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Volume II
Innovation in Web-Enhanced Learning

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INTRODUCTION

While virtual universities and remote classrooms have captured the headlines, there has been a quiet revolution in university education. Around the globe, the information and communications technology (ICT) infrastructure needed to support Web-enhanced learning (WEL) is well established, and the Internet and the World Wide Web (the Web) are being used by teachers and students in traditional universities in ways that complement and enhance traditional classroom-based learning (Observatory of Borderless Education, 2002).

The Web is most frequently used by traditional universities to provide access to resources—as a substitute for, or complement to, notice boards, distribution of handouts, and use of the library (Collis & Van der Wende, 2002). Therefore, most of the change has been incremental rather than transformational. Adoption of WEL has yet to meet its potential—some would say the imperative (Bates, 2000; Rudestam & Schoenholtz-Read, 2002)—to change the nature of learning at university and to transform the university itself.

BACKGROUND

WEL makes a difference when it is used to improve learning, for example, when it is used to enable collaborative learning (Hamilton & Zimmerman, 2002; Klobas & Renzi, 2003; Rudestam & Schoenholtz-Read, 2002). Nonetheless, computer-supported collaborative learning (CSCL) that makes a difference does not require expensive technologies (Hazemi & Hailes, 2002; Hiltz & Turoff, 2002).

To achieve effective, substantial, system-wide change through the adoption of new educational technology, universities must pay attention to more than the ICT infrastructure. Attention must also be paid to educational values, resources, and transformation of educational processes and organizational structure. Thus, WEL is more than new software and systems—it is organizational innovation.

Observers of the effect of technological change on universities emphasize the factors associated with effective change. These factors include reexamination of assumptions about pedagogy (Leidner & Jarvenpaa, 1995; Rudestam & Schoenholtz-Read, 2002), vision and leadership to implement large-scale organizational change (Bates, 2000), adequate financial resources (Surry, 2002), attention to development of human resources and reward systems (Collis & Van der Wende, 2002; Pollock & Cornford, 2000), student aptitude and preparation (Palloff & Pratt, 2002), and professional management of suppliers as well as internal ICT infrastructure (Klobas & Renzi, 2003). Less is known about the process of change.

Rogers (1995) proposes a generic model of the process of organizational innovation. Innovation is initiated through identification of organizational problems and the matching of potential innovations with problems. The relevant innovation may be an idea, a process, a technology, or a combination of these (Spence, 1994). The end of the initiation period is marked by a decision to adopt (or reject) the innovation. Subsequently, during the implementation period, the innovation and the organization undergo some mutual redefinition (Orlikowski, 1992), the organizational role of the innovation is clarified, and its use finally becomes such a familiar part of the organization’s activities that it is no longer recognizable as an innovation. Table 1 summarizes these aspects of the innovation process.

In this article, we study the process of WEL adoption at a traditional university using Rogers’ (1995) model of organizational innovation as the organizing framework. More detail of the case study described here can be found in Klobas and Renzi (2003).
Innovation in Web-Enhanced Learning

A CASE STUDY IN EDUCATIONAL INNOVATION

In 1998, Bocconi University, a private (non-profit) business university in Milan, Italy, announced the adoption of WEL to support new approaches to teaching. At the time, this single faculty university had around 12,000 students and a well-developed ICT infrastructure for Internet access. Quality of education is important to the University, which has a reputation for high standards and outstanding completion rates.

Agenda Setting

Several events contributed to setting the agenda for the change. In 1997, the Italian government announced significant changes to the educational system. Instead of offering the centuries-old mix of short (three-year) and long (four- to six-year) first degrees, a two-tiered system of a three-year first degree plus a two-year higher degree would be offered from the academic year beginning in October 2001. At the same time, the University was planning for significant growth and examining ways to further improve the quality of education.

