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Information and Communication Technologies in University Teaching and in Teacher Education: Journey in a Major Québec University's Reality

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Abstract

The authors present a relatively extensive review of the literature on the epistemological issues that underlie the integration of information and communication

technologies (ICTs) in university teaching. On one hand, we observe the presence of an ideological trend portraying the integration of ICTs essentially as a way to render university operations more profitable, allowing for the increase of teacher/student ratios through larger-sized classes. This tendency is related to the prevalent behavioural foundations of today's university teaching. On the other hand, a second trend, referred to by some authors as "techno-constructivistic," claims that the introduction of networked technologies will in itself lead to the modification of the relation to knowledge of both the teaching and student bodies. Finally, a third trend, described as constructivistic, considers that the integration of ICTs must be the result of a global reconsideration of the university-level relation to knowledge, the latter being perceived as the product of a social co- construction in which the main actor is the learner himself. The impact of these issues on the use of ICTs in teacher education is identified. The results of a survey carried out among faculty at the University of Sherbrooke with reference to computer literacy profiles, attitudes toward computers and the integration of ICTs in undergraduate teaching practices are then presented and examined in light of the conclusions drawn from a review of the Anglo-Saxon literature. Our results suggest that, in general, the level of technological competence among the professors at Sherbrooke University varies according to the faculty. It is superior in the faculties of administration and applied sciences than in those of social sciences and education. While the personal use of communications technologies is widespread among the teaching staff, the integration of these technologies in pedagogy remains isolated and sparse, and its implementation depends greatly, once again, on the faculty. Finally, the incentives of the teaching staff to integrate ICTs in their teaching practice reflects the variety of epistemological perspectives that qualify each staff member.

Introduction

Recently the integration of ICTs in university teaching and particularly in teacher

training has been the topic of much debate. In Québec, the relation between the development of ICT use in undergraduate education in the social sciences and the penetration of these technologies in faculties of education is dependent upon governmental policies.

Since 1996 the government has implemented a series of measures aimed at ensuring that teacher training include the development of conditions favouring the acquisition of minimal competencies in the pedagogical use of ICTs (Government of Québec, 1996a, 1996b). In fact the Ministry of Education has allocated several millions to faculties of education to acquire infrastructures and equipment permitting the training of students in the field. At the same time, however, it has made it clear to universities that there would not be any major investments in the area of equipment support in those faculties that have access to other resources. By doing so the responsibility for constructing computer infrastructures has been tied to the investment capacity of institutions or of teacher-researchers.

Three years have passed since this "technological shift." Beyond various "technophile or technophobic" discourses, what has happened to the integration of ICTs in university teaching in general and in teacher education in particular? An attempt to answer this question requires a few detours in order to establish links among several variables that determine or affect the relation between the individual and these "new" technologies, particularly within the framework of undergraduate education.

The Integration of Icts in University Teaching and Their Insertion in Teacher Education: Two Distinct Realities?

Since the second half of the 90s, and particularly since the explosion of accessibility to the W3 network, one notes a rapid development in the scientific literature dealing with the integration of ICTs in the preservice curriculum. Although particularly "dynamic" in the Anglo-Saxon world this literature is emerging in all industrialized countries. It can be categorized into two general domains. On the one hand, there is a profusion of writings on the integration of ICTs in university education, particularly in the United States and in Australia. On the other, still in the Anglo-Saxon world, but now more in Europe than in the US, one finds an abundant literature dealing with the integration of information systems and of computer communication in teacher education. If, from an epistemological perspective, the approach is avowedly reformist in the first domain, this is not the case in the second.

Technologies and University Teaching

Despite the technophile discourse extolling the virtues of computers and of ICTs as teaching or tutoring tools, a review of the scientific literature unearths few systematic researches carried out in this field. These can be classed into three categories of varying importance. The first touches upon the effectiveness of resorting to different forms of ICTs as a means of favouring or of sustaining learning. This type of research leads to the question of how teachers define the nature of knowledge, the process of knowledge construction by students, and the role of both the teacher and teaching materials in the midst of this process. The second deals essentially with the analysis and identification of teacher or student attitudes towards hardware and software environments. The third refers to the identification of the degree of penetration of ICTs in university teaching.

