ICT Supported Learning: A New Institutional Approach

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ABSTRACT

ICT diffusion at any level of society is offering a great opportunity to promote innovation in teaching and learning.

This paper presents the experience of Bocconi's Information Systems department in the field. Bocconi's I.S. Department has been an early adopter of any innovative teaching methods and of ICT in its courses both at the undergraduate and postgraduate levels.

Since the Spring semester 2000 it adopted Learning Space as pilot environment for one of the Management Information Systems classes (undergraduate level) and some of the executive courses of the Business Schools.

After three years of use and having a relatively big research sample (about 300 users) the research team can now sum up some of the most interesting results, which are the focus of this paper.

The analysis of the field experience bases on a research model which identifies the variables influencing the adoption and use decision of both students and instructors. Among the most interesting results of the research project it is worthwhile to mention the institutional variables which affect the first adoption decision and the successive decision to continue the use. Institutional variables include tangible factors, such as technical infrastructure or financial incentives, and intangible variables, such as friends' or colleagues' pressure.

INTRODUCTION

Information and Communication Technologies permeate everyday life [Drucker, 1993; Negroponte, 1995; Galimberti, 1999; Varian, Shapiro, 1999; Evans, Wurster, 2000] and education also experiences this trend [E.U., 1995; E.U., 2001; OECD, 2001], even if up to now it is not as advanced as other branches of society.

This statement leads to a logical conclusion: the use of ICT in education is no longer an option, an alternative to traditional education approaches, but it is a "must".

In other words, teachers and professors can no longer discuss whether it is worthwhile to use or not to use ICT in their courses, but they have to concentrate on how to use technology.

Even if relevant from any perspective (practice and pedagogy, to mention but few), the debate about how to introduce ICT in education has not reached a commonly agreed approach, yet.

Experiments and pilot studies have been launched in several countries and the first results are published and discussed.

This paper presents the experience of Bocconi's Information Systems department in the field. Bocconi's I.S. Department has been an early adopter of any innovative teaching methods and of ICT in its courses both at the undergraduate and postgraduate levels.

Since the Spring semester 2000 it adopted Learning Space as pilot environment for one of the Management Information Systems classes (undergraduate level) and some of the executive courses of the Business Schools.

After tree years of use and having a relatively big research sample (about 300 users) the research team can now sum up some of the most interesting results, which are the focus of this paper.

The first paragraph proposes an overview of the most recent literature about ICT based learning, with emphasis on factors influencing the use of ICT within courses. The review of dominant literature leads to the design of the research model (paragraph 2) that the research team developed to support data analysis. Paragraph 3 gives an overview of Learning Space experience in Bocconi. Eventually in the last paragraphs the main conclusions are discussed and some of the open questions are listed.

THEORETICAL BACKGROUND

Several theoretical approaches influenced the research project. In particular, they can be divided into two different classes:
- Pedagogical approaches regarding new learning models and the role of ICT in education, which influence the implementation and management of Learning Space course;
- Literature about Information Systems use and New Institutional theory, influencing the analysis of Learning Space experiences.

Pedagogical Approaches

The changing philosophical paradigm (from "Modernism" to "Post-modernism") is also deeply modifying the pedagogical approach of Western education. This evolution is consistent with the approach envisioning that the turn into the Post-modern stage is demonstrated by the reinforcement of "weaken structure" (opposed to the "strong structures" of the Modern Era). Therefore, rationality itself is less rigid, is softer [Vattimo, Rovatti, 1983; Vattimo, 1999].

Education also experiences this change, as its main objective is no longer to transfer technicalities or rules, but to teach how to learn. This implies being able to cope with ambiguity, diversity, uncertainty.

The traditional objectivist model of learning is being replaced by the constructivist model of learning (Figure 1) [Leidner, Jaarvenpaa, 1995; Van Baalen, 1999].

The objectivist model of learning considers reality an external variable, independent from the interpretative scheme of each individual. The first task of instructors is to structure objective reality into abstract and/or generalized representations. Then he/she tries to efficiently and effectively transmit these representations to the learner. Under this perception, learning coincides with an uncritical absorption of objective knowledge by the learner.

The teaching and learning style consistent with the basic assumptions of the model are, respectively, top-down and passive.