Matching

The University was aware, through teachers’ experiments with online learning and multimedia, of the potential for e-learning platforms to enable more active student involvement in learning. In May 1998, the University’s Multimedia Committee established a working party to introduce a platform for WEL. The cross-functional working party consisted of all the people needed to implement an initial pilot project, including pilot teachers, the group in charge of technological infrastructure design and implementation, and those responsible for computer center operations. The working party was thus able to monitor, from its initiation, all aspects of project feasibility. The most senior figures in University administration (the Managing Director) and teaching and learning (the Pro-Rettore for teaching) participated in working party meetings where key decisions were to be made. Information was therefore exchanged directly and decisions made quickly. All involved in the project were personally involved in planning and shared responsibility for project’s success.

<table>
<thead>
<tr>
<th>STAGE</th>
<th>ACTIVITIES</th>
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<tbody>
<tr>
<td>I. INITIATION</td>
<td>The organization becomes aware of problems that are perceived to require resolution through some form of innovation</td>
</tr>
<tr>
<td>Agenda-setting</td>
<td>A fit is found between a problem from the organization’s agenda and a specific innovation</td>
</tr>
<tr>
<td>DECISION</td>
<td>The organization decides to implement the innovation (or not to go ahead)</td>
</tr>
<tr>
<td>II. IMPLEMENTATION</td>
<td>The innovation is re-defined and the organization re-structured in a mutual process of reinvention and restructuration as a fit is sought between the innovation and the organization</td>
</tr>
<tr>
<td>Re-defining/Re-structuring</td>
<td>The relationship between the organization and the innovation is clarified</td>
</tr>
<tr>
<td>Clarification</td>
<td>The innovation becomes routine</td>
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</table>

Table 1. Rogers’ (1995) model of organizational innovation
Innovation in Web-Enhanced Learning

Goal Setting

Throughout the matching period, and indeed throughout the project, the innovation was defined as e-learning or WEL for on-campus students, rather than software adoption. The project was therefore a business project, driven by business goals, and implemented through new ICT. The long-term vision was to improve the quality of teaching and learning at the University. The short-term goal was to introduce WEL in a limited number of pilot courses, commencing in the first semester of the 1999-2000 academic year.

The first actions of the working party were to identify the critical technical elements in an e-learning project and a model for representing different uses of the World Wide Web to enhance the learning of on-campus students. Critical technical elements included the availability of PCs, provision of laboratories, network bandwidth, remote connections, and training. Drawing on Angerhn’s (1999) classification of Internet business strategies as creating virtual spaces for information, communication, distribution, and transactions (the ICDT model), the working party defined five profiles of use of the Web to enhance on-campus learning (Table 2).

All courses at Bocconi already had a traditional Web presence. The project was therefore concerned with enabling more complex uses, in particular, use of the interactive Web (level 3) and CSDL (level 4) profiles. This approach was endorsed by senior management in August 1998.

Software Selection

Two strategies were used to identify software that might meet the University’s needs: benchmarking during visits to other leading business universities, and presentations from major software and system suppliers. Microsoft and IBM were invited to submit preliminary proposals. A Microsoft solution would involve development of a custom-made system, while the IBM solution was based on IBM-Lotus LearningSpace.

Decision

In January, after meetings with the suppliers, working party opinion was split between the two solutions. The dilemma was referred to senior management, who opted for LearningSpace but also allowed experimentation with Microsoft-based development. This approach would reduce the risk associated with initial implementation because IBM—a long-term supplier of significant systems to the University—would act as lead partner across the whole project, managing network capacity planning, server configuration, software installation, tuning and monitoring of the system, on-site support, and training of technical staff, teachers, and students. At the same time, it supported development of innovative, custom-built systems without exposing these systems and the University to the risk associated with testing and development for large-scale implementation.

