Higher Education in Europe, Vol. 30, Nos. 3–4, October-December 2005 Routledge Taylor & Francis Group

Comparing Traditional and ICT-Enriched University Teaching Methods: Evidence from Two Empirical Studies

FRANCESC PEDRÓ

One of the best ways of incentivating the use of ICTs as university teaching tools is by providing clear evidence that this technology helps to increase educational benefits, i.e., that students learn more and more effectively – in conditions of equivalent efforts by both teachers and students. The point, however, is that little has been reported on the specific impact of Web enhancements on classroom activities – the face-to-face component of traditional courses – and the nature of that impact. This contribution is intended to publish some evidence based on two well-documented experiments on the use of the Campus Global, the e-learning platform for undergraduate, traditional face-to-face courses introduced at the Pompeu Fabra University as early as 1998. The first analyses the failures that often accompany the introduction of ICTs into traditional teaching. The second describes the results of an experiment aimed at comparing the academic performance of two equivalent groups of students of the same subject, one receiving ordinary, lecture-based teaching and the other being taught with the novel use of ICTs. Finally, the results are discussed and future lines of research are proposed.

Although the use of technology in web-based forms of higher education has grown exponentially in the past decade,[1] it is becoming increasingly obvious that traditional university teaching can also benefit from its advantages. Universities all over Europe invest heavily in course management software, expanded networks, and training and support capabilities to introduce web enhancements to traditional courses. There are at least two fundamental reasons that justify this increased investment.[2] The first is that university education has a responsibility to ensure that future graduates are well versed in the use of ICTs, since, in a knowledge economy, such technologies are an indispensable tool of everyday life in the world of work they hope to enter. There can hardly be a single profession or area of academic endeavour, in which progress is possible without recourse to technology, at some level. This in itself would justify efforts made to ensure the omnipresence of ICTs in universities, the incorporation of specific ICT skills subjects as for instance Pack (2003) suggested, and indeed efforts to ensure a cross-sectional approach by sharing ICT training among all subjects. This reason is obvious: in the knowledge society, ICTs are everywhere, and must therefore be present in university education.

The second reason is that ICT may contribute to more and better learning; i.e., they may improve the effectiveness of university education. Clearly, this argument meets

[1] There is no European counterpart yet to the US Campus Computing Project, the annual account of the use of ICTs in American higher education institutions since 1990, the main results of which can be found at <http://www.campuscomputing.net>.

[2] Aside from the benefits that this incorporation may provide for other areas of university life, such as communications, the management of and access to documents on the network.

ISSN 0379-7724 print/ISSN 1469-8358 online/05/030399-13 © 2005 UNESCO
DOI: 10.1080/03797720600625937

with a certain amount of scepticism. Part of this scepticism stems from a reasonable strain of educational conservatism that states that, if previously existing methods and resources prove sufficient to turn out well-qualified graduates, why invest additional effort in making changes if there is no incentive to do so? Clearly, the existence or otherwise of incentives is the result of a classical policy decision concerning the distribution of available resources. Change can only come about if policy "incentivates"[3] it.

Be that as it may, and mostly in the absence of incentive policies, faculty are embracing these tools as well and investing significant time and energy into adding web-based supplements to their traditional courses.[4] Most of the research on web use in higher education has focused on specific applications and their perceived effects on outcomes. Meyer (2002: 1–12), for instance, noted that assessing quality in traditional classrooms settings, when technology plays an important role, is extremely difficult and much of the research comparing the outcomes does not account for changes in instructional design and classroom teaching that may, or may not, accompany the introduction of technology. Meyer, along with Newman and Scurry (2001: B7), suggested that online learning initiatives go beyond the technology itself to encourage institutions and faculty to "question assumptions and renew attention to student learning" (2001). This quest for a renewed teaching paradigm and the role that technology can play has become an urgent issue, particularly for those European higher education systems in which the adoption of the ECTS system in the context of the Bologna Process requires an almost complete re-engineering of the predominant lecture-based teaching methodology. In addition, no doubt, ICTs are bound to have a crucial role in this process.