Figure 1– Relationship between the reason's crisis and learning models
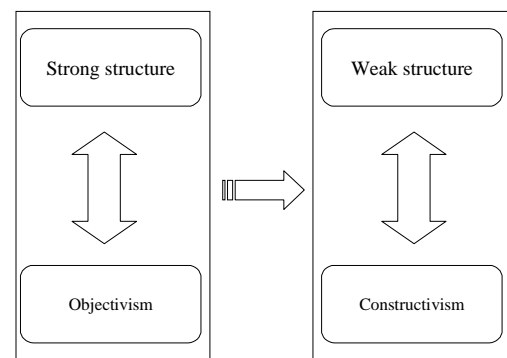
The constructivist model considers the existence of an objective world, but, unlike the objectivist model, denies the existence of an external reality independent of the interpretative scheme of each individual's mind. The learner, not the instructor, constructs the "reality" which is his own subjective representation of the objective

world. This poietic process is based on particular learner's experiences and biases. In this sense learning is the formation of abstract concepts to represent reality, while the task of teaching is to enable this creative process[1]. The objectivist model is instructor-based because the instructor has control over the learning environment, while the constructivist model is learner-based because the learner is the protagonist of the learning process. Then, according to the principles of the model the learning style and the teaching style are respectively active and bottom-up (Bielli, Basaglia, 2000).

Constructivism has two main offsprings [Leidner, Jarvenpaa, 1995]: the cooperative model of learning and the cognitive information processing model of learning.

In the basic constructivist model the learning process has an individual dimension, in fact the learning process bases on the interaction between the individual (with his/her own experiences and biases) and the objective world. The collaborative model substitutes this individual dimension with a group dimension in which knowledge emerges as a consequence of the interaction of individual with other individuals. In this sense the goal of teaching is to facilitate group dynamics [Bielli, Basaglia, 2000].

The cognitive information processing of learning focuses on cognitive processes which characterize each students involved in the learning process. The main assumption of the model is that students differ in terms of cognitive styles. Different cognitive styles imply different learning techniques and tools because cognitive styles influence the impact of instructors' inputs on mental model, that is the degree with which students recall or process instructors' inputs. The relationship between cognitive styles and learning techniques suggests the need for a personalization of learning processes (in terms of presentation form or contents) [Bielli, Basaglia, 2001].

Some authors[2] argue that technology *per se* is neither good nor bad in education; its use might produce positive or negative effects depending on its consistency with the learning and teaching objectives and on the interaction between education system and its environment.

Information Systems Use and New Institutional Theory

Adoption and use of ICT in learning (i.e. e-learning) can derive reference models from the literature field which observes in general the adoption and use of ICT. In particular, the research model is influenced by reflections on the decision process in ICT and on the factors explaining why some users keep on using ICT systems, while others reject them.

Beside this research stream which usually takes an individual's perspective (the decision maker or the adopter is often considered as an individual isolated from the environment), the authors considered both literature on diffusion of innovations and new institutional theories which focus on the environment (social, economic, technological sphere) as one of the key explanations for adoption or non adoption.

The main references influencing the research model are listed and briefly commented in the following table (Table 1)

RESEARCH MODEL

The research model identifies two main decision stages: the Acceptance

Table 1 – Literature review

Authors	Theory, Model, Content	Relevance for our research model
Bhattacherrjee, 2001.	Post-Acceptance Model of Information Systems Continuance	The distinction between Acceptance and Continuance ("acceptance and continuance are two temporally and conceptually distinct and possibly incongruent phases of I.S. use", p. 357).
Davis, Bagozzi, Warshaw, 1989.	Technology Acceptance Model (TAM)	The suggestion of variables influencing Acceptance of I.S.
Compeau, Higgins, Huff, 1999.	Social Cognitive Theory	The linkage between cognitive factors, affective factors and usage.
Rogers, 1995.	Diffusion of Innovations; The innovation-decision process.	The role of earlier adopters; the distinction between Adoption and Continued Adoption.
Meyer, Rowan, 1977; Powell, DiMaggio, 1983; Scott, 1987; Powell, DiMaggio, 1991; Scott, 2000.	New Institutional Theory	The role of institutional environment and institutional pressures.

