Chapter 13

Online Learning for Sustainability: The Student Perception in an Environmental Science Post-Graduation

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Abstract

The importance of a set of parameters on student satisfaction and on their perception of the learning effectiveness of an *MSc* online-learning programme in Environmental Citizenship and Participation at Universidade Aberta, Portugal, was assessed throughout its 4 editions. The majority of students showed a very high level of motivation and satisfaction with the course. Also, most students had the perception of having reached an affective learning outcome of values, attitudes and behaviour, which is a central element of education for sustainability. The main factors identified as contributors to student satisfaction and to their perception of the learning effectiveness were: (i) high quality and level of communication, both student-student and student-teacher, (ii) teachers' expertise and motivating skills, and (iii) pedagogical aspects, such as the depth of coverage of the subjects under study, receiving feedback in time, the didactic materials, the course structure, and the learning activities.

Introduction

One of the most important goals in achieving sustainable development is, along with social and individual understanding, developing environmental sensitivity. The last decades, especially the latter, have shown a change in the characteristic behaviour of advanced markets from markets which demand competitive prices to those which, in addition to price competitiveness, value other criteria such as quality, service and environmental awareness (Cloquell-Ballester et al. 2008). Educational programmes in environmental science are then receiving a growing interest by the working-student population seeking professional development in this field, but who have no available time or a university nearby to attend face-to-face courses.

Environmental science courses and curricula aim to train students in holistic thinking, which includes taking into account the interrelationships between environmental factors and processes (Ramasundaram et al. 2005). Laboratory exercises, field observations and field trips are then an important part of many environmental science courses. However, field observations and field trips can be constrained because of distance, time, expense, scale, safety, or complexity of real-world environments. Hence *online* education in the environmental sciences can be a complicated issue. Nevertheless, the use of up-to-date simulation models which allow the testing of multiple scenarios and their outcomes, videos, and other information and communication technologies, or intensive face-to-face activities given, in a short period of time, allow for the existence of these courses. Several authors have been working in developing new tools of e-learning in the environmental science field (e.g. Ramasundaram et al. 2005; Eneroth 2000).

E-learning has a role to play in this endeavour, as it allows global access to environmental education, independent of time and place, once the courses are available on the Internet. Additionally, *e*-learning has the potential of reducing the environmental impacts from face-to-face education. Potential resource savings can be found in the use of time, energy and waste (Eneroth 2000; Garrison 2000).

The increased use of internet-improved technologies, and web-based applications, as well as the increasing effectiveness of e-learning have become practical and theoretically important issues in both educational engineering and information system fields (Lee and Lee 2008). Research has strong evidence for the effectiveness of distance learning *per se* as a method of delivery (Moore and Thompson 1997). In distance-learning programmes, objectives and learning outcomes should be the driving forces (Tham and Werner 2005), and the effectiveness of measure becomes "how much and how well is this being absorbed?" (Kirkpatrick 1998). When designing and evaluating *e*-learning in higher education, essential aspects to take into account are the fact that distance learners are dynamic individuals that often change in response to both educational and life experiences (Gibson 1992), and that distance learners are a diverse group (Holmberg 1995; Altbach 2000) with different learning styles (Billings 1993).

Learning environmental satisfaction requires quality assessments of interaction, information, and system. Lee and Lee (2008) suggested the importance of qualitative assessment and interaction as well as system quality through e-learning. According to Cloquell-Ballester et al. (2008), it is important not to limit the evaluation of environmental education to a student satisfaction survey. It is important to develop specific studies about indicators for the real impact of environmental education on the socio-economic environment. The essence of quality education, in any form, is to ensure that learning objectives are achieved efficiently and effectively, without sacrificing the standards of the educator and his or her institution (Tham and Werner 2005). Therefore, the evaluation process seeks to confirm whether the learning objectives and outcomes have been implemented and achieved effectively (Odini 2000). According to a study by Paecher et al. (2010), the main aspects which contribute to the students' learning achievements and course satisfaction are their achievement goals and the instructor's support and expertise. These are critical components and competences that educational institutions should provide students in order for them to be better able to face society (Gardiner 1994).