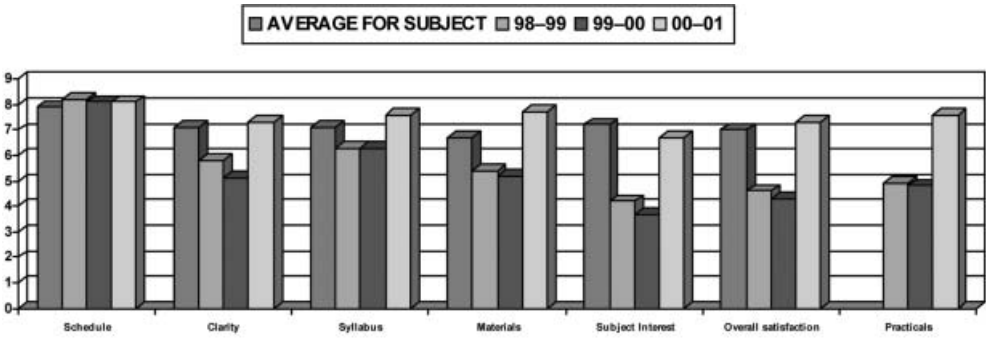
One of the best ways of "incentivating" the use of ICTs as university teaching tools, but not the only one, is by providing clear evidence that this technology helps to increase educational benefits, i.e., that students learn more and better – in conditions of equivalent effort by both lecturers and students. The point, however, is only a few reports exist on the specific impact of web enhancements on classroom activities – the face-to-face component of traditional courses – and the nature of that impact. There are some exceptions, though, such as the pioneering comparison by Smith and Dillon (1999) or the more recent multi-institutional study by Wingard (2004: 26–35), both carried out in the US. In this context of limited evidence availability, this contribution aims at adding more evidences, based on two well-documented experiments on the use of the Campus Global, the e-learning platform for undergraduate, traditional, face-to-face courses introduced at the Pompeu Fabra University[5] in 1998. The first experiment analyses the failures that often accompany the introduction of ICTs into traditional teaching. The second describes the results of an experiment aimed at comparing the academic performance of two equivalent groups of students of the same subject, one receiving ordinary, lecture-based teaching and the other being taught based on the novel use of ICTs. Finally, following the discussion of results, the author proposes some future lines of research.

[3] Term coined by the author.

[4] For an American account of faculty ICT-use, see, the Morgan Report (2003), published by ECAR.

[5] The Pompeu Fabra University is a public, government-funded university in the area of Barcelona, Spain, with no distance courses at all. For an account of the Campus Global, as e-learning platform and the difficulties associated to its use in a traditional, 'face-to-face' university, see Pedró (2001: 83–98).

FIGURE 1. SCORES OBTAINED BY THE SAME LECTURER OVER THREE CONSECUTIVE YEARS AND THE AVERAGE SCORES BY LECTURERS ON THE SAME SUBJECT



Source: The author.

Case 1. Does Technology Improve or Worsen the Quality of Teaching?

The first question we should ask is whether ICTs are essential in the process of improving the quality of teaching, or, in other words, if the introduction of ICTs to standard teaching contributes in itself to the improvement of the quality of teaching. In the case of our university, over the last few years, the efforts made to introduce ICTs to teaching have led to the design and generalisation of the Campus Global.

The first problem that arises is how to assess the quality of teaching and its momentary rises and falls. The case presented below shows that, in institutional terms,[6] the sole criterion available for the measurement of the quality of teaching is student satisfaction, measured through the corresponding survey. Thus, in this first case, this criterion serves to measure the development of the quality of teaching.