The Epistemologically Determined Nature of Icts as Teaching Material

For a few years now a number of works on the integration of ICTs as teaching material in university have tended to establish a more or less explicit relation between resorting to interactive environments and a constructivist epistemological stance. (Dalgarno,1996). There are three broad principles that together define the constructivist view of learning.

The fundamental principal, is that each person forms their own representation of knowledge, building on their own individual experiences, and consequently that there is no single "correct" representation of knowledge (von Glaserfeld, 1994). The counter view, that there is a single "correct" representation of knowledge, is labelled by constructivists as objectivist. The second principal, normally attributed to Piaget, is that people learn through active exploration, and that learning occurs when the learner's exploration uncovers an inconsistency between their current knowledge representation and their experience. Bruner was the first to espouse a detailed theory of instruction based on this principal, in his discovery learning theory (Bruner, 1962). The third principal, normally attributed to Vygotsky, is that learning occurs within a social context, and that interaction between learners and their peers is a necessary part of the learning process. Vygotsky (1978) describes those capabilities that are beyond the learner on their own, but are able to be carried out with the assistance of more knowledgeable peers, as capabilities in the zone of proximal development.

These works on the integration of ICTs as teaching material that sustains a "constructivist revolution" in university implies two postulates. The first postulates is that teachers share a constructivist or socioconstructivist representation of the teaching-learning relation. The adoption of "new technologies," insofar as they make the learner responsible and eventually favour

learner and learner-teacher interaction, are assumed to be the result of a significant rupture between the teacher and traditional or behavioural approaches to teaching.

The second implies the primacy of teaching material over epistemological orientations. Because ICT material allows or involves an interaction, it is assumed that learning will be its product. Thus this material guarantees the constructivist nature of learning and the collaborative dimension of teaching. (Choi and Yeom, 1996; Marton, 1994). As an aside it is interesting to note that this representation of the role of educational material is quite similar to the discourse held by the Ministry of Education of Quebec over the last twenty years (Government of Quebec, 1979).

Attitudes About Computers

Most of the research is about teacher and/or student attitudes with reference to information science, understood in its widest sense and, more particularly, about individual-computer interaction. The majority of research projects are on the constructs of anxiety and of stress in interactive situations with computers (Brown, 1996; Hudiburg, Ahrens and Jones, 1994; Hudiburg, Brown and Jones, 1993; McBride and Nagle, 1996; Ngin and Simms, 1996). This body of research flows from a relatively recent trend, mostly found in the US and less so in England and in Germany. It is a trend identified with social psychology and with the psychology of work, whose major object of study is the impacts of changes brought to work environments, notably at the time of major technical modifications. Although this field of research is relatively young in that it deals with the implications of the implementation of computer technologies in different working or educational environments, it reflects a well-established tradition in the psychology of work and, notably, in ergonomics.

Although specific research dealing with learner or teacher attitudes toward ICTs are few, it is a growing field (Brock and Sulsky, 1994; Larose et al., 1998; Larose, Lafrance, Grenon, Roy and Lenoir, 1998; McBride and Nagle, 1996). The construct of anxiety being new in this field, principal advancements are occurring in the domain of the development of valid and reliable instruments of measure and evaluation (Chappell and Taylor, 1997; Potosky and Bobko, 1998; Yaghi, 1997). Unfortunately, insofar as it relates to the use of computers in an educational context, most of this research is in the framework of a larger reflection on the implications of the construct of anxiety in reference to computers in the teaching situation, or on the probability of learning. However, few studies exist on social bases as well as on the effects of socio-economic

differences on the anxiety felt in relation to computer technologies.