The aim of this paper is to assess the importance of a set of parameters on student satisfaction and on their perception of the learning effectiveness of an *MSc* online learning programme in Environmental Citizenship and Participation at UAb. A set of data was analyzed using a triangulation methodology to assess the importance of parameters such as student motivation, student-content interaction, student-student interaction, student-teacher interaction, type of learning activities, type/regime of evaluation, and student environmental citizenship attitudes and behaviour. Preliminary results of this research were published earlier (Bacelar-Nicolau et al. 2009).

The MSc Programme in Environmental Citizenship and Participation

In recent years the Universidade Aberta (UAb), Portugal, has implemented an online teaching and learning system based on a pedagogical model (Pereira et al. 2007) and using the learning management system (LMS) Moodle. This aims to provide students with equal access to learning resources and communication channels with their teachers, fellow students, and academic and administrative support services. The learning communities interact with secretarial/administrative staff, coordinating programme team, and teachers in separate, individual virtual spaces; a virtual *Café* space is also available for social interactions.

The *MSc* programme in Environmental Citizenship and Participation offered at the UAb had its first edition in 2006/2007, and has since witnessed four new course editions. It is a formal course, organized according to the European Credit Transfer and Accumulation System (ECTS). Curricular units are delivered *via* e-learning except for one curricular unit that includes an intensive one-day face-to-face lecture during the second semester. The *MSc* lasts for three semesters, the two initial semesters being dedicated to the curricular units (60 ECTS) (table 1) and the third semester being dedicated to planning, developing, writing and defending a dissertation or project (40 ECTS). The semester is defined as a period of 20 weeks, the 4 final weeks being committed to the final evaluation.

This programme is designed to prepare students for working in environmental policy-making as well as in improving their environmental citizenship, participation and planning abilities. The programme is designed to help governmental workers, public and private environmental advisors, members of environmental non-governmental organizations, teachers, researchers and individuals involved in environmental practices, policies, planning, teaching, participation and citizenship. Subjects, methodologies and case studies are drawn from areas of environmental sciences and social sciences in a sustainability perspective.

Table 1: The Curricular Plan of the *MSc* in Environmental Citizenship and Participation offered at the Universidade Aberta (UAb, Portugal)

1st Semester – Fundamentals (select for a sum of 30 ECTS)

Curricular units (optative)	**ECTS**
Land Use Management	6
Pollution and Resources	6
Waste Management	6
Instruments for Environmental Management	6
Biodiversity, Geodiversity and Conservation	6
Food Consumption and Environment	6
Environmental Impact Assessment	6
Promotion of Health and Environment	6
Sustainable Management of Marine Resources	6
Elements for the Analysis of the Social Conjuncture	6
European Virtual Seminar for Sustainable Development (*)	

2nd Semester – Conceptual, Practical Methodologies and Techniques (30 ECTS)

Curricular Units (obligatory)	**ECTS**
Ethics and Environmental Citizenship	6
Sustainable Policies	6
Participation and Interactive Methods in Environmental Decision-Making(**)	6
Methodologies of Social Intervention	6
Projects and Methodology in Environmental Citizenship	6

(*) This CU is coordinated by the Open University of the Netherlands and has students from different universities that also offer this course.
(**) curricular unit which includes a one-day intensive face-to-face lecture.

Methodology and Research Instruments

The study, herein presented, was conducted between June 2007 and January 2010, during the four editions of the *MSc* online learning programe in Environmental Citizenship and Participation, to a group of 78 students.

In methodological terms, two confidential questionnaire surveys, sem structured personal interviews and observation grids for characterization of t curricular units were used to obtain a set of data that was analyzed using a tria gulation strategy. Even though this was an exploratory study there was a conce to approach it both in a qualitative as well as a quantitative manner. This w undertaken in order to gain a deeper insight into the nature and the type of paran ters involved in student satisfaction and in their perception of the learning effe tiveness of the programme.

The first questionnaire survey contained 25 questions, designed according appropriate questionnaire criteria of clarity and objectivity (Quivy and Campe houdt 2006) to characterize the individuals (i) in demographic terms, (ii) fr their evaluation of e-learning experiences, and (iii) from their evaluation of course (structure, pedagogical resources, learning achievements, among other In section (ii) students evaluated statements related to the learning process o 5-point scale ranging: "I agree completely", "I agree", "I do not agree nor d agree", "I disagree" to "I disagree completely". In section (iii) students asses various aspects of the course on a 5-point scale: "insufficient", "sufficient", "goo "very good" and also "not applicable".

