Chapter 12

Field activities within an Environmental Sciences Program: a B-Learning Case Study

Carla Padrel Oliveira, Ana Paula Martinho, Sandra Caeiro, Filomena Amador, Fernando Caetano

Abstract

A reflection on the use of fieldwork in environmental science programmes is conducted in this paper. It is generally agreed that for fieldwork to be effective, it must serve a clear purpose in the curriculum. For a good curriculum design, a fieldwork course must complement, enhance or extend an existing part of the curriculum or fulfil some major objective of the curriculum as a whole. Thus a successful integration of fieldwork within an undergraduate degree programme is particularly important. For an environmental science course delivered through online methodology, it becomes evident that special attention should be devoted to the design and implementation of such a course. If we consider the more general definition where the field is seen as the location, outside the classroom setting, where learning takes place, then fieldwork is the set of activities that will facilitate students' learning. It is generally agreed that a field course is much more difficult to integrate than a set of activities closely related to a specific subject. However, in a distance-learning university it is not plausible that students perform this type of activity very often. Therefore, the field courses are designed as a stand-alone module. The current work analyzes the design of the course entitled Fieldwork II which is integrated in the undergraduate degree in Environmental Sciences at Universidade Aberta. Many issues have to be taken into account when designing such a course that encompasses legislative, pedagogical and logistical matters. An overview of the research work that has been developed on the pedagogical value of fieldwork is given. Taking into account the specific learning methodology adopted at Universidade Aberta, we also present a fieldwork model for environmental sciences in a context of a blended learning (b-learning) undergraduate programme. The organizational effectiveness of the model and students' participation was assessed in two scholar years of a fieldwork course at Universidade Aberta. Also, the project assignment synopses were assessed in the context of education for sustainability. Finally, it should be stressed that fieldwork should be regarded as a form of learning which exploits the unique characteristics of the field environment to improve the student learning experience.

Introduction

The crucial role of higher education in providing opportunities for social learning and, in particular, introducing the concepts of sustainable development has been reported by UNESCO at the Johannesburg World Summit for Sustainable Development. An improved environment and quality of life can only be achieved through active and knowledgeable citizens as well as informed decision-makers making the right choices within interrelated economic, social and environmental issues the world faces today (UNESCO 2002). The UNESCO report identified the need for an education that questions current models and called for "deeper, more ambitious ways of thinking about education, one that retains a commitment to critical analysis while fostering creativity and innovation". This interpretation of education has been promoted by environmental educators: Saul (2000) who requires culturally critical perspectives and Huckle (1996) who argues that only through asking socially critical questions can we progress towards a sustainable future.

Environmental studies appeared as an academic topic in the late 1960s when these challenges became a concern of society in general and coincided with scientific disciplines raising awareness of ecological imbalance. As a result, higher education institutions responded with two different approaches: an "environmentalization" of the disciplines and an "interdisciplinarization" of the environment (Bursztyn 2008). The first approach, which is an adaptation of the common disciplinary approach, introduces new subjects and new content in the existing courses. The second approach requires a new interdisciplinary programme between existing groups of disciplines.

Interdisciplinarity now plays a major role in the debate concerning the future of higher education and, consequently, the future of universities. To face these challenges, European countries devised a reform plan, known as Bologna Process, which aims to create a higher education area on a continental scale, while maintaining national and regional differences. A central issue for the Bologna Process was to simplify and also unify the higher education systems with three central pillars of mobility, employability and interdisciplinarity.

Environmental sciences are the study of the relationship between man and the natural world, and it provides an integrated, quantitative, and interdisciplinary approach to the study of environmental matters. This is more than a new science because it requires dealing with problems that cannot be effectively treated in isolation as it might have been with the mature disciplines often referred to as natural and social sciences. Indeed, environmental sciences must be a general approach, uniting concepts and skills.

Since 2007, the Universidade Aberta (UAb) has offered a 1st cycle degree in Environmental Sciences, according to Bologna Process principles. UAb is a

distance-learning university where the pedagogical model is based on e-learning and relies on the use of online communication tools; the model promotes interaction between students and teachers and is deeply focused on students as individuals who actively build their own knowledge. The goal of our course is as follows: (1) provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world; (2) identify and analyze environmental problems both natural and human-made; (3) evaluate the relative risks associated with each problem; and (4) examine alternative solutions for resolving or preventing them.

The 1st cycle degree in environmental science (ES) includes a face-to-face field component, which requires the students to be present at a certain location for a specified time. This can be seen as a form of blended learning: e-learning complemented with instructor-led training and other live formats (Bersin 2004). This particular degree follows a blended learning methodology (b-learning) where the fieldwork permits use of the academic disciplines with real-world problems, encouraging the acquisition of generic and subject-specific skills, which will be valuable for future employment.

In this particular case, blended learning is driven by the following factors: (1) that field work is considered to be an essential component of environmental science; (2) proper training in environmental studies is driven by coupling "book-learning" to field work; and (3) that a "local perspective" is a useful teaching approach, enabling students to observe how concepts are relevant to their local environment (Bersin 2004).

Recently there has been a significant reduction in fieldwork conducted as part of a traditional science course. It seems that this pattern has several possible causes, including an over- prescriptive science curriculum, financial constraints, changing of professional values and bureaucratic complexities. However, for field sciences such as environmental, the laboratory is the "field"; anywhere else the experience becomes second-hand, out of context and relatively meaningless (Fisher 2001).

Fieldwork courses within an environmental science programme are important because they engage students and provide a first-hand connection with society and sustainability. This concept is supported by Besenyei et al. (2004) who states that there are a variety of matters that students can learn from their fieldwork experience. These can vary from practical aptitudes to the development of identification skills. Fieldwork provides a wider experience of the environment as a whole and the opportunity to relate theory with practice. According to Besenyei et al. (2004), it is not possible to replace fieldwork with any other learning methodology and it is impossible to gain a degree or qualification in environmental sciences without fieldwork. Fuller (2006) also supports that fieldwork helps to improve the understanding of a specific subject and consequently enhances

learning skills. The work undertaken by Lima et al. (2010) also showed that it is possible to create field trips in an informal setting encouraging group discussion and team work that provides informed citizens.

