e-learning promotes students' deep learning: a case study

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Introduction

This paper reports on a second part of a research and development project being conducted at the Department of Industrial Engineering. The first part of the project researched and developed an e-infrastructure to support students' learning, which was qualitatively evaluated, reported at the CSNDSP' 2002 and awarded a Best Paper Prize by the IEEE UK/Republic of Ireland Communications Chapters.

The second part of the project, reported here, has been concerned with a more quantitative evaluation of the impact of the developed e-infrastructure upon students' study styles. Therefore the paper, after this introduction summarises the first part of the project. Then it presents the theoretical background to the second part. Next the course organisation and the instrument used for the quantitative evaluation are presented.

Results of students' responses are then presented and commented. Finally, some remarks are made as conclusions.

Summary of previous work

The paper presented at the CSNDSP' 2002 (Lopez et al, 2002) reported a research and development to create an e-infrastructure to support the new approach to teaching and learning. Firstly, it described the research activities and operational model of students' learning used to build the e-infrastructure. Then, it presented the organisation of courses, which included the modelling of contents, activities and evaluations.

Secondly and in more detailed, the paper described the e-infrastructure developed. This was done in terms of the design of a synchronous/asynchronous web portal to support new courses contents, activities and evaluations.

Finally, it presented some of the reactions of students regarding the use of the e-infrastructure. Main findings were the strength of course organisation and its structure and the usefulness of the e-infrastructure developed.

Students said that the course organisation was good for them because the teaching team was made up of five people (one lecturer and four assistants). They pointed out that such a team is not usual in departmental practices and represented a good opportunity to have an enriched interaction. This allowed them to a better group work and in at ease manner. Students stated that the way in which the materials were prepared facilitated going through them, gave them the opportunity to better organise their time and plan activities of this and other courses. The organisation of the assessment, it was said by several students, with so many marks made it that individual marks had low impact in the final mark, which decreased pressure on individual marked activities.

The e-infrastructure was the item most mentioned by students in the interviews. For all of them, this was their first course to be based on an e-learning experience, which had extensive support of information technologies integrated to Internet. Students valued not to 'have to' go to the lecture theatre, and 'to go to class' at whatever time they could or had the opportunity, with the "materials there, as if they were waiting for me", as one student put it. It was also stressed that this gave them much autonomy and that this was not always possible to adequately manage. It was also repeatedly mentioned that the e-infrastructure had novelty of use, which produced a new sort of encouragement to revise the materials and that it was fairly easy to access its learning resources.

The major conclusion was that a robust e-infrastructure for distant and distributed learning was developed and, a formative evaluation conducted showed that students had an enthusiastic reaction, that the e-infrastructure was interesting, useful, allowing them a deeper knowledge and that they would very much appreciate more courses in a similar format.

Theoretical background

The development of our e-learning environment has been strongly influenced by both our experiences and two main conceptual learning frameworks. Our experiences had showed us that our traditional approach to teaching made students who recall by memory and, with time passing by, a risk of failing to remember. The conceptual learning frameworks are the "experiential learning approach" and the distinction between "deep learning" approach and "superficial learning" approach. As a result of the use of these frameworks, our own ideas of what learning meant also changed.

The first theoretical element that came to contribute to our development of an e-learning environment was the experiential approach to learning (Kolb, 1984). The crucial question that this approach addresses is how students learn. Although originally formulated to address the question of adult education, it has made an important contribution to understand how students learn in general. In this approach, learning is understood as a process in which "people generate from their experience the concepts, rules and principles that guide their behaviour in new situation" (Kolb, et al., 1991, p. 60). The effectiveness of their behaviour depends on how they adapt their concepts, change their rules or discover new guiding principles.

Learning takes place through a continuous and recurrent sequence of actual experiences and, as experiences by themselves are insufficient, they must be accompanied by thought, observation, abstract concept construction and trying out these concepts in new experiences. Thus, the learning process is conceived as a four-stage cycle. (1) concrete experiences are followed by (2) observation and reflection of such experience, which leads to the (3) formation of abstract concepts and the constructions of principles or generalisations which follows (4) the testing of such concepts in new situations.