Figure 1 shows the survey results obtained by the same lecturer over three consecutive academic years (i.e., 1998–1999, 1999–2000, 2000–2001) for the same subject. Since the same lecturer delivered the same subjects to three groups simultaneously, the scores for each criterion represent the arithmetic mean of the scores obtained in the three groups.[7] The Figure also indicates, as a point of reference, the average scores obtained by all lecturers over the academic year 2000–2001.[8] Appendix 1 offers the exact wording of the survey questions.

An initial assessment of the data shows that, during the first analysed years, student satisfaction positions this subject some way below the average obtained by other lecturers of the same subjects, except for observing the course schedule. In two aspects (subject interest and overall satisfaction with the teaching of the subject), the scores for

[6] In fact, what happens at the Pompeu Fabra University illustrates common practice and cannot be considered as being extraordinary, although it does not resist serious pedagogical analysis. We shall return to this question in the discussion of the results.

[7] We should mention that on no occasion has there been any significant difference in the scores awarded by the different groups.

[8] The average scores of academic year 2000–2001 are taken as reference. These average scores show no significant differences when compared to the ones corresponding to the two previous academic years, i.e. 1998–1999 and 1999–2000. The average for lecturers is not calculated according to the evaluation of practicals since not all subjects taught include practicals.

this subject are below 5. Furthermore, there is a tendency for satisfaction to decrease between the first and second years considered; surprisingly and statistically significant ($P<0.005$), this tendency changes radically over the third year. In all aspects considered in the survey, the scores obtained by this lecturer are above the average scores obtained by lecturers of the same subject. Two exceptions: first, with regard to interest in the subject, which, despite a significant improvement on the previous two years, is still below the average for the studies, albeit a negligible percentage (0.5 percent) and, second, with regard to observance of the schedule, which has always been highly valued. In summing up, something happened during the 2000–2001 academic year, which transformed a subject (the teaching of which had traditionally caused low student satisfaction) into a subject valued higher than the average achieved by the other lecturers of the same subject. This change is so evident that it is even statistically significant.

Questions arise: Does this change coincide with the introduction of the Campus Global into the teaching of the subject? Was it during the 2000–2001 academic year when the Campus Global was introduced?

The answer is negative. Actually, the Campus Global was first introduced into the teaching of this subject in the 1999–2000 academic year. Paradoxically, as seen in Figure 1, if anything accompanied this introduction, it was a patent, though not statistically significant, decline in student satisfaction. It is interesting, concerning this point, to pause for a moment and comment on the reasons that may contribute to explaining this maintained, if not increased dissatisfaction, following the introduction of the Campus Global. The impressions of the lecturer and the opinions expressed by the students in the ''free'' area of the satisfaction survey, as well as through informal conversations, basically highlight the students' lack of practice with the Campus Global at the time and, equally or more so, a lack of points of access to the Campus Global, in the building where this teaching took place and the high degree of obsolete equipment used. However, there are other less obvious reasons related to the pedagogical approach magnified by the Campus Global. In essence, the adoption of the Campus Global initially created an increase in workload for the students; the technology meant it was possible to increase the volume, intensity, and magnitude of the reading and work to be done, without altering the structure of the lectures. Once the initial attraction had passed, the students discovered that the Campus Global, despite enriching the possibilities of study, increased the degree of demand and effort in a subject that, prior to the Campus Global, had not been the case. All of these reasons together only increased student discontent.

In the light of the above, a second question arises: Why then, did the scores obtained significantly increase during the following academic year, 2000–2001? What changed? Did the Campus Global cease to exist?

The answer, once again, is negative. The Campus Global continued to operate, even more so than the previous year. However, what happened was that the lecturer radically changed their teaching methods, using the Campus Global as a support or lever for change. This was undoubtedly the secret of their success. It is appropriate at this point to briefly comment on the characteristics of this new methodological approach, as they are to be found again in other experiments of innovation in University teaching.

Essentially, the characteristics consist of:

- a 33 percent reduction in the number of lecture hours;

- the number of students in working groups (from 6 to 8 members);
- the planning of activities to be carried out by these working groups, based on questions to be solved using the digital materials created as support for the Campus Global;
- seminars to discuss and assess activity results;
- the continuous assessment of students.