In this paper, we reflect on the use of fieldwork in the UAb's environmental science programme, delivered through distance-learning methodology, which will be described. We also present our analysis of the results obtained from the Fieldwork II course for the scholar years of 2008/09 and 2009/10, as well as the registered interaction of the students in the appropriate forum. A final topic will be devoted to the discussion of the work developed towards the promotion of skills and competences for sustainable development within the course.

A Fieldwork Model for an Environmental Sciences Degree

Environmental sciences is a domain with poorly defined borders that combines many scientific disciplines. This in itself requires integration of teachers from both social and natural sciences in the same teaching project. Our experience has shown there are numerous obstacles to be overcome to achieve an interdisciplinary collaboration in a fieldwork course, and these are summarized in this section. We also present a reflective analysis, which will also be described, that has formed the basis for the development of an intervention model.

Field trips can provide teachers with different educational and epistemological functions such as the following: illustrative, inductive, motivating, training (skills training) and investigative (Compiani and Carneiro 1993). The illustrative function reinforces concepts already mentioned while the investigative function sequentially guides the process of observation and interpretation, thus students can solve a problem posed by a teacher. Motivating tours are intended to raise students' interests to specific questions that can be the subject of future study. Skills training is concerned with acquisition of practical skills, for example, operation of a compass. The investigative function promotes student autonomy, establishing a hypothesis, structure observations and interpretation, deciding on the most appropriate strategies to validate them and report their findings. These activities are complementary to the online component and this particular approach is more often utilized for an adult audience. In those cases there is a greater need to integrate different disciplines, and therefore the investigative component increases throughout the degree.

The integration of knowledge within environmental sciences is "generally situated in a dualistic intellectual paradigm in which 'nature' is perceived as being separate from human 'culture'" (Strang 2009). The term "environment" is associated with ecology rather than with socio-cultural and economical contexts.

This is of course the fundamental misconception regarding sustainable development. We need to reconceptualize human relationship with nature, accepting an influence in both directions and, at the same time, understanding that any distinction or classification are purely heuristic.

Before suggesting some guidelines for interdisciplinary collaboration between teachers it is necessary to identify the matters that hinder this work, and these are as follows:

- The term fieldwork assumes different meanings depending on the discipline. It is important to introduce an epistemological component to ensure the terms used have the same meaning for each teacher irrespective of the discipline;
- Development of the curriculum requires determining the subjects to be included, their association with the acquisition of skills, the appropriate sequence, required learning resources, and the assessment and evaluation methods to ensure the course objectives are achieved;
- Higher education occupies a central position in the way in which future generations learn to cope with the complexities of globalization. At this time universities need to teach the skills required to be successful in the labour market. Universities must also cultivate in students, faculty and staff a positive attitude towards cultural diversity regarding understanding of how people contribute to a better life in a safer world. It follows that significant and close collaboration is expected between academic staff. To do so requires conditions that promote and facilitate the internal communication so that at least a basic understanding of the principles and methods of 'Sustainability Science' are achieved. This position means all disciplinary identities are retained while the expertise of each is assimilated into one;
- Not less important are the issues related to the distinct "profile" of each of the teachers which requires coordination in assigning different tasks to different teachers.

So far we have identified matters that may deter interdisciplinary collaboration. However, the importance of interconnecting the goals, competences and skills developed by students in a fieldwork course must also be emphasized. The pedagogical value of fieldwork is recognized by several scientific disciplines where it is already part of core *curriculum* for it provides students with concrete phenomena and materials and positive cognitive, psychomotor, and interpersonal skills (Orion 1993). These matters are particularly relevant to the teaching of environmental sciences where a main goal is the development of holistic models; these include the interrelationships between environmental factors and processes, analyzing different case studies and developing a project based on problem-solving methods. Students are given autonomy to establish a hypothesis, structure the observations

and interpretations, decide on the appropriate strategies to validate and discuss their findings.

On a theoretical level Giere (1988; 1992) proposes a model to explain the evolution of scientific knowledge that is of particular relevance to activities within fieldwork, and these are as follows: 1 – Identify the aspects that will be studied, 2 – Identify the model to represent the world; 3 – Identify the information obtained by observation, 4 – Identify the model predictions, and indicate what information can be obtained if the model explains reality; 5 – Determine if the observations are consistent with the predictions and 6 – Determine whether other models provide similar predictions. If we apply this approach in a pedagogical context, then we ensure students identify pertinent problems, examine assumptions, evaluate how to obtain data, verify the results and compare them with those determined from a model and apply the model to new problems.

We share Giere's perspective and extended it to include fieldwork approach advocated by Orion (1993). Orion (1993) highlights the following matters: i) the role played by fieldwork in the learning process; ii) the existence of different types of fieldwork and iii) the importance to an organization. This model follows a constructivist approach and conveys the need to establish a relationship between new information and the cognitive structure of students. The main determinants of meaningful learning are the students' predisposition to learn and the existence of material and strategies that establishes "bridges" within students' cognitive structures. Fieldwork then needs to combine concrete learning experiences with higher levels of the cognitive process. Orion (1993) states "the main role of the field trip in the learning process is the direct experience with concrete phenomena and materials and is the direct sensoriomotor experience that can facilitate the construction of abstract concepts, enhancing meaningful learning".