Thus, we realised that following this model we could incorporate new learning activities to emphasise each phase of the cycle. Thus, we thought of introducing seminars with small groups, with a view to have debates or discussions on new concepts. Assessing students through the development of a case study applied to a real world situation, which was conducted as a course project. Assigning minor research work on the e-learning environment and developing a more personalised instruction.

The second theoretical source that influenced our development was the distinction between the *superficial approach* and the *deep approach* to learning. With these important concepts, we realized that some students have different ways of confronting the learning process. While some students take learning simply as a matter of memorizing concepts and reproducing knowledge; other students approach learning with interest in ideas and understanding and with a clear intention to transform such ideas based essentially on their previous experiences and knowledge (Entwistle, 1981).

Having in consideration these distinctions, we rapidly asked ourselves how to promote a deep approach to learning among our students (Entwistle, 2000, Gibbs, 1999). That is to say, we started looking for an e-learning environment that fostered the interest in ideas and understanding in contrast with the prevalent approach observed in our Department principally focus on memorising concepts. Our objective was to conceive a series of related activities supported with e-learning technology that helped us to stimulate and develop, in our students, the ability to seek meaning, relate concepts and make sense of their experiences within and beyond the frontiers of our courses.

Such a challenge required a different teaching model. We found it on what Entwistle (2000) calls a learning oriented approach to teaching. In this model, the teaching and learning process changes from being centred in teaching to be centred in learning. Educators became facilitators and learners are much more active (Gibbs, 1999, Cervera & Gonzalez, 1997).

So, in the process of developing the e-learning technology, our own conception of teaching changed—from a content oriented to learning oriented. From imparting information and structuring what knowledge students learned to an approach that facilitates understanding of concepts and encourage conceptual change. This process was naturally not easy and we learned as we developed the e-learning environment and experimented by supporting our students with such an environment. In this regard, Enwistle (2000) indicates that "the approaches to teaching adopted by teachers also influences their students' approaches to studying and through those the learning outcomes" (p. 4).

Our own change of conception of how to approach the teaching and learning can be summarised as follows. The lecturer in the traditional approach is a deliverer, unique assessor and decides what and how students learn. Students are dependent, individualist and receptive. On the other hand, in the new approach lecturers are managers, planners, designers, facilitators and guides. Students are autonomous, collaborative and engaged. It is this latter approach that we have attempted to recreate through the development and use of an e-learning environment to support student's learning.

e-learning courses

The organisation of courses was based on the experiential learning cycle. Consequently, courses were organised to provide students with opportunities for experiences, thoughts, observations, abstract concept construction and probe of new experiences. For abstract conceptualisation there was an initial conference per course unit as well as reading of articles, papers and book chapters. For experiences and probe of new ones, students developed, throughout the course, a case study. For thought and deliberation there were two seminars per unit. Contents, activities and evaluations were available in the e-learning platform.

The Inventory

To investigate if the e-learning infrastructure (synchronous and asynchronous Web portal plus modelled contents, activities and evaluations) had any impact on students' study styles, the Approaches and Study Skills Inventory for Students (ASSIST) was used (ASSIST, 1997).

The inventory was built to discriminate students learning styles. It has three parts: conceptions of learning; approaches to study; preferences for different types of course and teaching.

The part on conceptions of learning is made up of nine questions. The part on approaches to study is divided in three sections: deep approach; strategic approach; surface apathetic approach. The deep approach is divided in three subsections (seeking meaning; relating ideas; use of evidence) with four questions each. The strategic approach is divided in four subsections (organised studying; time management; alertness to assessment demands; achieving; monitoring effectiveness) with four questions each. The surface apathetic approach is divided in 4 subsections (lack of purpose; unrelated memorising; syllabus-boundness; fear of failure) with four questions each. The preferences for different types of course and teaching scored as the sum of the four items (questions) for two sections (supporting understanding and transmitting information). Students respond to items on a 1 - 5 scale. The part on preferences for different types of course and teaching is made up of two sections to set apart if their liking is for the deep or surface approach; each section has four items to be responded.

817 first-year university students drawn from ten contrasting departments in six British universities completed ASSIST. A correlation analysis between the variables deep, strategic and surface apathetic approaches was conducted, as illustrated in the following table.