The second questionnaire survey was applied at the end of the second seme and was composed of 29 questions using the same criteria of clarity and objectiv It aimed to evaluate (i) student's knowledge acquisition on key concepts of en ronmental sciences (e.g. water, waste, land use, air, natural conservation, soil sustainable consumption), (ii) student's sensing of personal attitudinal change specific environmental areas, (iii) student's sensing of personal behavio changes in specific environmental areas and (iv) student's course global achie ments relating to their expectations (acquisition of professional competen public participation, etc.). In all sections of this questionnaire students evalua statements in a 5-point scale ranging, as above, from "I agree completely" t disagree completely".

The semi-structured interviews were carried out by a researcher on a conv ience sample (4 students who completed the course) two weeks before the en the course. Each interview lasted for ca. 1hr, and aimed to clarify trends issues that were brought up by the questionnaires, as well as to characterize n weaknesses and strengths of the *MSc* programme. Informal observations of master programme coordinators were also used with the same purpose as semi-structured interviews.

Each virtual curricular unit was characterized, by the respective teacher, ing a predefined observation grid (Bacelar-Nicolau et al. 2009), for content ganization, pedagogical instruments, learning activities (e-activities), sync nous/asynchronous communication, support materials, and type of assessmen

Results and Discussion

Curricular Unit Characterization

The virtual space of each curricular unit, as characterized by the observation grid, had a number of essential structural and organizational elements: a learning contract, indicating the structural and organizational aspects of the CU (including a plan of learning activities, study materials, timetables, how/where/when students are expected to communicate with staff and other students in the context of learning activities, evaluation process), a notification forum for unit announcements, a discussion forum for student queries. Optional support elements *e.g.* electronic resources were available in most CU.

Units were similarly organized into topics, each topic being developed during one to three weeks, depending on the subject area. The LMS Moodle activities included lessons, mini-tests, glossaries, discussion *fora* and blogs. Each topic was generally associated with one learning activity. E-activities used were discussion *fora* (mostly involving group work, role-play, and case-study analysis), written assignments and blogs. Communication was mostly asynchronous. Support materials included e-books, textbooks, research papers, internet sites, study texts prepared by the teachers, power point presentations, and video clips.

Student Satisfaction Perception of the Learning Effectiveness

The questionnaire surveys had an overall response rate of 50% which is a good result for an online voluntary survey (Cook, Heath and Thompson 2000). Students enrolled in the course were 63% female and 37% male. Most students, 48%, were between 47 and 50 years old; 30% were 31 to 40 years old; 10% were 29 years old or younger, and 10% were 51 and older. Their main motivation for enrolling in the course was interest in the scientific area (35%) and flexibility of learning relating to time and place (31%), but some needed specific training in the area (13%) and some needed professional promotion (13%) or for other reason (1%). The majority of students, 70%, had not previously enrolled in e-learning courses; only 17% had attended one course in e-learning and 7% had attended two e-learning courses.

Even though most students had not previously taken e-learning courses, by the end of the 1st semester all students agreed that an e-learning course could be as good as a face-to-face course, and 79% agreed that the use of information and communication technologies (ICT) could efficiently replace face-to-face lectures. However, 25% of students still preferred enrolling in a face-to-face course, and 17% had no opinion on whether they preferred one or the other type of learning regime. The online regime was also considered by 74% of students to be able to enrich the learning methodology used by the teacher (10% had no opinion, 17% disagreed). Nevertheless, 17% of students thought that the e-learning regime weakened the importance of the teacher's role, although most (80%) disagreed with this statement, and some (3%) had no opinion.

During the course, 83% of students used the Internet daily, and 17% used the Internet 3 to 4 times per week. 40% of students spent more than 20 h/week connected to the Internet with activities relating to the course, 27% spent between 15 and 20 h/week, 27% between 8 and 14 h/week and only 7% spent 7h/week or less on the Internet.