Yet these questions are of crucial importance in that they refer directly to the position we adopt towards the social mission not only of universities but also of the educational system as a whole. In fact, they lead us directly to the key-question of the educational network's mission, as an instrument of equalization of opportunities as well as of social mobility (Larose, 1997a). Thus, it may seem obvious that the stress or anxiety felt by a student confronted with the necessity of using a computer in a learning or performance context could vary depending on his degree of computer literacy, the latter itself possibly being linked to whether or not the student has had prior access to a personal computer and for what length of time.

Certain studies tend to show, to this effect, that the level of infiltration of domestic micro-computer technologies varies according to the social class. Nakhaie and Pike (1998), in a study based on Canada-wide data, note that domestic computer technologies are seeping very slowly and sparsely to the working class. Confirming the results of prior studies, this research shows that parental schooling is the best predictor of the availability and of the utilization of a home computer. In the same vein as Bourdieu, the authors affirm that the middle and upper classes adopt ICTs as an integral part of their social reproduction strategy. The strategic nature of the mastery of ICTs as a basis for "knowledge economics," and thus for the survival of economic and social advantages enjoyed by the middle and upper classes, is confirmed by many recent studies, both European (Bell, 1996; Greenan et Mairesse, 1996) and North American (Gera, Wulong et Lee, 1997; Morissette et Drolet, 1998), dealing with the impact of computer-use on the standing of employee salary.

In spite of the above, we were unable to find studies, in the scientific documentation, outlining the relationship between the anxiety felt towards the integration of computer technologies in university pedagogy and the social origin of the students, or even the frequency and duration of access to or ownership of a home computer. We were also unable to find studies dealing with the link between access to a home computer, the socio-economic standing of the students and their performance in terms of their studies. Yet, a recent study (Attewell et Battle, 1999), although conducted with elementary-school children, brings forth two disquieting questions in terms of the impact of social distribution of technological environments. On the one hand, the authors note that children with access to a computer at home tend systematically to obtain better scores in reading and in mathematics than their peers who do not have this opportunity. On the other hand, the children from lower socio-economic backgrounds, but who

also have access to a home computer, do not perform as well as their peers who come from a higher socio-economic class. In both cases, the data collected centers on populations attending schools in which ITCs are widespread and have been subject to systematic implementation through the program of massive computerization of public education set forth by the Clinton administration.

Identification of the Degree of the Use of Icts in University Teaching and the Causes of Observed Limits

As mentioned earlier there is little research presently available that provides stable data on ICT user profiles among university professors. When they do exist, as is the case in some recent Canadian research (Proulx & Campbell, 1997) as well as in certain less recent American research (Geoghegan,1994; Faseyitan & Hirschbuhl, 1992; Mackowiak, 1991), such data fail to take into account the type of integration of ICTs in teaching.

In fact, the studies currently available, in their dealings with the integration of new computer technologies in university teaching, present individual cases, or case-studies as they may be called. For those studies dealing with the teaching profile of a university, these are limited to the computer-literacy profile of the teaching staff. By so doing they restrain or exclude all reflection on the nature of the relationship that should exist between the representation that teachers have of the teaching-learning relation and the type of technological support to which they turn.

User Profile of ICTs in University Teaching: A Function of the Epistemological Stance of the Teacher?

Several authors suggest that the inclusion of ICTs in teaching practice by teachers who do not have certain individual characteristics such as having "traditional qualities" necessary for an adequate teaching intervention, or mastering the ICTs, may do more harm than good (DeKerckhove, 1997; Rhéaume, 1997). In reality the scientific literature on this matter is split into two major schools of thought. The first, very powerful in the Pacific "anglophone" countries, most particularly in Australia, identifies integration of ICTs both as a condition of survival of university institutions and as a context favouring the modification of teaching practices in a socioconstructivist epistemological perspective. These approaches favour the development of cooperative teaching practices, thereby showing to advantage the integration of networked environments (Dalgarno, 1996; McNaught, 1996).

A second school of thought, more pragmatic than the first, considers that the

integration of ICTs in university teaching is not and will not be particularly associated with the modification of teaching practices and will not affect by itself the epistemological stance of practitioners. Teaching will remain essentially traditional, characterized by a neobehaviourist epistemological perspective. As teaching material, information technologies simply take the place of print or the use of the chalkboard, or of the "low resolution overhead projector" (Gosper & *al*., 1996; Tapper, 1997).