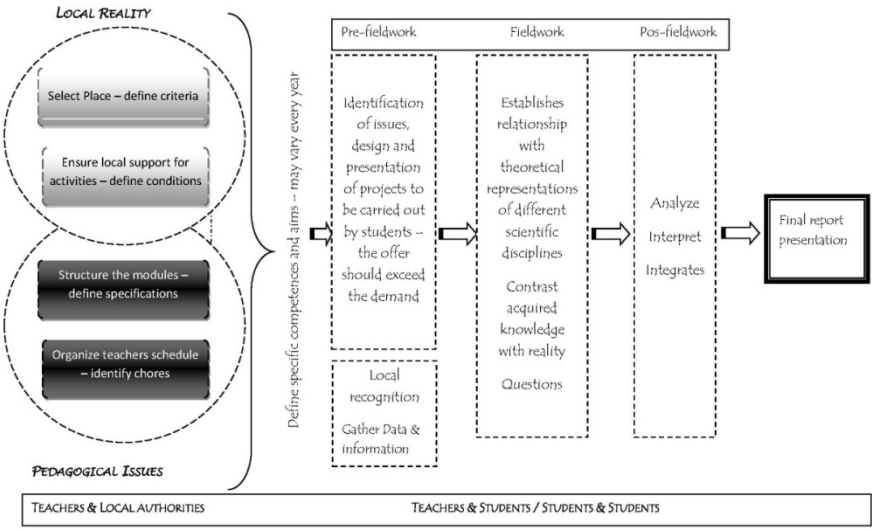
B-Learning Field Course Design

For the design of the fieldwork curricular units and activities, we have adopted the methodology proposed by Orion (2003). This approach includes a preparation unit that seeks to minimize the impact of adopting a different learning environment. In this case, students receive information in advance to permit integration of knowledge and understanding obtained from different cases. These materials can include maps, photographs and a booklet with the objectives, teaching method, identification of the different stops and its purpose; we will assume the student reads and absorbs the material provided in advance. These procedures reduce the element of surprise that may give rise to disruption of the student's observation and reasoning. The field trip is the central part of the course and is

guided from modules in an illustrative manner. During the course, students are encouraged to discuss their observations with peers. According to Orion (ibid.), the final module of the course is the most complex for both students and teachers alike because they are required to integrate knowledge acquired in the field with hierarchical networks of information and to develop abstract concepts with a view to eventually providing a meaningful learning experience.

The model of fieldwork adopted within the ES degree is shown in Figure 1. Three phases were considered: previous to the opening of the course, a second stage corresponding to the teaching period by the teacher's team and the last phase focused on the evaluation processes.

Fig.1: Fieldwork course design model



The starting point for the development of such curricular unit in each scholar year results from the junction between the local reality (socio-economic, cultural and environmental) of the selected place where the field trip will take place and the pedagogical issues that derive from the proposed model, as shown in Figure 1. One of the most critical aspects in this whole process is the selection of the region to conduct the face-to-face activities. From our past experience a set of criteria must be met and taken into account when choosing a region. These issues are as follows: i) ability to involve the local institutions and the local community; ii) good support concerning logistics, namely housing and transport; iii) existence of a diversity of attractive places with relevance to the context of an envi-

ronmental sciences degree. It should be stressed that the involvement of the local community is a crucial point if we want to promote deep experiential learning as well as social learning. Furthermore, from the viewpoint of transport, it should be an accessible place and transportation should be provided during the activities. Accommodation, too, should be found in a way that the whole group can be housed in a single place, increasing the levels of interaction between students and between students and teachers. In addition, access to meeting spaces should be taken into account. Finally, costs also play an important role.

Simultaneously, it becomes necessary to organize the three modules that actually form the course. This requires the distribution of the different tasks among the teachers involved which entails a broader set of functions and competences such as: i) facilitators' skills in order to conduct online discussions and keep them within the defined themes and issues; ii) knowledge of the local reality and the important topics to be able to pose the appropriate questions that promote the involvement of students; iii) recognize the need for facilitating communication between the different players and identify the appropriate way to overcome those difficulties; iv) be aware of individual needs or behaviour to avoid creating any troubles within the group.

A further matter that has been privileged is the definition of the research themes for the final project. All participating teachers should be involved in the identification of research questions, and special attention should be given to those issues that are directly related to local needs or to the local community. Several of these examples will be given in this paper. Whenever possible, the projects should be developed in close liaison with the community who could also be involved in the final assessment.

Finally, it is also our purpose to contribute to the local development of those communities promoting the concept of sustainability in its different components, namely environmental and social.

Environmental Sciences Programme: the Pedagogical Model

The UAb has reorientated its educational and training activities from an "industrial" distance education model constructed around a learning package that favours the interaction between the student and the materials, to a model focused on the development of competences utilizing information technology. This transition was made possible by technological development and conforms to the European Higher Education Space, in which students are expected to take greater responsibility for their own learning and also requires teachers to emphasize the acquisition and development of core competences.

Interaction is seen as central to an educational experience, and the focus on interaction in online learning emerges from the potential of technology to support sustained educational communication. Internet technologies provide a communication through asynchronous interaction (Garrison and Anderson 2003). The purpose of an educational experience, whether it is online, face-to-face, or a mixture of both, is to structure the educational experience to achieve the desired learning outcome. In this context, interaction must be structured and systematic. Some have argued that it is valuable and even necessary in higher education to create a community of inquiry where interaction and reflection are sustained. Interaction in such an environment goes beyond social interaction and the simple exchange of information and must include various combinations of interaction among content, teachers, and students (Moore 1989; Garrison and Cleveland-Innes 2005).

At UAb, pedagogical strategies have been developed that engage students as active participants. The model includes principles permitting teaching and learning activities for each curricular unit to be performed at a distance, in a virtual learning environment, using an e-learning platform. An introductory module, held totally online, is intended to familiarize the students with the virtual environment and the e-learning tools as well as promoting the acquisition of online communication and online social skills.

The undergraduate courses follow a pedagogical model (Pereira et al. 2007) specifically designed for online learning at UAb. This learner-centered model, where students are responsible for knowledge building, is based on the flexibility of access without temporal or spatial constraints. It also relies on diversified student-teacher and student-student interaction as well as students and learning resources in a social context. The implementation of these principles requires three vital elements in the learning process:

i) the student attends a *virtual class* where the learning activities for each curricular unit take place. In this space, accessed both by students and teachers, the interaction occurs through two types of forums: those that are moderated by students and those moderated by teachers. The former are workspaces for the class in which students interact about the subjects they are studying while the latter are intended to permit students to ask questions and assist overcoming difficulties that have not otherwise been solved through the discussion between themselves;
ii) The *curricular unit plan* (PUC) is a document presented by the teacher at the beginning of the curricular unit intended to guide the students' learning process. The guide contains information on the objectives of the curricular unit, its subjects and contents to study, the competences to be developed,

the organization of the learning process, the learning resources, what is expected of a student, what a student can expect from the teacher (or tutor), and the assessment criteria;

iii) The *learning card* is a personal device that allows students to visualize at any time the marks obtained in the continuous assessment activities (e-folios) during the semester. These e-folios are complemented by a p-folio which is performed in a face-to-face location. The final grade of the curricular unit will be the sum of the marks obtained in both the e-folios and in the p-folio.

