think that the ratio of theoretical and practical was appropriate?	yes 88%	no opinion 12%	no	
GOAL OF THE COURSE				
In your opinion, the goal of the course is	interesting 100%	no opinion	not very interesting	
In your opinion, the organisation of this course into workshops was	interesting 78%	no opinion 12%	not very interesting	

It is true that continuing the endeavour with another project would help to improve and increase the digital material available to students and increase the number of possible examples, namely, megalithic sepulchres in Catalonia linked to their geological setting, in order to share them with students, since it is impossible within the normal duration of a course to visit all the sites.

In any event, with regard to the strictly educational aspects, the goal of giving students insight into the problems and working methods of such different disciplines yet ones that together can resolve specific problems was met. In this sense, we believe that the students found the course a very positive experience in terms of concepts like transversality, interdisciplinarity, teamwork and a more practical, applied methodology. The results gleaned from these surveys show widespread acceptance and satisfaction on the part of the students who took this course.

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Interesting link

- Innovation website: <http://geoarq.uab.cat> [2008]

Keywords

Prehistoric archaeology, geology, transversality, cultural heritage, dolmen.

Financing

This project was financed by the AGAUR programme on Improving the Quality of Teaching at Catalan Universities (MQD) for 2005 (ID number 2005 MQD 00189).

Supplementary materials on the CD-ROM

Demonstration of the GEOLOGY AND MEGALITHISM website: virtual tour of sections of the website and examples of the materials used for this course.

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Presentation of the project leader and the working group

Maria Rita Estrada Aliberas, project leader, is a member along with several other members of the team in the Research Group on Teaching and Disseminating Geology (GREDEGE). She has also participated along with members of this team in other teaching innovation projects financed by the Generalitat de Catalunya revolving around optimising field practices using multimedia.

Internationally, she is participating along with Aureli Álvarez and Xavier Clop in the «TRAINMONHER» project financed by the EC – INCO Programme –(SSA – Multilateral) - VI FP 518697_SSA_20051215154333.CPF

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