The key point was undoubtedly to find a balance between lectures, students' work, seminars held by the lecturer without overloading the students, and the lecturer's serious investment in time and hard work. To achieve this balance, emphasising the design of the learning process followed by the student, and favouring less frequent but closer contact with the lecturer seem to be the key to this subject's success in the eyes of the students.

Therefore, two conclusions arise from the questions formulated concerning this case. The first is that technology, per se, is not a critical factor in the achievement of greater student satisfaction, quite the contrary. The second conclusion is that satisfaction improves if the adoption of ICT applications, such as the Campus Global, triggers a change in teaching method. In other words, it is the change in the teaching method, and not the adoption of technology that results in a higher quality of teaching, measured by student satisfaction.

Yet, these conclusions suggest new questions left unanswered based on the information concerning this case. One such question is whether, besides student feedback and satisfaction compared to other subjects, students actually learn more and more effectively because of the introduction of the Campus Global or, rather, because of a different teaching methodology based on the use of the Campus Global. Another question is whether the relationship between the investment required and the results obtained – in terms of improvement in the quality of teaching – is significant; because it may be that the same resources also invested in other things – such as teacher-training or smaller groups of students – would lead to improved pedagogical performance. The next case deals mainly with the first question.

Case 2. Is It True That More Is Learnt More Effectively?

To determine whether students learn more and more effectively as a result of the changed teaching method made possible by the Campus Global is not an easy task. To begin with, there are two problems that are hard to solve: What is meant by a student learning more, or more effectively? Second, how can one assess and measure this?

Traditionally, in university teaching, the assessment of learning is well reflected, at least to a sufficiently high percentage, by means of an examination on the course content.

Pedagogically speaking, this traditional viewpoint may easily be criticised and it would be enough to establish if an examination on knowledge is a suitable mechanism for assessing the complex objectives that most university courses set for their students, especially when formulated in terms of competence.

The second problem is how to manage and create the conditions to perform an experiment that allows for a comparison of the results obtained by equivalent groups of students regarding the objectives themselves, but with different teaching and learning methods?

TABLE 1. ESTIMATION OF STUDENT EFFORT IN HOURS

Course Elements	Lecture model	Experimental model
Lecture hours	8 sessions of 2 ½ hrs=20 h	8 sessions of 1 hr=8 hrs
Common hours	2 sessions of 3 hrs=6 h	2 sessions of 3 hrs=6 hrs
Individual-/team-work hours	10 hrs	18 hrs
Seminar hours	0 hrs	4 hrs
Total	36 hrs	36 hrs

Source: The author.

Methodological Approach

In the case presented, the options chosen with regard to these two problems are debatable, but the general conditions of university teaching do not allow for alternatives. In terms of the methodology, a group of 92 students enrolled for the same subject were divided into two smaller groups. The division took place at random, based on students' identification numbers (odd or even).

The first group (lecture-based model) received traditional teaching, characterised by 2 1/2-hour lectures by the lecturer, once per week. In addition to attendance, students had to complete an individual piece of work applying the content of the subject. The final assessment was broken down as follows: 70 percent examining knowledge (consisting of three questions and the development of a theme) and 30 percent for the course work completed.

The second group (experimental model, centred around the Campus Global) received teaching which combined lectures (reduced in number to a third of what would normally occur in the traditional model), problem-solving teamwork and, finally, a seminar on the subject of the lecturer. The protocol was as follows: the course was divided into five teaching units and a sixth optional unit. Each unit was presented via a one-hour lecture. The students, organised into groups of up to six members, had to solve four questions for each unit, using materials specifically created for this purpose using the Campus Global.[9] Once the questions were solved, each team sent the results obtained to the lecturer and gathered in a seminar session (of approximately one hour for each unit) at which the students presented their answers and discussed them; finally, the lecturer assessed the students. The teams could propose new answers as many times as they wished in order to obtain a higher mark for each unit. Of the final mark, 70 percent corresponded to the results accumulated from the different pieces of teamwork, assessed continuously at the corresponding seminars held for each team in conjunction with the lecture; 30 percent represented a final examination (based on one question corresponding to each didactic unit of the course).