Redefinition

The implementation process began with the working party’s definition of the technical and human require-

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Table 2. Hierarchy of WEL use profiles

<table>
<thead>
<tr>
<th>Level</th>
<th>Label</th>
<th>Use</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Traditional web</td>
<td>An environment to inform about the course. The course web site usually available at universities, containing course description, book lists, timetable, teacher name(s) and contact details, exam procedures and calendar.</td>
</tr>
<tr>
<td>2</td>
<td>Advanced web</td>
<td>An environment to distribute educational material. Content is more dynamic, put online from time to time during the course. Content may include: educational material used by teachers in the classroom (slides, case studies, newspaper articles, site URLs related to course content), text of past exams, exam solutions, communication from teachers and the University.</td>
</tr>
<tr>
<td>3</td>
<td>Interactive web</td>
<td>A bi-directional interactive environment. Teacher-student and student-student interactions based mainly on course forums, resource contributions, self-evaluation tests, delivery of assignments, and secure online exams.</td>
</tr>
<tr>
<td>4</td>
<td>CSDL</td>
<td>A CSDL (Computer Supported Collaborative Learning) environment with learning in student groups. Supports collaborative group learning and activities that go beyond those possible with simple course forums. Activities may include group projects that involve sharing materials or preparation of joint documents.</td>
</tr>
<tr>
<td>5</td>
<td>Experimental</td>
<td>An experimental environment for pilot applications and testing new ideas. Available for teachers to experiment with new tools or technological solutions.</td>
</tr>
</tbody>
</table>

a. Use at each level includes uses at each preceding level; b. This level was later split into two: a) distribution of standard course material, and b) distribution of additional material by individual class teachers.
ments for implementation in February-April. The risk associated with introducing a technologically complex new system at the beginning of the academic year, with relatively large numbers of students enrolling and placing a heavy and somewhat unpredictable load on the system, was sufficiently high that other aspects of project initiation were designed to be as low-risk as possible. Three courses were selected for pilot implementation in the first semester of the 1999-2000 academic year. Altogether, around 500 students in five classes were involved. Specific teachers were chosen because they already had considerable experience in use of technology in education. The computer center team that already supported teachers acted as project manager and interface with the supplier.

Initial Redefinition of Teaching and Learning

Redefinition of teaching and learning began with teacher training. The training combined online course design with software skills. Trainers advised teachers on ways to use the software to meet their educational goals. All pilot courses were at least partially redesigned to include CSCL activities for students such as directed online discussions, collaborative online group work and in-class group presentations.

By the first day of semester in September 1999, initial course materials were loaded, the system had been tested, and load simulations done. The information technology infrastructure had been upgraded, a Lotus Domino server was activated, and the building’s office had fitted out two new classrooms with PCs dedicated to project activities. Online LearningSpace courses were developed for students, and a tutor was assigned to each of the classrooms. There was a strong sense of camaraderie among those who had planned for the start-up, a recognition that some teething problems were inevitable, and a commitment to identify and resolve problems rapidly.

Some Technology Redefinition

As use of the system increased to peak load during the initial weeks of semester, response times deteriorated. Monitoring tools revealed bandwidth saturation at a critical point in the network. In a combined action, the computing center and IBM rapidly installed and configured a second server and re-allocated resources within the University network. This solved the problem and provided information with which to review some components of the system architecture and plan additional features to balance the load.

Mutual Redefinition of Technology and Teaching

The educational success of the pilot implementation was monitored during the semester and in formal end-of-semester evaluations. Across all the courses, 77% of participating students agreed that they would like other courses at the university to adopt WEL. Redefinition of university education began for these students as they adopted and adjusted to the new ways of learning introduced in these courses.

The pilot demonstrated that LearningSpace was suitable for CSCL (level 4), but would it also be suitable for more simple uses of WEL? The platform was tested with the advanced Web (level 2) profile during a second pilot semester. All 2000 students enrolled in a large, core unit were issued the same username and password, enabling them to download course material and participate anonymously in course forums. Both staff and students regarded this trial as a success; it provided a simple system for giving students timely course materials and an optional forum for discussion.

The success of the first year, from the points of view of system reliability, ease of use, student demand, and learning outcomes, produced an unexpected outcome—teachers who had not participated in the first-year trials began to request LearningSpaces for their courses. By the end of the third year (2001-2002), 25% of the University’s courses were supported by LearningSpace and a significant proportion of the student body had used the system for at least one course.