So, as the research demonstrates, with a little preparation and technical support, but without varying their teaching strategy with respect to the traditional university approach, teachers integrate data entry of their course notes or the more-or-less interactive electronic manual into their practice. In this same perspective, they may take into consideration the "learning" dimension of the educational relation and provide their students with diverse tools that they will have to manage by themselves in the course of their studies (McIntyre & Wolff, 1998). The integration of tools such as "online" formative self-evaluation software or access to glossaries and complements of course notes entered as tele-accessible hypertext, respond principally to these types of preoccupations (Dirand and Larose, 1997; Larose, 1997*b*, 1998).

The hypothesis formulated by Bloom in his elaboration of the concept of mastery learning is identical to the one discussed here (Bloom, 1979; Bloom and Broder, 1950). The increase of time and the frequency of access to information as well as the regularity of feedback, particularly if it is stripped of the affective component associated with summative evaluation, guarantees learning in the learner. If the learner still does not perform, it will be because of individual characteristics, therefore failure will be the learner's responsibility and not that of the teacher, of the context of teaching or of the institution. Having recourse to computers does not challenge the teaching strategies nor the teacher's position on the relation to knowledge or on its construction. The professor is simply better equipped (at least in theory) to reproduce a teaching model in a context where he can no longer have direct contact with the learner and the latter is better equipped to compensate this loss of individual contact "in real time," or if one prefers, in a class situation.

Technologies and Preservice Teacher Education

A second body of works centered on the use of ICTs in teacher education exists parallel to the one already reviewed. This literature is linked to a research tradition focusing upon an observed weak transposition of computer literacy acquired during preservice education to the field of practice by young teachers

(Brummelhus & Plomp, 1994; Byard, 1995; Kay & Mellar, 1994). All of this research leads to the same conclusion: regardless of the quality of computer equipment available to teachers in the school environment and independently of the quantities of courses which they have taken during their undergraduate studies, the level of transfer of acquired competencies and learning to practice is very weak.

No matter if the discourse and the education are on what was once called "computer assisted education" or on the integration of multimedia technologies, the results are identical. The major impact of education on the educated remains at the level of the "private" use of these technologies and not in their integration into daily teaching practices.

Burbules and Callister (1997) and Callister and Burbules (1998) attribute a minimal learning effectiveness to strategies of training and sensitizing people to the use of computers among teaching professionals. The authors point out that many of them, no matter the level of education, have minimal computer literacy but do not use it in their pedagogy because of the fear that the rapidity of obsolescence of the hardware and of the software will make their task more complex and interminable. Others explain this trend by pointing to the low level of computer literacy of students at the time of their insertion in preservice education as well as that of the young professionals in practice (Ferren, 1993; Lee, Pliskin and Kahn, 1994; Tapper, 1997).

The Concept of Computer Literacy

For Mcmillan (1996) the concept of computer literacy is theoretically fuzzy and changing in that the definition of the concept is more or less precise depending on whether it occurs at the level of the definition of "operational" abilities or at the level of political discourse. As most contemporary authors do, he tends to center the definition of computer literacy around a few competencies or abilities, identifiable as "open" behaviours (Bradley, 1996; Reid, 1997; Stein, Craig & Scollary, 1997). The characteristics are the following:

- the individual knows how to use a word processing software, an email and a browser for Internet navigation.
- the individual is capable of registering or of downloading information on a diskette (or some other external saving unit) so as to recuperate and print it elsewhere.

To these behavioural "competencies," Stein, Craig & Scollary (1997) add a cognitive dimension, one that is also recognized by the Australian National Board

for Employment, Education and Training (NBEET, 1995): the ability to use ICTs to identify and search efficiently for specific information in order to build knowledge and develop critical and creative thinking.