The model previously described (fig. 1) has been used for the design of the current course and the three modules proposed are as follows: the first part is preparatory and an online asynchronous module where students are exposed to materials and information necessary for the field trip; the second module is the field trip, which provides the necessary stimuli for higher levels of cognitive learning; the third and final module is devoted to the elaboration of the project that will congregate the theoretical knowledge obtained from other curricular units.

Environmental Sciences (ES) Programme: an Interdisciplinary Approach

The UAb has developed an undergraduate *b*-learning programme in Environmental Sciences directed at an adult audience (over 21 years) who are typically working individuals seeking professional development. The purpose of the course is to promote and develop a set of professional skills and competences within environmental sciences. The first two years are composed of mandatory curricular units of Science and Environmental Technology (40 ECTS), Biological Sciences (22 ECTS), Earth Science (22 ECTS), Mathematics (12 ECTS), Chemistry (12 ECTS), Physics (6 ECTS) and Legal Sciences (6 ECTS), for a total of 20 compulsory curricular units. This structure provides the student with a broad based curricula. In the final year the student can then study one of three minors that are as follows: Natural Heritage, Environmental Health, and Environmental Management and Sustainability. Each of these courses comprises a 60 European Credit Transfer System (ECTS)[1].

1 More information about the study plan of the ES programme and its course description is available at *http://www.univ-ab.pt/guiainformativo/eng_planoestudos1.php?curso =10&ma =3.*

The whole programme has been designed and developed to promote integration of scientific disciplines with economics, earth sciences, biology and technology. This leads to the concept of sustainability science, which is an integrative science, a science that sets out to break down the barriers that divide the traditional sciences (Martens 2006). The fundamental principle of sustainable development is to manage both personal and social responsibility between generations and global issues (Juárez-Nájera et al. 2006). In the last 20 years it has become evident that science and technology education need to supply the knowledge and tools to permit transition to a sustainable environment. A pragmatic definition of 'Sustainability Science' was provided by Carter (2007) who stated that "sustainable science is a field defined by the problems it addresses rather than by the disciplines it employs".

Bursztyn (2008) has also considered the educational issues of sustainability and concluded universities should introduce environmental issues and relate these to the need for sustainable development within the framework of traditional courses. Bursztyn also advocated an interdisciplinary approach that is complementary rather than competing with discipline- orientated education. Academic communities and university departments are hierarchical discipline-orientated organizations. Juárez-Nájera et al. (2006) argue the education of sustainability requires a new academic and professional culture that revolves around the concept of sustainability rather than the particular knowledge obtained studying a subject. Solely on this basis can sustainability claim the status of a traditional science: hence the term sustainable science.

The Bologna Process has changed European universities. However, these changes have not addressed the educational requirements of society operating within the concept of sustainable education. In this regime, educators need to be conscious of the qualities required of future scientists devoted to sustainability: they have analytical insight, problem-solving competences, and the skills to present their findings both orally and in written form (Martens 2006). Today's students will be the citizens of tomorrow in all fields of life and work.

A preliminary study was conducted in the first year of the ES programme to examine the *curriculum* and evaluate how both teachers and students use the role of sustainability science (Amador et al. 2008). This study shows additional information on sustainability science and the education of sustainable development is required within the study plan of the programme. This recommendation resulted in continuous improvement to provide better sustainability education.

Fieldwork II

In Fieldwork II students are exposed to a variety of local economic activities related to agriculture, industry, production or tourism within a particular region of Portugal. This selection is based on the following requirements: the existence of activities, relationship with local and global environmental matters and the availability of local support for the organization. The final goal is the preparation of a report whose assessment will be based on written documentation produced as well as an oral presentation followed by a discussion with an examination panel. By the end of this curricular unit, students will be expected to be able to do the following:

1. Demonstrate a broad and interdisciplinary understanding of the problem posed;
2. Acquire data and organize information clearly and coherently, using specialized vocabulary as appropriate;
3. Write structured and reasoned arguments and develop teamwork skills;
4. Reflect on their own learning and elicit constructive feedback;
5. Develop oral and written communication skills using online and text-based resources;
6. Manage time effectively and prioritize learning tasks to achieve pre-determined outcomes;
7. Undertake independent study and work to deadlines.

The assessment rules and criteria, with which students are acquainted from the start of the course, are shown in Table 1.

Table 1: Assessment criteria of Fieldwork II course

	Activity	Criteria	Marks
Pre fieldwork	on-line asynchronous	Establish frequent interactions with teachers and other colleagues in the corresponding forum, raising relevant questions, helping to prepare face-to-face activities	2/20
Fieldwork	Residential week	• Follow the activities also showing interest, curiosity, placing relevant questions; • Comply with the pre-established timetable. • Interact with colleagues, teachers and other intervenient, revealing teamwork abilities.	4/20

	Activity	Criteria	Marks
Post fieldwork	Written project on-line asynchronous	• Demonstrates the relevance and interest of project. • Scientific rigor, appropriate vocabulary and adequate organization. • Creativity of the approaches taken	10/20
	Oral Presentation face to face	• Communication skills • Clear seminar, developing a coherent argument.	4/20

This course is organized in 3 distinct modules with specific aims and sequentially presented during the semester, as follows:

a) Pre-Fieldwork

An online asynchronous module that provides the necessary information, both from the logistics and scientific viewpoint, required for the activities intended for the residential week. The complete schedule for the residential period is given, and students are encouraged to provide additional information on the subjects as well as on the places to be visited. Following the work of Besenyei et al. (2004), it is also our understanding that the incorporation of an initial preparation period dedicated to the background information enforces what is going to be learned during the field trip.

As shown in Table 1, the interaction and relevant information provided to prepare the face-to-face activities is one of the assessment criteria. Table 2 shows the schedule for the residential week that took place in the last two academic years of 2009 and 2010 in two different regions. In the second year it was thought more efficient to have theme days with subsequent activities and visits.