Figure 2 – ICT Acceptance model: students' perspective
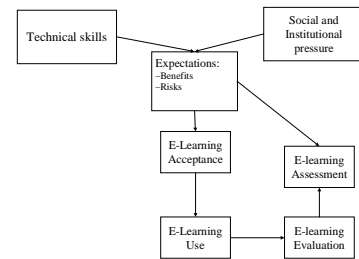
stage and the Continuance stage. Each stage is split into two levels: the student level and the instructor level.

At the first level of the acceptance stage, the framework identifies the variables affecting the process of acceptance and use of I.S for the students. The core idea is that the student's decision is mainly influenced by the expectations – positive (that is benefit) or negative (that is risk) - of the course which in turn derive from technical skills or from the social and institutional pressures (i.e. internal marketing campaigns promoted by the university, and so on) (figure 2).

The instructor's decision to accept and to adopt (use) I.S. is similarly influenced by his/her expectations (benefits and/or risk) of the course which are again influenced by the instructor's previous experience with multimedia or innovative teaching/learning, by

social and institutional pressure (i.e. department policies, colleagues, etc.) and by technical and pedagogical skills. Moreover, previous experience is influenced by technical and pedagogical skills (figure 3)

In the second stage (continuance phase), the student's decision to continue to use e-learning is largely influenced, from one side by the same variables of the first stage, but with different intensity or factors (in terms of research methods it means same variable, but different operators); at the same time decision is also influenced by a new variable, previous experience. Previous experience influences expectations and technical skills, in particular, it improves students' technical skills (figure 4).

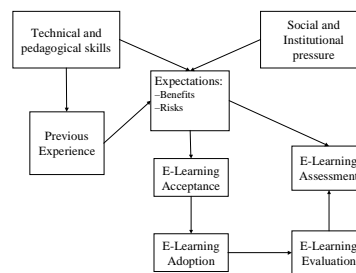*Figure 3 - ICT Acceptance model: instructors' perspective*

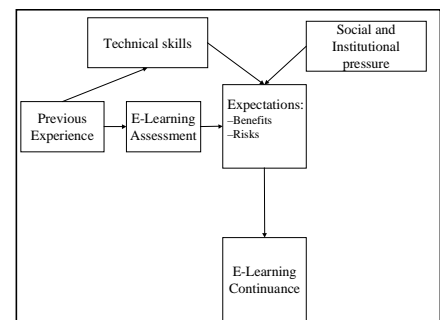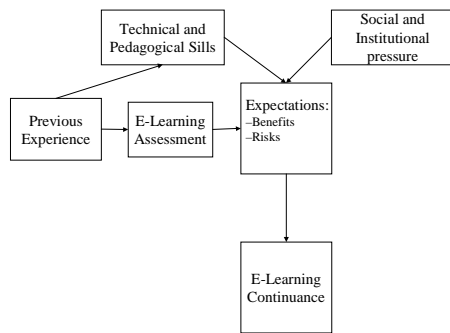*Figure 4 – ICT Continuance: students' perspective*

Figure 5 – ICT Continuance: instructors' perspective

The instructor decision to continued use is influenced by the same variables of the first phase, but there exists a difference from an operational point of view (i.e. now previous experience regards past L.S. experience, not only general multimedia experience) (figure 5). In fact, the results of the evaluation process taking place after the first L.S. experience strongly influence the instructor's expectations, that is his/her perception of benefits and risks.

LEARNING SPACE EXPERIENCE AT BOCCONI UNIVERSITY

In 1999 Bocconi decided to heavily invest in ICT to develop learning platforms for its undergraduate and MBA programs. The committee for innovative teaching methods agreed on promoting pilot courses using Learning Space (L.S.) as test environment[3]. Bocconi's approach to ICT in education considers technologies as enabling factors to improve effectiveness and efficiency of in class lessons. In fact, Bocconi decided not to enter the pure Open and Distance Learning (ODL) environment[4] as it is not consistent with Bocconi's mission.

In Bocconi, a first group of four courses per semester was selected and the chairpersons were expected to select his/her colleagues ready to lead the experiment. Management Information Systems (a third year compulsory exam in the Management track, with five parallel classes of about 250 students each) was one of the four candidates in the Spring semester 2000 (A.Y. 1999 – 2000). Experimentation has continued during A.Y. 2000 – 2001 and A.Y 2001 – 2002.