Table 1: ASSIST - Correlations between factors

	I	II	III
Factor I (Deep)	1.00		
Factor II (Surface Apathetic)	- 0.20	1.00	
Factor III (Strategic)	0.35	- 0. 22	1.00

The correlations clearly show that:

- Surface apathetic and deep approaches (-0.20) are almost not related.
- Strategic and deep approaches (0,35) are feebly related.
- Strategic and surface apathetic (-0,22) are not related.

Hence the questionnaire is well designed to discriminate among study styles.

Results

Being a good inventory, ASSIST was duly translated to Spanish and the 82 students in the course were asked to fill it in. Answers were coded into the suggested 1 to 5 scales and processed with the Statistical Package for Social Sciences (SPSS).

The initial statistical analysis was to ensure that the 82 students' responses preserved the no relation between the factors. Therefore the same statistical test was carried out and table 2 shows the results.

Table 2: COURSE - Correlations between factors

	I	II	III
Factor I (Deep)	1.00		
Factor II (Surface Apathetic)	- 0.20	1.00	
Factor III (Strategic)	0.52	- 0. 12	1.00

In general the 82 responses had a similar behaviour that those of the 817 British students. The main divergence with ASSIST is that in this case the deep and strategic approaches present some relation.

To segregate responses, some descriptive statistics are presented. Descriptive statistics are used to describe the basic features of the data in the study. These basic characteristics are in the following tables.

Table 3: Factors - Descriptive statistics

	N	Mean	StDv
Factor I (Deep)	81	3.92	0.80
Factor II (Surface Apathetic)	82	3.29	0.92
Factor III (Strategic)	81	3.79	1.09

Regarding students' study approach, the central tendency of the distribution shows that students in the course tended to be deep learners (3.99) rather than superficial (3.29) or strategic (3.79).

The somehow weak relation found between deep and strategic approaches (correlation of 0.52) is reflected by the closeness of their means (3.92 and 3.79 respectively).

Table 4: Factor I (Deep) - Descriptive statistics

	N	Mean	StDv
Seeking meaning	82	3,99	0,73
Relating ideas	82	3,92	0,83
Use of evidence	81	3,95	0,75
Interest in ideas	81	3,84	0,87

Within the deep approach to learning it is interesting to note the nearness of responses for the four items (means between 3.84 and 3.99). It is also notable that their standard deviations are relatively low.

Table 5: Factor II (Surface) - Descriptive statistics

	N	Mean	StDv
Lack of purpose	82	3,42	1,02
Unrelated memorising	81	2,87	1,12
Syllabus-boundness	82	3,27	1,11
Fear of failure	82	3,58	1,12

The means of surface apathetic approach items are markedly lower than the deep items, they range from 2.87 to 3.58 and their standard deviations are over one. This is a more detailed indication that students in the course tended to be deep learners rather than superficial.

Table 6: Factor III (Strategic) - Descriptive statistics

	N	Mean	StDv
Organised studying	82	3,62	0,92
Time management	82	3,66	0,94
Alertness to assessment demands	82	3,79	0,96
Achieving	82	4,08	0,89
Monitoring effectiveness	81	4,02	0,74

The strategic approach ended up to be somehow related to the deep approach (correlation 0.52 between them); hence it follows that strategic items have means in the neighbourhood to those of the deep approach.

Table 7: Preferences for different types of course and teaching

	N	Mean	StDv
Deep approach	79	4,12	0,82
Surface approach	79	3,46	0,97

The last section of the inventory intends to draw students' preference for an approach. Table 7 clearly shows that the students on the course had an inclination for the deep approach, since its mean is 4.12 with a standard deviation below one.

Conclusions

For the case of the students of the Department of Industrial Engineering that used the e-infrastructure, ASSIST was a good instrument to discriminate among the three learning styles (deep, surface and strategic).

Results from ASSIST showed that students not only appeared to have developed a deep approach to learning but also they prefer this approach for courses in general.

The research question whether the e-learning infrastructure (synchronous and asynchronous Web portal plus modelled contents, activities and evaluations) had an impact on students' study styles was positively responded: e-learning promoted, in this case, a deep approach to learning.

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