Table 2: Schedule activities for the residential 5 days

	Day 1	Day 2	Day 3	Day 4	Day 5
2008/2009	*Seminar* Towards sustainability: environment, health and education	Organic farming; rural tourism	Integrated solid waste management systems	Water treatment plants; Electricity production	Food industry equipments; Waste water treatment plants
2009/2010	*Seminar* Sustainability: environment and health	*Cork* From the cork oak to cork	*Water* – Bottled water company; – Water treatment plant; – Waste management system	*Sustainable agriculture* Organic farming; Livestock and pasture	*Nutrition* Small food industry: mushrooms; Wine production

It should be noted that the first day of the residential week is devoted to a seminar with both academic presentations on the different subjects as well as reports of local entrepreneurs from different sectors. Since this is an open-day event an active participation of representatives from local industries as well as local intervenients is also expected.

Another very important purpose of this preparatory module is the choice of the themes proposed for the final project or report. The aim of the project is to promote and integrate knowledge acquired on the other courses to solve or to develop a practical approach to a specific problem. A list of different projects is published and it is expected that students interact with each other and with the teachers providing information and questioning the themes and the proposed projects.

Table 3 shows some of the projects taken in the past two years, grouped by main topic, which is within the 3 areas of the corresponding minor: Natural Heritage, Environmental Health and Environmental Management and Sustainability.

Although the projects are individual, some of the themes can be chosen by more than one student, provided they are adjusted to different realities. The final choice of the projects by the student takes place in the week before the residential period.

Table 3: List of Projects available to students in the last two scholar years

Environmental Health	**Natural Heritage**	**Environmental Management and Sustainability**
Environmental impact of meat consumption	Educating young people for the conservation of geodiversity	Waste management
Organic agriculture as a strategy for the control and reduction of health risks	Identification of threats to geodiversity	Turning waste into raw material
Traditional products with protected names: its influence in reducing the perception of food risk	Promotion of biodiversity	Waste water treatment
Food safety at home	Science, Society and Environment – formal education projects for young population	Biodiesel production
Challenges of nutritional information and health promotion	Municipal Markets: its importance in the revitalization of villages	Integration of local land-use management tool: potentials and conflicts
Household food waste and environmental impact	Video Production within Science, Society and Environment relationship	Environmental impact assessment in your area
		Carbon Economy – contribution of cork oak forests
		Alternative energy – solar energy
		Sustainability of an organization
		Life cycle analysis of cork products: potential for eco-label

b) Fieldwork

This module concerns the residential period which refers to the 5 consecutive days that students are together. It is expected that the students are actively involved in all the activities and discussions, bearing in mind that all the information was given and also time should have been spared in the preparation of the visits. A space for discussion is also provided in the virtual learning environment but not much asynchronous interaction is expected to happen there.

As shown in Table 2, the schedule is rather intense, especially if we consider that bus trips have to be taken quite often in order to get from one place to another. The whole period is organized to enable the following skills: observation, interpretation, investigation and critical analysis. Therefore informal face-to-face discussion spaces are also organized so that students can interact with the teachers as well as with their peers.

c) Post-Fieldwork

This final module occurs online with tutorial orientation focusing on the documentation of the final project. The interaction is mainly between the teacher and the student, developed in a more individual way, since it is mainly concerned with project documentation. The teacher will provide material for a specific project with the expectation that the student will perform a critical literature survey on the theme and organize the final written report. Within this block there is a general interaction *forum* where students can share resources. The main purpose of the individual space is twofold: provide the student with a *private tutorial* where he can exchange views on the project with the teacher and also to provide the teacher with an easy and simple way to follow the progress of the work obligatory for final assessment.

Assessment of Students' Participation and Learning Outcomes

Where appropriate, participation was divided into categories defined by types of discussion. For the scholar year of 2008/09 and 2009/10, the analyses were performed separately to permit a comparison. In the scholar year of 2009/10 only blocks 1 and 2 were analyzed owing to the absence of data; at the time this work was conducted the projects were incomplete and the interactions under development.

As previously mentioned, the ES programme started in 2007/08 and therefore the course Fieldwork II had its first edition in the scholar year of 2008/09. From

a total of 111 students in 2007, 21 enrolled into the second year. According to the UAb regulations, only students that complete 60% of the first year curricular units can proceed to the second year of the undergraduate degree. From the total of students, who went through to the second year, 12 enrolled in this course. For the 2009/2010 academic year, the number of students who took the course doubled to 24 students from a total number of 72 students who registered for the second year. Fieldwork II had enrolment of about 30% of the total number of students. This low subscription rate can be ascribed to the requirement to spend 5 consecutive days at a location and the additional cost associated with accommodation and transport.

In the scholar year of 2008/09, in the preparation forum (that is the pre-fieldwork module), the student questions concerning the field trip were about 20% of the total forum participation. The other contributions were related to information about visiting places (25% of the total forum participation) and organizational questions concerning the fieldwork week which contributed to about 50% of the forum participation. In this forum the course coordinator published four posts that were related to the organization of the field work.

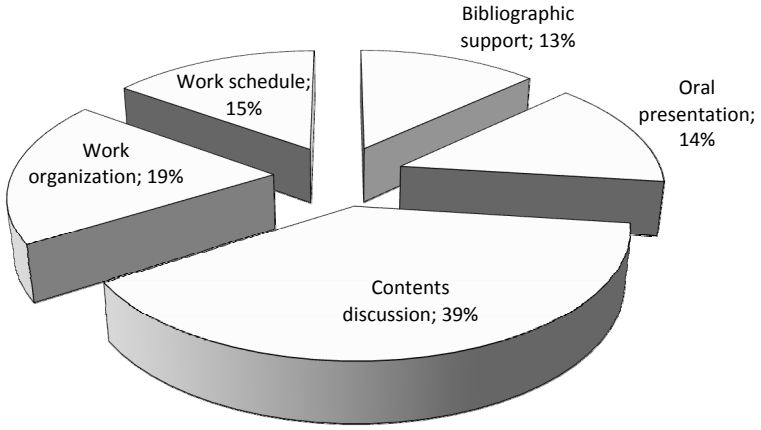
In the scholar year of 2009/10, in the same preparation forum, the number of interactions was higher. About 12% of total participants were concerned with locations and field trip information. The other contributions concerned information about the places to be visited (40% of total forum participation); only 3% of the questions posed were regarding fieldwork organization. The pre-fieldwork module contained a project choice step in the second year the course was run and, as expected, this generated a significant number of student-to-student interaction (76 entries representing 46% of total forum participation). This option was not available during the first year of the course. There was also a considerable increase in the posts published by teachers, and these were mainly related to the list of proposed themes and project selection (about 71% of total entries by teachers).