As seen in the Table 1, equivalent effort was required of both groups, estimated in class hours and work; but the fundamental difference was that, in the case of the experimental group, a higher percentage of student activity was required, in exchange for a reduced number of lecture hours. We should note that the same lecturer delivered both groups' lectures.

[9] The students on the lecture-based group also had access to the Campus Global materials, but such access was in no way a requirement.

Assessment of Results

The methodological approach described, guaranteed obtaining two equivalent groups subjected to alternative methods with equivalent student effort[10] – clearly, the effort required on the part of the lecturer is far higher in the case of the experimental group, both in terms of lecture time and time needed for the preparation of materials. The crucial question concerned the evaluation of the experiment results. Evaluation was approached from three complementary perspectives:

- *Evaluation of learning*. There were two methods chosen to evaluate student learning. Firstly, an objective multiple-choice test was given to address the question of whether students learn more. Secondly, a more complex evaluation method was used, different in each case, as already explained in the description of the methodology. This led, therefore, to two different assessments for each student: that obtained in the objective test and that obtained as a final course grade.
- *Evaluation of student satisfaction*. This question was also crucial, since an important difference in academic results may not so much obey the method used as the effort made by the lecturer in order to guarantee the correct functioning of the teaching and learning processes. Only an equal degree of student satisfaction in both groups could guarantee that the lecturer carried out both methods with the maximum interest and dedication. So as not to interfere with the institutional evaluation, the students were asked to fill in an additional anonymous survey on satisfaction with regard to the teaching received, but in which they had to indicate which group they belonged to, the lecture-based group or the experimental one.
- *External evaluation*. The third component of results evaluation consisted of the contribution of three lecturers on the same subject in other Spanish universities. The reason for external evaluation lies in that it seems necessary to demonstrate that the teaching objectives set out and the content were suitable and equally demanding as those at other universities. This third criterion helps to clear up any shade of doubt concerning the difficulty or the academic level of the course. The results of this third evaluation are as yet still unavailable, given that the corresponding reports have not been received.

Obtained Results

Table 2 offers a summary of the results obtained for both academic performance and student satisfaction. The first two rows show the results obtained at the initial and final tests; the third, the final grades; and the last two indicate student satisfaction with the subject and lecturer. Each column shows the average value; in brackets, is the typical deviation.

The results concerning the tests show, in the first place, that the groups were equal at the start of the course, given that the scores obtained in the initial test show no significant differences between the two. Interestingly, the same thing happens when applying the end-of-course test, where no significant differences are seen either. This result contrasts, however, with the final grades obtained by the students in the two

[10] It may be argued, however, that the effort needed to attend an hour of lectures is not equal to that needed to solve a problem.

TABLE 2. SYNTHESIS OF RESULTS OBTAINED

	Lectures	Experimental	Signification
Initial test	2.7 (2.2)	2.2 (3.3)	N/A
Final test	12.7 (2.9)+10.0	12.3 (2.4)+10.1	N/A
Final grades	7.1 (1.9)	8.2 (0.8)+1.1	%<0.0005
Overall satisfaction	9.4 (0.8)	9.0 (1.2)	N/A
Satisfaction with lecturer	9.8 (0.6)	9.8 (0.6)	N/A

Sour*ce*: The author.

TABLE 3. DATA CORRESPONDING TO FIGURE 1

	Schedule	Clarity	Syllabus	Material	Interest	Overall satisfaction	Practicals
Subject	7.9	7.1	7.1	6.7	7.2	7	–
98–99	8.2	5.8	6.3	5.4	4.2	4.6	4.9
99–00	8.1	5.1	6.3	5.2	3.7	4.3	4.8
00–01	8.1	7.3	7.6	7.7	6.7	7.3	7.6

Source: The author.