Variables Affecting the Degree of Computer Literacy

The level of computer literacy attained by an individual may be relative. For example, in the faculties of education, as in most university preservice programs, a sizeable proportion of students owns a computer and, generally, masters sufficiently minimal word processing abilities. Nevertheless, the proportion of those who also own a modem and who consider themselves as having the financial resources to afford a commercial server subscription is clearly smaller.

When the time comes to begin university studies, students have a varying degree of computer literacy (Larose, 1998; Larose, Lafrance, Grenon, Roy & Lenoir, 1998). This literacy level depends essentially on previous access to a computer and on free or playful use of its functions (Dugdale, Dekoven & Ju, 1998). In turn, these experiences are a function of ethnic and social class origins of students (Hawkins & Paris, 1997).

The Integration of Icts in University Teaching and in Preservice Teacher Education: Portrait of a Quebec University

During the winter 1998 semester we carried out a systematic survey of the teaching faculty of the University of Sherbrooke in order to identify the computer literacy of teachers, their attitudes towards ICTs and the integration of electronic teaching tools in their practice. From May to September 1998, we carried out two successive data collections: first, we distributed a questionnaire to all professors and to a sizeable sample of lecturers insofar as they carried out at least a part of their workload in the first semester; second, we carried out fifty two semi-structured interviews of as many of those teachers, professors or lecturers who had indicated their willingness to participate in the earlier questionnaire. We are presenting here only some of the results of both data collections.

Method

Survey

From May 25 to June 30, 1998, a total of 800 questionnaires were mailed to all faculty (N = 600) as well as to a sample of 250 lecturers. The questionnaires were distributed through internal mail to those who had mailboxes or by regular mail to those who did not have a fixed, regular, institutional mail service. Sampling was simple. The questionnaire was distributed to all individuals

appearing on a sampling frame of the list of all professors obtained from the various faculty deans as of May 15, 1998. As for lecturers a sample of 30% was randomly selected from a sampling frame obtained from the same source.

The data collection instrument was a close-ended questionnaire divided into three sections, in addition to the section on respondent identification. The first section deals with the type of ICT equipment owned by the respondents, favourite softwares and competence profile with respect to the use of various computer and communication environments.. The second part contains items centered on the use of these tools, on both a private and a teaching level. The third part is composed of seventeen dichotomous items or statements making up a scale of attitudes about computers.

Interviews

Contrary to the methodology that we, in the GRIFE, have developed, and that is generally adopted by the researchers in our team as part of the analysis of social representations and teacher attitudes (Larose, Audette et Roy, 1997*a*, 1997*b*; Larose et Lenoir, 1995, 1997), the semi-structured interviews were conducted following the large administration of the survey. The interview sheet contained fourteen questions grouped in three principal categories. The first was centered on the personal experience with private use of computer technologies of those interviewed. The second category dealt with the identification of advantages and disadvantages of ICT implementation in university pedagogy. Finally, the third category pertained to the identification of irritants as well as basic conditions favouring the pedagogical use of ICTs and networks.

Sample

Survey

We used a convenience sample, composed of 269 respondents (76.6% males and 23.4% females) teaching at the undergraduate level in fifty departments regrouped in the nine faculties of the University of Sherbrooke. The majority of respondents are professors distributed across all levels of the professorial hierarchy. Faculty members represent 78.8% of the sample and lecturers 21.2%. There is a significant statistical association between the variables gender and professional status (L^2= 31.68 (4), $\alpha < 0.0001$; Cramer's V = 0.334, $\alpha < 0.0001$). The strongest representation of women is found within the two most unstable categories in terms of employment and of weak influence on the curriculum, lecturers (42.9% of the category) and sessional lecturers (42.1% of the category).

The mean age of the respondents describes a relatively young faculty ($\mu = 44.91$; $\sigma = 8.70$), but full professors are significantly older than their colleagues in other professorial categories ($\mu = 51.77$; $\sigma = 5.92$). Women in the sample are significantly younger than men ($t = 3.64$ (236) $\alpha < 0.0001$).

The majority of respondents teach exclusively at the undergraduate level in the various faculties. The proportion of respondents teaching concomitantly at the graduate level remains marginal. The greater part of the sample is composed of experienced teachers having an average undergraduate teaching experience of 13.8 years ($\sigma = 9.08$). Full professors stand out from the rest of the sample with an average undergraduate teaching experience of 22.39 years.