In scholar years 2008 and 2009 the registered contributions in the forum available within the fieldwork module were, as expected, very few and not worth considering. This is not surprising, bearing in mind that the students are all in a face-to-face environment with the teachers during this time, and little attention is therefore paid to the asynchronous communication environment.

Although definitive data is not yet available for the current scholar year of 2009/2010 similar results are expected to those obtained for 2008/09. So far, the forum with the most contributions is the project elaboration theme (post-fieldwork module), with a total of 300 participations. These *fora* were individually organized for each of the projects where only the student, the corresponding supervisor teacher(s) and the coordinator of the course had access. A pattern

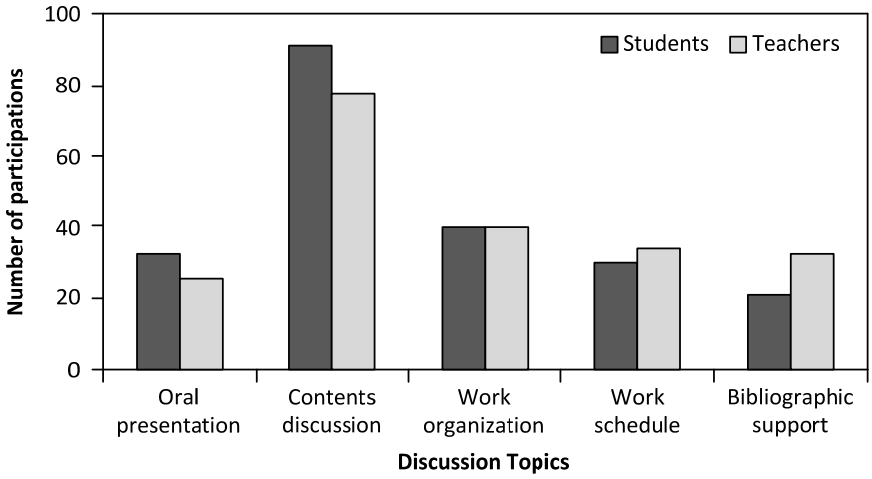
has been identified and is illustrated in Figure 2. In general, the forum discussions concern bibliographic support rather than work schedules and organization and content of the written report. Matters concerning the oral presentation and power point presentations have increased. Nevertheless, 39% of the participation in the forum concerned the scientific content of the written report and 19% addressed organization or the work.

Fig. 2: Discussion topics in the project elaboration forum in the scholar year of 2008/09



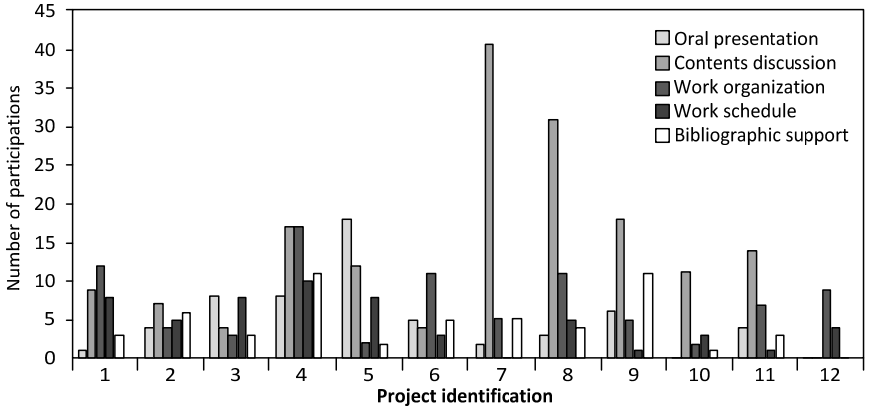
The contributions are, as shown in Figure 3, divided equally between teacher and students, showing that there is an effective interaction and supervision by the teachers.

Fig. 3: Students and teachers participations by topics discussed in the project elaboration forum in the scholar year of 2008/09



A further analysis of the different *fora* showed the following: the projects concerning specific and concrete situations were responsible for the highest participation. Figure 4 shows the different types of interactions that took place in each project. Project 7, devoted to the development of a waste water treatment system for a particular village, and 8, concerning a biodiesel production system, registered the highest number of participants mostly in relation to content. From the discussions in this forum and the posts published by students we conclude some students contacted the teacher through synchronous *Skype*™ meetings that were not considered in this analysis.

Fig. 4: Division by issues discussed in the forum of each one of the projects for the scholar year of 2008/2009



1. Environmental impact of meat consumption; 2. Organic agriculture: a strategy for control and reduction of health risks; 3. Integrated waste management; 4. Recycling: transforming waste into raw material; 5. Municipal markets: its significance in the revitalization of villages; 6. Traditional products with protected names: its influence in reducing the perception of food risk; 7. Waste water treatment in a production unit; 8. Biodiesel production; 9. Educating young people for the conservation of Geo-diversity; 10. Integration of local land-use management tool: potentials and conflicts; 11. Identification of threats to Geo-diversity; 12. Biodiversity promotion

In the post-fieldwork module a general *forum* can also be found where little participation related with organization of the projects supervising or assessment of the projects were also registered.

The final presentation of the project is done orally, in a synchronous face-to-face environment, which in some cases involves the use of video conference. The majority of the students showed contentment with the organization of the whole curricular unit as well as with the project supervision, through discussions conducted with peers in the informal virtual spaces (the *café* space). The majority of the testimonies reinforced the importance of contact with local communities with real problems where the application of the theoretical content learned previously is evident. According to Curtis and Mahon (2010), fieldwork activities and projects enhance student learning and provide a valuable real application of their classroom coursework. Students support this view because they found the project useful in building skills for future employment, which will also be valuable to their personal lives and growth as individuals. These results are in accordance with the work carried out by Besenyei et al. (2004) where face-to-face fieldwork effectiveness was tested within environmental science. Besenyei et al. (2004)

concluded that fieldwork provides a valuable learning experience. Accordingly, some of these experiences could be measured by learning outcomes but a large number are beyond measure and can be classified as life experiences. Students considered they had developed key learning skills through fieldwork and that their curiosity regarding environmental matters had increased significantly. It seems that the benefit is far more important than the cost of running these courses. Manzanal et al. (1999) conducted a study to evaluate the relationship between ecology fieldwork and students' attitudes towards environmental protection. Manzanal et al. (1999) concluded fieldwork clarifies concepts and intervenes directly in the development of more favourable attitudes toward the defense of the ecosystem. Both components are seen when judgements for the resolution of problems, which otherwise negatively affect the ecosystem, as well as actions and solutions are determined which should be adopted.