Technological Infrastructure

Aware that infrastructure and support play a critical role in innovative teaching projects, Bocconi University had made the following decisions:
- Lotus and IBM would provide L.S. experts on a 5 day presence per week;
- An internal expert team would be set up with 3 full time people and 1 part time person supporting and counseling professors;
- IBM would install in Bocconi 3 dedicated servers;
- Bocconi would install 4 classrooms exclusively dedicated to L.S. students (each classroom with LANs of about 60 PCs Pentium III 733, 64 Mb, Word Millenium Edition, connected to the Notes Server and to Internet);
- The pilot courses used Learning Space 3.0 as SW platform;
- Each professor adhering to the project would receive a lap top computer with L.S. client on it and would attend one day training course;
- Each student would attend a training course (with certificate at the end of the course), would enter the computer classrooms any time and without duration constraints five days a week.

After the experience in year 2000 also in the following academic year the initiative took place with 23 Courses involved (around 5000 students and 45 professors)[5].

To complete the overview of the technical platform adopted, L.S. is shortly described in its main functions. L.S. includes four main sections: schedule, media center, course room and profiles.

The Schedule is the *road map* for students throughout the course: it lists the sessions of the course with the topic of each session and can be ordered by date or subject.

The MediaCenter includes all teaching materials for the course (such as readings, articles, web sites, video clips, graphics, presentations).

The CourseRoom is the asynchronously interactive, virtual classroom of the course supporting discussions among students and between students and instructors, information sharing for project works and assignments filling in or grading.

Eventually the Profiles area contains information about course participants and instructors (personal data, areas of interest, projects, groups, contact information).

Learning Space Implementation

Learning Space implementation is influenced by:
- The principles of Constructivism as regard relationship between instructor and student;
- The statements of Cooperativism as regards relationship among students;
- The ideas of Cognitivism as regards the design of multimedia content.

As stated at the beginning, L.S. was considered as support to traditional lectures. The role of the SW platform was to:
- Enable the students to access as many real cases and projects as possible;
- Provide an environment to communicate with professors and colleagues in structured and unstructured ways (through assignments, forum, case discussions);
- Stimulate the active search for additional material (paper, newspaper articles, video, films) referring to study topics;
- promote projects and personal study.

Learning Space Use by Students (Methodology to Evaluate Students' Participation/Use)

Learning Space students' use is measured through students' participation to Learning Space activities. Learning Space activities are: discussions (for instance forum) and comments. Students can start a discussion or continue a discussion (comment) within the Course Room. Each discussion and/or comment is considered as a document. Students' participation was analyzed from a quantitative point of view (number of documents produced by students) and from a qualitative point of view. In order to satisfy qualitative analysis, all the documents were divided into two classes: Value-added documents and not – value – added documents. A Value-added document is a text with an original content, that is the product of critical reasoning.

The Main Problem

Students' participation during the second and third year of experimentation was greatly lower (both from a quantitative point of view and from a qualitative point of view) than that of first year (table 2).

Comparison Among First Year, Second Year and Third Year

L.S. implementation process was the same in the first year, second year and third year, in fact the professor was the same. Moreover, the same pedagogical methodologies and techniques were applied.

Students participating to L.S. activities have expressed an high degree of ex-post satisfaction, both at the end of A.Y. 1999 – 2000 and at the end of A.Y. 2000 – 2001 (table 3).

It is necessary to distinguish between adhering to the pilot class and participating to L.S. activities. The first decision is a formal use of I.S., while the second decision represents a real use of I.S. (decoupling "form" and "substance"[Meyer, Rowan, 1977]). Students of the A.Y. 2001 – 2002 can only decide if participate or not participate to L.S. activities, because they have been assigned accidentally to the pilot course (figure 6).