TABLE 4. DATA CORRESPONDING TO FIGURE 2

	Schedule	Clarity	Syllabus	Material	Interest	Overall satisfaction	Practicals
Subject	7.8	6.6	7.3	6.5	6.7	6.7	
00–01	9.1	9	8.8	8.8	8.7	8.9	8.5

Source: The author.

groups, where, statistically, there is a very significant difference in favour of the experimental group, achieving, on average, one point more than the lecture-based group. There are many ways in which these differences may be explained, but emphasis should be laid on the essential cause: the grades obtained by the experimental group are, at least, equivalent to those of the lecture group – as can be seen in the results of the final test. Nevertheless, in greater depth, it should be borne in mind that, due to their very nature, the questions in the test are memory – or comprehension-oriented. This is an important factor when evaluating the differences obtained in the final evaluation. The final evaluation considers other equally important aspects, which go beyond memorising concepts or understanding their relationships and test the ability to interiorise the essential aspects of the course concerning the analysis or the conveyance of learning, which is better reflected in the continuous assessment throughout the course than by means of the multiple choice test.

Finally, it is also important to realise that the experimental group has a far lower typical deviation than the lecture group, which should be interpreted as a more homogenous achievement of the objectives set out by this group of students. It is an indirect, but equally suitable measurement of the goodness-of-fit of the experimental

methodology, reducing the differences in level between the students, despite achieving clearly higher performance.

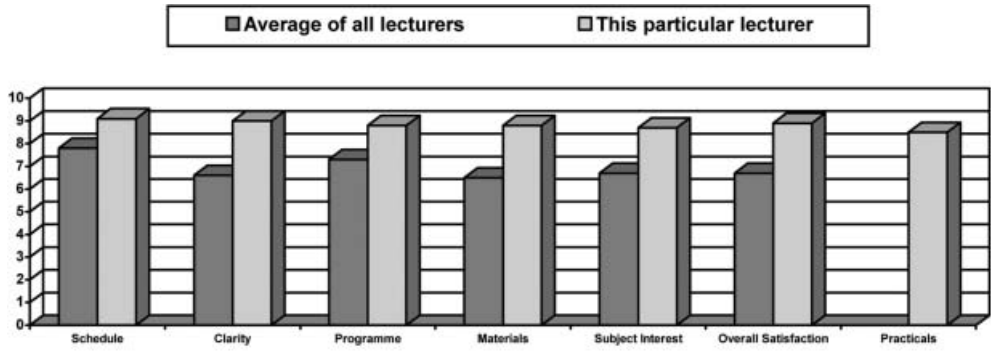
As an indicator of student relative satisfaction, we should also consider the evaluation of this subject teaching compared to others of the same studies, as shown in Figure 2.

It can be seen that the scores obtained for the subject are superior in all aspects of the institutional survey to the average obtained by the lecturers of the same studies and are all in the upper percentile. When comparing the experiment with regular teaching, the data are of great significance, as they show that the students value the teaching of this subject most highly in both modalities.

What conclusions may therefore arise from this second case? The most resounding conclusion – already mentioned – is that the experimental methodology guarantees the achievement of the same didactic objectives as traditional methodology, in terms of the memorisation of concepts and their understanding. Moreover, it does so, with significantly less input than teaching through lectures (8 hours compared with 20 for the lecture group).