Undergraduates often find little connection between academic studies and their future career. Fieldwork courses and projects can be an important stage for students to get acquainted with the real world. This is particularly important in applied and interdisciplinary educational programmes such as environmental sciences. This is further emphasized when the course is taught for working students through a distance-learning process.

Evaluation is a key element of design for all teaching activities and is particularly important for fieldwork given the relatively high cost of provision. Therefore continuous work needs to be carried out in order to confirm the educational value of the fieldwork course and to evaluate to what extent this activity is achieving the desired learning outcomes. We will also continue to assess the effect that fieldwork is having on students' confidence and more simply whether they enjoyed it.

Assessment of the Project Assignment of the Curricular Unit Fieldwork II within Sustainability Education

To analyze the project assignments and their relevance within sustainability education, we adopted the methodology reported by Bardin, 1977: "A set of communication analysis techniques aiming at obtaining, by means of systematic and objective procedures for description of message content, indicators (quantitative or not) which will allow the inference of knowledge related to the conditions of production/reproduction of such messages." This analysis has three parts: description where the characteristics of the text are identified; interpretation that corresponds to the meaning granted to these characteristics; and inference which

represents that explicit transfer from description to interpretation. These inferences seek to clarify the basis of the message or the consequences that the message might cause.

These principles were combined with the categories listed in Table 4, for the 30 project proposals listed in Table 3, to analyze Fieldwork II. Each proposal consists of a title, a synopsis as well as a list of the main objectives of the work to be developed, and this was presented at the commencement of the unit.

In the present study the categories are not exclusive in view of the fact that they can be concerned with different features of the concept of sustainability. Therefore the same text can be included in more than one category. In an attempt to diminish the inevitable subjectivity, the project classification was performed based on phases (registration units) of the proposals. Furthermore, the categorization was carried out by two of the authors and the average was also taken in order to avoid bias.

Table 4: Number of proposals by categories within education for sustainability

	Category/Indicators	**Nº of proposals (average)**
Competence objectives	Application of knowledge	8
	Acquisition of specific competences for sustainable development	13
Level of coverage	Respond to societal needs and demands at a regional and local level	13

Table 4 shows for each of the categories defined previously that it is possible to identify trends which, in some cases, might be related to the characteristics of the curricular unit. Since there are several projects related to local problems, the student report seeks to develop strategies for change to respond to societal needs.

Furthermore, it should be stressed that it is inevitable that the teachers involved in such a course not only have a very different background as well as a different understanding and interpretation of the sustainability concept: some with a weak concept of sustainability and others more linked with the values of nature conservation, closer to a concept of strong sustainability. However, Fieldwork II is the “time and the place” where students can apply their theoretical knowledge previously acquired as well as broaden horizons by being in direct contact with reality and real-life situations.

Conclusions

In this work we presented a fieldwork model to environmental sciences in a context of a blended-learning undergraduate programme. The organization effectiveness of the model and the students' participation was assessed in two scholar years of a fieldwork course at Universidade Aberta, Portugal. The project assignment synopses were also assessed in the context of education for sustainability.

According to the teacher's perception of student's participation during the whole programme, students were very satisfied with this course in terms of its organization, contents and assessment. Also, the course allowed them to get to know each other better, to know the teachers and to build a student's community and a learning community. The analysis of the student's participation in the asynchronous forums within the virtual learning space will be a valuable help to rethink the relevance of some of the forum and also to redefine their purpose even if the interaction students-teacher was always present and profitable.

Although the current work is developed within a formal learning environment, the contents of curricular unit Fieldwork II also include field trips which are intended for the students to gain a better sense of the real world environment and processes, as well as to promote the exploitation of the local features of the place where the outdoor activities happen. In this context there is also a non-formal side to the learning process which will contribute to the student's education for sustainability and integrated knowledge.

Fieldwork is frequently sidelined as a learning strategy by educational institutions because of factors such as time to cover comprehensive curricula, financial constraints, legal issues and commitment by teachers (Gerber and Kim Chuan 2000). In spite of the fact that in e-learning systems environmental virtual field laboratory being a growing reality (e.g. Barak and Nater 2002; Ramasundaram et al. 2005), it is our opinion that face-to-face fieldwork will always be required and will have a crucial role for the reasons explained throughout this work. The new virtual technologies are important but not sufficient, because they do not encourage the development of key learning skills, attitudes and values towards environmental conservation and sustainability development at the same level as face-to-face fieldwork.

Nevertheless, the discussion of the results needs a comprehensive analysis in order to be able to fully support our interpretations. A more detailed content analysis will be conducted into project assignments developed by the students and questionnaires and surveys to appraise the course aims, organization and assessment and evaluate students' perception about competent objectives and coverage level within sustainability concerns. With these new guidelines, we wish to promote the development of competences and skills – in both lecturers

and students – that will lead to the implementation of problem-based learning methodology as well as proposals for final projects related to local issues and problems, presenting innovative solutions for different case studies in order to produce graduates with new competences for sustainability development practices.

Further work concerning the evaluation of field activities will be performed, namely in relation to the quality of the learning environment of outdoor science activities. The use of purpose-designed techniques such as that described by Orion et al. (1997) will be considered. In this case the method evaluates environmental interaction, integration, student cohesiveness, teacher supportiveness, and preparation and organization and material environment. Additional questionnaires, interviews and supplemental observation will be applied.

References

Amador, F., Caeiro, S., Oliveira, C., Caetano, P., Bacelar-Nicolau, P., Azeiteiro, U.M. and Martinho, A.P. (2008), Curricular development on higher education and sustainable science: A b-learning course in environmental science. In papers proceeding EMSU 2008 International Conference. Environmental Management for Sustainable Universities. A New Knowledge Culture. Barcelona. 15 to 17 October, pp. 1-12 (available at: www.emsu.org).