Interviews

The sub-sample of participants for the interviews is therefore composed of 50 respondents, principally professors (78%) and lecturers (22%). The whole of the teaching ranks is represented. Only 8 of the 9 faculties are represented, as none of the teachers in theology, ethics and philosophy were contacted. The subjects are mostly males (84%). The calculation of the *t* of Student does not allow the identification of significant differences in the age distribution between the survey sample and the sub-sample of the participants for the interviews. The calculation of the association measures does not allow us to note, on the one hand, the association structure under the variable "part of the general sample or of the sub-sample", and on the other hand, the variables of professional standing, sex or faculty of origin. We can therefore assume that, in terms of the principal variables qualifying the subjects, the sub-sample of participants in the interviews is representative of the general sample in this study.

However, the general sample and the sub-sample differ in two respects. First, the calculation of the *t* of Student allows us to identify a significant distinction in terms of the measure of a particular attitude between the two categories. The respondents who participated in the interviews have an attitude that is significantly more positive than their peers in light of the use of technological pedagogy ($t = -2{,}00$ (68,36), $p < 0{,}05$). Nonetheless, in practice, the proportion of these respondents who use email ($c^2 = 3{,}82$ (1), $p < 0{,}05$; $V = 0{,}121$, $p < 0{,}05$) and access Internet ($c^2 = 7{,}88$ (1), $p < 0{,}05$; $V = 0{,}175$; $p < 0{,}05$) in the context of their teaching practice is lower for those who took part in the interviews than for the rest of the sample.

Results

Survey

The majority of teachers at the University of Sherbrooke have access to a computer at home as well as at the office; 89.4% of respondents reported having access to an individual working station whereas 92.4% of them own at least one computer at home. Those who do not have a computer belong to two particular professional categories: full professors and sessional lecturers. Almost two thirds of those who own a computer at home are capable of communicating with the university network via modem whereas almost three quarters of them can use this network from the office. University teachers are principally users of office softwares, primarily, word processing softwares. If they have access to integrated software packages, such as Microsoft Office, they do not use its various functions equally. Word processing tools are used more frequently than spreadsheet (Excel) or presentation (Powerpoint) tools.

If recourse to integrated office softwares appears to characterize the greater part of the sample, the level of expertise to which respondents lay claim varies from one faculty to another. In all faculties, half or more of respondents evaluate themselves as average users of these softwares. However, in law, sciences and applied sciences, close to half of the respondents consider themselves to be "expert" users.

The greater part of the teaching staff has at least marginal recourse to electronic mail. Only in the faculties of education, physical and sport education, humanities, social sciences and medicine do we find a minimal percentage of respondents who never use email. Surprisingly, the stronger proportion of non-users of email (12.1% of respondents) is found in the faculty of education. As well the same faculty also hosts the stronger percentage of non-users of the Web (W3), (14.3% of respondents).

The majority of respondents do not use, or use only marginally, electronic teaching supports such as electronic acetates, laser projectors, and video conferencing. However, the first two of these instruments are used more frequently, more than 20% indicating occasional use, whereas video conferencing is not used by 90% of respondents.

Computer Use in University Teaching

In the survey questionnaire four rubrics were dedicated to the identification of the integration of computers, Internet, email or networked software in respondents' teaching practices. Given that individual or networked computer stations are used by students, it is safe to say that the use of computers can no longer be considered as a marginal reality at the University of Sherbrooke ( ).

However, the use of computer communication in teaching methods at the undergraduate level remains a relatively rare practice among our respondents.

The application of measures of association between faculty and each of the four variables describing the type of integration of ICTs in teaching practice reveal a significant relationship only with the variables "use of computers" ($L^2 = 21.46$ (8), $\alpha < 0.006$; $V = 0.282$, $\alpha < 0.008$) and "recourse to networked environments" ($L^2 = 22.51$ (8), $\alpha < 0.0008$; $V = 0.307$, $\alpha < 0.002$).