Also, by the end of the 1st semester, 90% of students thought that overall competences gained with the course were good or very good (10% thought they were sufficient). The quality of the pedagogical materials was rated good to very good by 87% of the students (sufficient by 13%), and 80% considered that the proposed learning activities contributed well or very well to the learning objectives of the course (17% of students thought they were sufficient). Among the diverse pedagogical materials used in the course, students preferred, from a higher to lower degree of preference: Moodle's lessons and websites, texts prepared by teachers, power point presentations and scientific papers or textbooks. Concerning the learning activities, 82% of students felt that they were correctly assessed by the individual learning activities; 17% had not formed an opinion. Among the various learning activities used by teachers, students rated, from high to low, the written assignments (group and individual), followed by Moodle's lessons, discussion *fora* or Moodle's mini-tests, blogging activity, synchronous discussions and, finally, the use of glossaries. A teacher's involvement and teacher's competence were considered good and very good by 84% and 90% of the students respectively, and sufficient by 7%. Students rated the different types of assessment used in each curricular unit, from high to low, as follows: formative evaluation, group written assignments, online final exam, and finally, synchronous discussion of written assignments (e.g. via Skype).

All students agreed that the interaction between colleagues was an important factor in the e-learning process, and this was rated as good or very good by 90% of the *MSc* students, sufficient by 3%, and insufficient by 3%. Still, 37% of students thought that the *online* environment was emotionally poor and incapable of generating strong relationships among people, while 53% of the students thought that the *online* environment generated strong relationships among people; 7% had not formed an opinion. In agreement with this, to some extent, moments of synchronous communication in the e-learning course were dispensable for 23% of the students, but indispensable for most, 60%; 17% had not formed an opinion.

At the end of the curricular year most students (82 to 100%, depending on the subject) perceived they had acquired knowledge in the main areas of the *MSc* course e.g. sustainable use of water, sustainable use of solid residues, land management,

air quality, management and soil conservation, nature conservation, sustainable consumption). As regards their attitudinal changes in those main areas, 82 to 100% of students perceived changes in their personal attitude, although only 76 to 89% had effectively changed their attitude in those environmental areas. On completion of the course, all students agreed that they intended to alter other people's attitude and behaviour in environmental subjects.

Also, on conclusion of the course, all students perceived that they had improved in their professional competences and the tools developed.

Most students, 64%, felt that the main obstacles in an e-learning course were ICT-related rather than pedagogically-related; 17% had not formed opinion; and 20% disagreed. This was particularly true for students experiencing e-learning for the first time, as has been reported by other authors (Tyler-Smith 2006). For these students, a greater effort in motivating and giving ICT support had to be given by the course coordinators, and also by teachers, particularly during the first three months of the course.

These results emphasize the growing acceptance of online distance learning, particularly in environmental education and in sustainability issues, as reported by other authors (Cloquell-Ballaster et al. 2008; Palmer and Holt 2010; Paechter et al. 2010), but the need to further improve through e.g. ICT methodologies, motivating skills, which are directed to different learning and intelligence types (Lee and Lee 2008; Ramasundaram et al. 2005).

Synchronous moments in the course were used as an attempt to bridge the distance felt by students. This was done in two distinct modes: (a) synchronous moments on the LMS, in the context of two curricular units, (b) face-to-face one-day sessions, between students and teachers, at 3 distinct periods: opening session of the *MSc* /1st semester; beginning of the 2nd semester; and one-day intensive session (half-way through the second semester), in the context of the CU *Projects and Methodology in Environmental Citizenship.* All of these sessions were transmitted, in real time, over the Internet for those students who could not be present. These synchronous moments were highly valued by the students. The UC characterization and the student interviews clarified that the synchronous moments on the LMS were orientated for the UC's final assessment, as oral presentations of individual or group assignments, and that these moments were cherished by the students. These results contrasted with those from the initial study, were synchronous moments were considered dispensable by the students (Bacelar-Nicolau et al. 2009); for the earlier edition of the *MSc*, synchronous moments were orientated towards the clarification of study matters, and this was valued less in the learning process. Moreover, the 3 days of face-to-face sessions were important for bridging the distance gap and for strengthening the e-learning community, a fact that was also evident from the increasing number of students who generally attended these sessions throughout the year. In fact, the b-learning regime, even though limited to a minimum of face-to-face sessions, has the potential of strengthening the virtual learning community, as has been pointed out by other authors (Tyler-Smith 2006; Moore and Gilmartin 2010).

The results of the personal interviews and the informal observations of the programme coordinators emphasized the importance of the "high communication level", both student-student and student-teacher, the "depth of coverage of the subjects under study" and the "effectiveness of the e-learning process" for the high motivation and *MSc* programme satisfaction felt by the students. Student-student interaction was considered to be "fundamental" because "it was a part of the asynchronous learning process" and also because "of the emotional support it gave when times were harder". The student-teacher interaction was also considered "fundamental", and in some cases the "fellowship bond, when distance between students and teachers had disappeared, contributed enormously to the learning progress". The teachers' motivating role was also pointed out by students to be a "fundamental pedagogical factor".