Barak, P. and Nater, E. (2002), The virtual museum of minerals and molecules (avalilable at: http://www.solis.wisc.edu/virtual_museum/index.html).

Bardin L. (1977), Análise de conteúdo. Edição 70, Lisbon.

Besenyei, L., Watkin, G. and Oliver, K. (2004), An evaluation of the educational effectiveness of fieldwork within environmental science awards at the University of Wolverhampton. University of Wolverhampton. Learning and Teaching Projects 2003/2004, pp. 63-70.

Bersin, J. (2004), The Blended Learning Book. Best Practices, Proven Methodologies and Lessons Learned, Pfeiffer.

Bursztyn, M. (2008), Sustainability Science and the University: Towards Interdisciplinarity, CID Graduate Student and Research Fellow Working Paper no. 24.

Cachapuz, A., Praia, J. and Jorge, M. (2001), Ciência, Educação em Ciência e Ensino das Ciências. Ministério da Educação, Lisbon.

Carter, L. (2007), Sociocultural Influences on Science Education: Innovation for Contemporary Times". Science Education, 92, pp. 165-181.

Compiani, M. and Carneiro, C. (1993), "Os papéis didácticos das excursões geológicas". In Enseñanza de las Ciencias de la Tierra, 1.2, pp. 90-97.

Curtis, K. and Mahon, J. (2010), Using Extension Fieldwork to Incorporate Experiential Learning into University Coursework. Journal of Extension 48 (2), pp. 1-8.

Fishera, J.A. (2001), The demise of fieldwork as an integral part of science education in United Kingdom schools: a victim of cultural change and political pressure? Pedagogy, Culture and Society, 9 (1), pp. 75-96.

Fuller, I.C. (2006) "What is the Value of Fieldwork? Answers from New Zealand Using Two Contrasting Undergraduate Physical Geography Field Trips". New Zealand Geographer 62, pp. 215-220.

Garrison, D.R. and Anderson, T. (2003), E-Learning in the 21st Century. A Framework for Research and Practice, RoutledgeFalmer.

Garrison, D.R. and Cleveland-Innes, M. (2005), Facilitating Cognitive Presence in Online Learning: Interaction Is Not Enough. The American Journal of Distance Education 19 (3), pp. 133-148.

Gerber, R. and Kim Chuan, G. (eds.) (2000), Fieldwork in Geography: Reflections, Perspectives and Actions. Kluwer Academic Publishers, Dordrecht.

Giere, R.N. (1988), Explaining Science. A Cognitive Approach. University of Chicago Press, Chicago and London.

– (1992), "Introduction: Cognitive Models of Science". In Giere, R., Cognitive Models of Science, vol. 15 "Minnesota Studies in the Philosophy of Science", xiii-xxv. University of Minnesota Press, Minneapolis.

Gold, J., Jenkins, A., Lee, R., Monk, J., Riley, J., Shepherd, I. and Unwin, D. (1991), Teaching Geography in Higher Education: A Manual of Good Practice. Blackwell, Oxford.

González, W.J. (eds.) (2002), Diversidad de la explicación científica. Barcelona Ariel.

Huckle, J. (1996), Teacher Education. In Huckle, J. and Sterling, S. (eds.), Education for Sustainability. Earthscan, London.

Juárez-Nájera, M., Dieleman, H. and Turpin-Marion, S. (2006), Sustainabilty in Mexican Higher Education: towards a new academic and professional culture. Journal of Cleaner Production 14, pp. 1028-1038.

Kempa, R.F. and Orion, N. (1996), Students' Perception of Co-operative Learning in Earth Science Fieldwork. Research in Science and Technological Education, 14 (1), pp. 33-41.

Kent, M., Gilbertsone, D. and Hunt, C. (1997), Fieldwork in geography teaching: a critical review of the literature and approaches. Journal of Geography in Higher Education, 21, pp. 313-332.

Kuhn, T. (1990), La estructura de las revoluciones cientificas. Fondo de Cultura Económica, México.

Lima, A., Vasconcelos, C., Félix, N., Barros, J. and Mendonça, A. (2010), Field trip activity in an ancient gold mine: scientific literacy in informal education. Public Understanding of Science, 19 (3), pp. 322-334.

Manzanal, R.M., Rodríguez, M.R.L. and Casal Jiménez, M.C. (1999), Relationship between Ecology Fieldwork and Student Attitudes toward Environmental Protection. Journal of Research Science Teaching, 36 (4), pp. 431-453.

Martens, P. (2006), Sustainability: science or fiction? Sustainability: Science, Practise, & Policy, 2 (1), pp. 36-41.

Mathews, M.R. (2003), Thomas Kuhn's Impact on Science Education: What Lessons Can Be Learned? Science Education, 88(1), pp. 90-118.

Moore, M.G. (1989), Three types of interaction. The American Journal of Distance Education 3 (2), pp. 1-6.

Orion, N. (1993), A Model for the Development and Implementation of Field Trips as an Integral Part at Science Curriculum. School Science and Mathematics 93(6), pp. 325-331.

Orion, N., Hofstein, A., Tamir, P. and Giddings, G.J. (1997), Development and validation of an instrument for assessing the learning environment of outdoor science activities. Science Education, 81, pp. 161-171.

Pereira, A., Mendes, A.Q., Morgado, L., Amante, L. and Bidarra, J. (2007), Modelo Pedagógico Virtual da Universidade Aberta para uma universidade de futuro. Universidade Aberta, Lisbon.

Popper, K. (1988), Conocimiento objectivo. Tecnos, Madrid.

– (1990), La logica de la investigación cientifica. Tecnos, Madrid.

Ramasundaram, V., Grunwald, S., Mangeot, A., Comerford, N.B. and Bliss, C.M. (2005), Development of an environmental virtual field laboratory. Computer and Education 45, pp. 21-24.

Saul, D. (2000), Expanding environmental education: thinking critically, thinking culturally. Journal of Environmental Education, 31(2), pp. 5-7.

Strang, V. (2009), Integrating the social and natural sciences in environmental research: a discussion paper. Environmental Development Sustainability, vol. 11, pp. 1-18.

UNESCO Report (2002), Education for All. Is the World on Track?