A brief look at the frequency distribution of the use of networked computers in undergraduate teaching according to respondent's faculty of origin ( ) reveals here again, a predominance of the integration of ICTs in the faculties of applied sciences and administration. Inversely, it is in the faculties of theology, ethics and philosophy and in law that the computer (both stand-alone and networked) is least integrated in teaching practices as a teaching tool.

The variable status (professorial rank) is significantly associated with the use or non use of the computer as a teaching tool ($L^2 = 14.41$ (4), $\alpha < 0.006$; $V = 0.230$, $\alpha < 0.008$). Non-permanent teachers integrate ICTs in their teaching practice in a less systematic fashion than do their permanent colleagues. This is borne out by . However, although gender is not directly associated with the integration of computers in undergraduate teaching practices, there is an effect when it is used as a contrasting variable according to professorial rank among the male respondents in the sample ($L^2 = 13.70$ (4), $\alpha < 0.008$; $V = 0.256$, $\alpha < 0.01$).

Overall, two distinct profiles appear in the pedagogical use of ICTs. If more than 40% of teachers use networked or stand-alone computers in their practice, less than 15% of them have recourse to email and Internet in their teaching. The use of computers in teaching is very significantly associated with certain professorial profiles. Relatively speaking, teachers from the faculties of administration and applied sciences systematically integrate computer resources in their undergraduate teaching (more than 70% of the respondents from these two faculties) whereas in law and in theology, ethics and philosophy the proportions are inversed. In other faculties from 40 to 45% of respondents integrate computers in their teaching practices in some manner.

Teaching Staff Expectations About Student Ict Literacy

We had five items targeting the identification of the minimal computer literacy competency that students ought to have in the following fields:

- use of a word processing software
- use of a spreadsheet or of a calculator
- use of email
- Internet navigation
- ability to save, recuperate and print information on an external unit

Each of these "competencies" are listed according to a four item "scale" ranging from "not important" to "indispensable." As the reader can see ( ), all of the identified competencies ought to characterize the computer literacy of our clientele.

Our questionnaire contained a list of 17 dichotomous items related to three distinct and complementary areas. A first series of statements dealt with the perception of respondents with respect to the usefulness of ICTs in the private domain of their work (course preparation, communication with colleagues, documentary research, etc.). A second set of statements referred to the representations that respondents have about the usefulness of ICTs as undergraduate teaching tools. Finally, a third set of statements sought to address the stress experienced by respondents when they are confronted with a computer environment.

The additivity of response structures allowed for the construction of an attitude scale on ICTs in university teaching as well as of three specific subscales. The validation data for our instrument as well as its metrological properties are the subject of publications (Larose & al, 1998; Larose, David & Grenon, to be published). The general scale and the three subscales have a satisfactory internal consistency coefficient (alpha) particularly when we account simultaneously for the format of the sample and for the universe of restricted variation which is imposed by a dichotomous response format ( ).

Our instrument is distributed according to the following polarities. On the general scale, a weak score corresponds to a negative attitude towards ICTs whereas a strong score corresponds to a positive attitude. On the subscale on attitude about the usefulness of computers for teaching, a low score corresponds to a weak valuing of recourse to ICTs whereas a high score corresponds to a strong valuing. On the subscale of attitude about the usefulness of computers at a personal level, a low score corresponds to a weak valuing of personal recourse to ICTs whereas a high score corresponds to the opposite. Finally, on the subscale of anxiety about computer environments, a weak score corresponds to a low level of anxiety when the respondent must use computers either personally or for teaching and a high score reflects a high level of anxiety ( ).

At first sight, teachers have a positive general attitude towards computer use. Upon closer examination however this attitude is more positive with reference to having recourse to computers for personal use than for teaching practice. Finally, the level of anxiety with regards to computer environments is relatively low.