Feelings of declining motivation and dissatisfaction with the master programme were transmitted to the coordinators by students who, later, failed to complete the first year of the course. The main reasons for those feelings and for the subsequent student's dropping out were: (i) time conflicts between study, and work and/or family, (ii) ICT problems, (iii) "overload by too much to study, and multiple conversations to, and (iv) "solitude feeling that decreased motivation". Other reasons for dropping out, such as instructional design of the course/programme, or the feeling that students had learned what they needed or wanted (Tyler-Smith 2006) were not referred to during the 4 editions of the *MSc* programme. In fact, the drop-out percentage in the *MSc* programme declined from an initial 50% rate to 37% throughout its 4 editions (data not shown), values that are in the lower limit of the drop-out range referred to in Tyler-Smith (2006). The declining drop-out rate was attributed to (i) the implementation of a 2-week "introducing e-learning course", tutored by the programme coordinators, prior to the beginning of all *MSc* programmes, and (ii) to extra-support, both ICT-related and emotional, from programme coordinators and also from some unit teachers.

Conclusion

E-learning is becoming increasingly widespread in the context of higher education, responding to an increasing need to provide more flexible, time and/or place-independent study pathways in the face of growing trends towards part-time

employment and student mobility, and also because e-learning potentially caters for student's different paces of learning and different learning styles. The use of e-learning in the education of various science courses, traditionally taught in face-to-face lectures, is also becoming more widely implemented and accepted (e.g. Mohanna 2007; Moore and Gilmartin 2010). Moreover, the new set of expectations of the younger "net generation" may cause in "those who have grown up with interactive technology" a discomfort with the information transmission approach of traditional lectures. The younger generation of "students expect a relevant and engaging learning approach" (Garrison and Vaughan 2008).

The large majority of students of the *MSc* programme in Environmental Citizenship and Participation at UAb showed a very high level of motivation and satisfaction with the course. Also, most students had the perception of having reached an affective learning outcome of values, attitudes and behaviour which was suggested by Shepard (2008) to be a central element of education for sustainability. The main factors identified as contributors to student satisfaction and to their perception of the learning effectiveness are similar to those reported by other authors (Palmer and Holt 2010; Paechter et al. 2010) and were the (i) "high quality and level of communication", both student-student and student-teacher, (ii) teachers' expertise and motivating skills, and (iii) pedagogical aspects, such as the depth of coverage of the subjects under study, receiving feedback in time, the didactic materials, the course structure, and the learning activities. The e-activities introduced later, e.g. role-play, problem-based learning, group analysis of real-case studies, discussion *fora* or blog activities, all of which stimulate reflection and affective responses (Shepard 2008). One aspect which was emphasized both in the personal interviews and in the informal observation by the programme coordinators is the central role that the programme coordinator has for the success of the virtual learning community. This aspect has also been pointed out by Moura et al. (2010).

The early attrition felt in e-learning courses can, and has been reduced in our MSc programme, by the implementation of a 2-week "introducing e-learning course" prior to the beginning of all programmes and by extra-support (technical and e-motivating) from both master programme coordinators and UC teachers, until the e-learning community is affectively and effectively bound. A recent administrative decision that allows for the possibility of enrolment as part-time students, which in the *MSc* corresponds to a minimum of one CU out of five per semester, appears to result in a decrease in the drop-out rate, even though it may delay the necessary initial cohesion of the e-learning community. We believe that the research methodology of this study should move towards a further deepening of reflection on teaching practice from the perspective of integration between research and action. In the present case, the results obtained already led to modifications in successive years of the *MSc* programme.

As regards students' attitudinal changes in the main areas of environmental citizenship and participation, and although most students perceived changes in their personal attitude and behaviour, a new survey will be conducted sometime after the end of the programme to confirm the results presented here.

The complexity of variables affecting e-learning need further and continuous research, from which will result, in time, e.g. improvements in ICT, more understanding of online pedagogy, more effective course design, more learner-centred design and support, or more adequate motivating and teaching skills. Some of the difficulties still felt in e-learning may be an evolutionary issue, and also in time, be resolved by the growth of a learner population for whom online learning is as normal as the classroom has been for former generations of learners for the last one hundred and fifty years.

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