Table 2 – Students' participation

	I year	II year	III year
Number of class students	180	120	130
Number of participating students	141	77	7
Number of Discussions, Comment and Assignment	1071	436	11
Value added Discussion and Comment	296	41	0
Document per student	7,6	5,66	1,57
Percentage of value added documents	28%	9%	0%
Value added documents per student	2	0,5	0

Table 3 – Students' satisfaction

Question	MIS A.Y. 1999-2000	MIS A.Y. 2000 - 2001
	scores: 1 to 10	scores: 1 to 10
Overall assessment of L.S. as support tool	7,78	7,61
Contents	7,43	7,23
Link between lecture and L.S. contents	7,17	7,91
Students' interaction	6,79	6,57
Students' - professors interaction	7,35	7,27
Interface	7,49	6,7
Browsing	7,51	6,55
At the end of the L.S. experience:		
You have improved your business knowledge	7,41	7,44
You have improved your business trends	6,92	6,55
You have improved your technical trends	7,65	7,45
You can better use PC	6,57	6,6
Would you suggest to your colleague to attend a L.S. course?		
	MIS A.Y. 1999 - 2000	MIS A.Y. 2000 -2001
yes	98%	85%
Would you attend another L.S. course?		
yes	77,3%	76,5%

The students of the first L.S. course are different from the students of the second L.S. course in terms of previous experience and technical skills. In fact, first year experimentation is consistent with the Acceptance model, while second year experimentation is consistent with the Continuance model.

The continuance occurs inside different courses: students cannot attend twice the same course, therefore they can decide to look for another course which uses the same e-learning platform. Different courses mean different professors, different learning techniques and different L.S. implementation processes. So the main difference between the first and the second year is students' experience developed within different courses, an environment on which M.I.S. professors have not any form of control. The satisfaction degree of a course influences the students' expectations regarding another course.

LESSONS LEARNED

The preliminary results deriving from the comparison of successive courses using Learning Space allow the research team to draw some conclusions.

First of all, the empirical evidence clearly showed students' high expectations towards ICT in learning, but at the same time it focused that students have not a precise idea of what benefits and risks can be. Therefore, decision to attend an ICT based course is mainly a matter of personal curiosity or a social choice (groups of friends candidate themselves together). Once they experience what ICT offer in practice, a small part of the participants remains, as the additional effort required by the course does not fit with the updated expectations.

At the instructor's level, first adoption decision is partly due to previous experience in teaching innovation (also independently from ICT propensity or use) and partly to institutional pressure (university projects, department decisions, incentives, etc.).

Continuance is strongly influenced by the first test assessment, which in turn can be reinforced or weakened by institutional variables. In this case, institutional variables include quality of the technical and support infrastructure, availability of guidelines and experts supporting the instructor, interest of the institution to assess results, etc.

ENDNOTES

1   Von Glaserfeld [1984] defines constructivism: "a theory of knowledge in which knowledge does not reflect an objective ontological reality, but exclusively an ordering and organization of a world constituted by our experience".

2   This field is known as Interpretive-hermeneutic approach (Lee, 1994; Van Baalen, 1999) of ICT in education.

3   Literature [Calvani, Rotta, 2001] classifies technical learning environments with respect to four learning models: Time-independent learning model; Real-time learning model; Simultaneous learning model; Autonomous learning model. Each learning model requires specific tools and infrastructure with functionalities and performance consistent with learning requirements. The first learning model requires environments oriented to manage community and to share resources, the second group needs environments oriented to situational simulation and problem solving; the third class asks for environment oriented to manage one-to-many synchronous situations and to provide interactive lessons and the last model requires tools oriented to provide structured material. According to this synthetic classification, Learning Space belong to the first category.

4   Open Learning might be defined as [E.U., 1995]: "any form of learning which includes element of flexibility which make it more accessible to students than courses traditionally provided in centers of education and training. This flexibility arises variously from the content of the course and the way in which it is structured, the place of provision, the mode, medium or timing of its delivery, the pace at which the student proceeds, the forms of special support available and the types of assessment offered (including credit for experiential learning). Very often the openness is achieved, in part at least, by use of new information and communication media". While Distance Learning is [E.U., 1995] "any form of study not under the continuos or immediate supervision of tutors, but which nevertheless benefits from planning, guidance and tuition of a tutorial organization. Distance learning has a large component of independent or autonomous learning and is therefore heavily dependent on the didactic design of materials which must substitute for the interactivity available between student and teacher in ordinary face to face instruction. The autonomous component is invariably supported by tutoring and counseling systems which ideally are provided at regional/local study centers and to an increasing extent by modern communication media".

5   During year 2000 the initiative took place with 9 courses (around 1000 students and 15 professors).

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