Second, if in addition to the traditional objectives of lecture-based courses, as reflected in traditional exams, assessment of student learning is on a continuous basis throughout the course and with criteria that reflect analytical ability and the conveyance of the subject matter, then the results are far superior in the case of the experimental methodology. This is, by no means odd, given that, inherent to the methodology of this course, learning is based on research and interpretation and not merely on rote learning. Furthermore, the group achieves the aims far more homogeneously than the traditional group and, therefore, the distance separating those who have learnt best from those who have done so less successfully is far lower in the experimental group. In short, the second case itself can justify the efforts made towards favouring experimentation with new methodologies. Nevertheless, it is still questionable whether the criteria for the continuous assessment applied may contain subjective bias by the lecturer or, in other words, whether the continuous assessment applied decidedly favours one type of result of learning other than what we may traditionally expect of a university course.

FIGURE 2. SCORES OBTAINED FOR THIS LECTURER COMPARED TO THE AVERAGE SCORES BY THE LECTURERS OF THE SAME STUDIES



Source: The author.

Discussion

In view of the results of the two cases, we should go back and answer the question of whether the intensive use of ICTs – in our case, the Campus Global as an e-learning platform – really manages to improve the quality of teaching, even leading to students learning more and more effectively. In the light of the cases analysed, the answer is plainly and clearly affirmative. It has been seen how the students learn at least the same as if their learning is exclusively assessed in traditional terms, by means of objective tests that measure the acquisition of concepts and their understanding. Nevertheless, in greater depth, for reasons related to the methodology adopted, the students that follow an experimental modality score higher in the continuous assessment, and achieve their objectives far more homogeneously as a group than when they are the object of traditional teaching methodologies.

Now, the opposition to these two conclusions is equally categorical. The first point is that continuous assessment should be the subject of an external audit. The second is that, in order to conclude the superiority of the methodologies that hinge around the intensive use of ICTs, the students should be re-evaluated later. On the one hand, there would be a deferred assessment of the persistence of the learning, and on the other hand, of maintained student satisfaction once they have already started working. Thus, there is a need for such deferred, external evaluation that should provide evidence that is more conclusive.

However, the most critical observation with regard to the previous conclusions has to do with the role played by the Campus Global as an e-learning platform in improving the quality of teaching. The combination of the results of the two cases analysed seems to show that, although technology is the most apparent and innovative, the key to improving both the quality of learning and student satisfaction is not the technology per se but rather the change in teaching methodology and organisation induced and made possible due to the e-learning platform. As Smith and Dillon noted, "…it is not the technology that has an effect; it is the way it is used" (1999: 23). It may well appear to be an obvious conclusion for many, but what is important now is to avail of conclusive evidence to this end. Therefore, it may seem that the Campus Global and, in general, the intensive use of ICTs, is an unnecessary luxury because, in the end, what is relevant is the change in teaching method and organisation and not the technology used. Accepting that some truth does lie in this statement, it may be turned around and the question may be asked as to whether the experiments of changing the methodology presented here would also have come about if the Campus Global had not clearly introduced a question mark concerning the traditional teaching practices and how to innovate them in order to improve the quality of university education.

Whatever the value of this last observation, we should acknowledge the role as a lever of change,[11] inductor, or opening a window on the opportunity that an intensive use of ICTs may represent to innovating and improving student learning in regular teaching. The response to the need for pedagogical improvement is not the Campus Global, because it is and must be conceptualised as being purged of traditional teaching practices that questions whoever uses it. For the same reason, to present the use of e-learning platforms as mere complements to teaching, as an extension to the

[11] See the discussion about technology as a lever in implementing sound pedagogical changes in undergraduate university education in Chickering and Gamson (1987: 3–7); Chickering and Ehrmann (1996: 3–6).

traditional lecture-type class, means renouncing the potential for didactic renewal to be contributed to university teaching and this would be a use that would probably never justify the extra teaching effort – in terms of teacher dedication – which is, for the time being, implicit. The changes in the teaching process identified here – such as adjustments in the amount of lecturing, focus, and difficulty level of lecturing; increased interaction; heightened student engagement; increased comfort levels; and heightened faculty expectations – seem to evolve over time and with experience. The point is that the longer the faculty work with the Web, the more likely they are to pursue and derive pedagogical benefits from the technologies, but this process may take longer and require more collaboration than anticipated.