As new teachers adopted WEL and LearningSpace, they too redefined their modes of teaching and learning; 94% of all courses that used LearningSpace incorporated some form of active learning (adopting either an interactive Web or CSCL profile), and only 6% used it just to distribute course materials (advanced Web). The technology had enabled and encouraged teachers to adopt more varied approaches to teaching and learning than they had used in the past. Where the teachers incorporated more active learning in their courses, students expressed high satisfaction with learning technology and a desire to have it adopted more widely across the university.
Clarification

Clarification of the relationship between the University and the innovation began when the most active LearningSpace teachers met in July 2001 to reflect on their experiences during the first two years. They developed a list of suggestions for enhancement of WEL at the University, including:

- suggested migration paths for teachers moving from traditional classroom teaching to WEL;
- suggested migration paths for teachers moving from simple to more complex uses of WEL;
- increased technical support for teachers wishing to adopt WEL;
- deeper analysis of the relative roles of teachers, tutors, and other support staff as the modes and methods of teaching and learning change;
- incentives for teachers; and
- other structural redefinition to underpin and sustain the redefinition of educational method and technology that occurred during the previous two years.

These issues were reiterated in a review workshop in June 2002.

Routinizing

Routinizing is occurring at a different rate at different layers of adoption. For individual teachers and students, WEL became routine during the first course in which it was used. Once a teacher has used LearningSpace in one class, it seems natural for him or her to use it in other courses that he or she teaches. Student pressure on teachers to adopt LearningSpace is an expression of how its use is routine for the students. At the organizational level, routinizing began when the computer center, without questioning, activated LearningSpace for any teacher who requested it. Nonetheless, the teachers’ suggestions for change indicate that several issues related to pedagogy, organizational structure, and reward systems need to be resolved if WEL is to become routine.

Success Factors

The case study described in this article confirms other authors’ observations about the factors associated with success of educational technology in universities. A clear vision of the required educational change, reliable ICT, and training of staff and students all contributed to the early success of the project. By studying the process of innovation, we have also been able to identify operational issues associated with success. These include a strong and well-defined relationship with the technology partner, and leadership by staff with knowledge and experience of educational innovation, supported by an active steering committee that is representative of all the groups and points of view needed for successful implementation. Ongoing success, however, will require greater attention to support for radical change in pedagogy and organizational structure and associated changes in staffing structure and reward systems.

FUTURE TRENDS

Recognition that WEL is an organizational innovation underlines the significance of the organizational and pedagogical change that accompanies its implementation. Both university and technology will undergo changes as teachers, students, and administrators gain more experience with WEL. Until WEL becomes routine, universities need to be aware of the process of mutual redefinition of organization and technology, attending to the requirements of the organization as well as to changes in pedagogy and ICT if the potential of WEL is to be achieved.

CONCLUSION

We have presented a case study in educational innovation and confirmed that management vision, leadership, appropriate technology, planning, training, teamwork, and project management all play a role in success. A successful project is, however, insufficient for successful innovation. Pedagogy and the university itself undergo change as both technology and organization are redefined during implementation. To achieve transformational change that goes beyond current incremental changes, universities need to recognize, support, and manage the restructuration, redefinition, and clarification that are part of the process of organizational innovation that is WEL.
REFERENCES


KEY TERMS

**Adoption:** The decision to implement an innovation.

**Agenda Setting:** Recognition of a problem that may be solved through innovation.

**Collaborative Learning:** Learning that occurs through the exchange of knowledge among learners.

**Implementation of an Innovation:** The process of mutually fitting innovation and organization to one another until the fit is so good that the (former) innovation is routine.

**Innovation** (noun) A new technology, idea or process; (verb) The process of identifying, adopting and implementing a new technology, idea or process.

**Matching:** The process of finding a fit between an organizational problem and an innovation to resolve the problem.
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Redefinition: The process by which an innovation is redefined to fit the organization during its implementation. See also Restructuration.

Restructuration: The process of structural change associated with an organization’s implementation of an innovation.

Routinizing: The final stage in the innovation process; the innovation becomes part of the organizational routine.

Web-Enhanced Learning (WEL): Use of the World Wide Web (Web) to provide students studying in the classroom with access to electronic resources and learning activities that would not be available to them in traditional classroom-based study.