In addition to these two cases, and after more than five years of intensive use of the Campus Global – mandatory in more than 50 percent of all undergraduate courses – the university has drawn additional conclusions:

1. The use of technology in a given course does not lead to any financial saving (rather the opposite) and nor does it lead to any reduction of teaching effort. The only exception being when implementation (and the required spending) is over a medium- or long-term period and groups are sufficiently large for there to be significant savings.
2. It would appear to be clear that, at least for the lecturer, the benefits of the investment start to materialise in the third year, when sufficient experience has been gained in working with the materials, technological platform and methodology, and when the effort required for design and production of teaching materials is reduced to simple maintenance.
3. When the incorporation of technology into a subject lacks a reform in the teaching methodology, the results are negative in terms of student satisfaction, since workload tends to increase.
4. There is no conclusive evidence that introduction of technology into ordinary courses, even when accompanied by changes in teaching methodology, leads to improved academic performance by students – at least not if measured in traditional terms, for example in terms of retention; however, neither do results deteriorate; nor does student satisfaction appear to vary in any significant manner.
5. It is highly probable that the academic benefits of intensive use of new technologies are not evident because our conception of academic benefit is a traditional one. These benefits remain hidden or perhaps intangible, as exams or other standard traditional evaluation mechanisms fail to reflect them.
6. It would appear reasonable to conclude that teaching methodologies strengthen student's role in common or shared area skills, such as teamwork or problem solving. Therefore, work needs to be done on how best to evaluate these skills, and for a comparison of the benefits of traditional and technology-weighted approaches in this regard.
7. The specific skills required for the academic use of ICT can be acquired during secondary education.

The main conclusion is however, that the main benefits of the ICT-use for university education are not the direct outcome of the technology itself; rather they arise from the fact that the use of technology leads lecturers to perceive the need for rethinking teaching methodologies and the ways in which they manage the whole process of students' knowledge acquisition.

Future Lines of Research

Bearing the above in mind, there would appear to be at least three different issues awaiting further research. These three areas must be seen as policy priorities due to their importance for the management of teaching.

First, we need to identify precisely and evaluate the new skills and objectives (as opposed to the traditional skills and objectives) associated with the intensive use of ICT in university teaching. If, as has been found, traditional evaluation methods find both approaches to be equivalent, how then can we claim that an approach departing from traditional methodology and placing the emphasis on the student is better? In what sense is it better? And finally, we must ask whether these new objectives are of central significance or whether they are merely complementary.

The second area requiring research is the exact definition of the real contribution of ICT to teaching in traditional university settings. If, as it would appear, the determining cause of differential learning lies in methodology more than technology, then we must ask whether Campus Global, in addition to its stimulating effect, serves the improvement of teaching. In short, how much of teaching innovation or methodological change is due directly to Campus Global or more generally to ICTs, and how much is quite independent of it?

The third area lies in an entirely different domain. If we assume that technology-based teaching methodologies lead to better performance in terms of teaching objectives, i.e., students learn more and learn more effectively, then we must ask what is the economic cost of this improvement – organisation of teaching, materials preparation, infrastructure costs, etc. Is this economic cost in proportion to the pedagogical gain? Does the pedagogical gain justify the extra cost?

Clearly, the two critical and original questions – How much more and how much more effectively do students learn? and What is the cost of this advance? – should not lead to a reduction of our willingness to experiment with new methodologies, thereby contributing to a deepening of educational debate within the universities and especially, providing a basis for decision-making with regard to management of university education in the context of the knowledge society.

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Appendix 1

Wording of the Questions Included in the Survey on Student Satisfaction

Question 1: Does the lecturer attend classes according to the established schedule?
Question 2: The lecturer's explanations are clear
Question 3: The syllabus is covered in the classes
Question 4: The teaching materials are suitable
Question 5: The subject is interesting
Question 6: Overall I am satisfied with the teaching I have received