Variables According to Which Respondents Differ

The application of a *t* test reveals a significant difference between the observed means according to gender with reference to the variable "anxiety about computer environments" ($t = -2.73$ (91,17); $\alpha < 0.008$), where variances are not homogeneous (F Levene = 15.57; $\alpha < 0.0001$). In that case the level of registered anxiety is higher among women ($\mu = 4.48$; $\sigma = 1.28$) than it is among men ($\mu? = 3.98$; $\sigma = 1.05$).

An analysis of unidimensional variances allows for the identification of significant differences between observed means in the subscale "anxiety about computer environments" according to respondents' professorial status ($F = 2.94$ (4), $\alpha < 0.02$), where variances are not judged to be homogeneous (F Levene = 5.27 (4, 248); $\alpha < 0.0001$). Associate professors report a significantly higher anxiety level ($\mu = 4.63$; $\sigma = 1.27$) than full professors ($\mu = 3.86$; $\sigma = 1.04$), the Bonferroni test being significant at the 0.05 level. Significant differences are also observed between means according to the faculty of origin of respondents on all scales ( ).

A significant difference is noted on the general attitude scale between the attitude profile of respondents from the faculty of education on the one hand and those of the faculty of applied sciences on the other. The latter exhibit a more positive attitude towards ICTs than the former. On the subscale measuring the usefulness of ICTs for teaching, teachers from the faculty of administration display a more significantly favourable attitude than their colleagues in law and in the faculty of theology, ethics and philosophy. With reference to the subscale on the personal usefulness of ICTs the administration faculty display a significantly more positive attitude than respondents in the faculties of law and education. Finally, teachers in applied sciences have a significantly lower level of anxiety about computer environments than their colleagues in the faculty of theology, ethics, philosophy and in the faculty of education.

Respondents have distinct attitudes depending on whether they have access to a computer at home or at the office. Those who have access to a computer at the office have a general attitude about ICTs significantly more favourable than those who don't ($t = 2.43$ (207), $\alpha < 0.02$). These respondents also display a weaker

anxiety level with reference to computer environments than their colleagues (t = 3.69 (242), $\alpha < 0.0001$). When they have access to a computer at home, respondents have a significantly higher score than their colleagues in the subscale "personal usefulness" (t = 3.34 (225), α 0.001) and on the general attitude scale about ICTs (t = 2.98 (208) $\alpha < 0.003$).

We also carried out a series of MANOVAs between available metric variables (scales and subscales of attitudes) on the one hand, and faculty of origin and professional status on the other. The interaction between these two variables affected only the distribution of the measure of attitude about the usefulness of computers in university teaching (F = 2.28 (227, 10), $\alpha < 0.015$), variances presumed to be homogeneous (Cochran test not significant), the interaction explaining only 18% of the total variance.

To conclude, we had wanted to measure the predicting value of the results recorded from the measures of attitudes with regard to three variables: use of electronic teaching aids, use of technologies in university pedagogy and the expected abilities in computer literacy among students. illustrates a synthesis of the predicting functions observed during the calculation of logistic regressions. The last column indicates the inadequate ranking, percentage in link with the variable predicted during the calculation of the regression function.

Table 9 highlights that the result for the measure of general attitude systematically appears to be the best predictor for the use of other electronic teaching aids, computerized learning environments or expected abilities for students. A positive attitude seems to predict this adequately. The interaction between a positive attitude towards the pedagogical use of technologies and the appreciation of technologies as useful personal tools appears to be the best predictor of two variables: the use of videoconferencing and the belief that the mastery of spreadsheets by the students is invaluable.

The results also highlight two particularly interesting elements with regard to the probability of teachers using computer technologies for pedagogical purposes. On the basis of the data obtained, it appears that the level of personal anxiety related to technological environments could be the best predictor of teachers' expectations with regard to their students' mastery of email. It also seems that a more or less positive attitude towards the personal use of computers and technology could be the best predictor of high expectations pertaining to the necessity for students to surf on the Internet.

Use of Computers in the Faculty of Education

Insofar as the dimensions of the computer literacy of professors, their private use of ICTs and their expectations about the computer literacy of their students are concerned, teachers in the faculty of education are not different from the general profile of the teaching staff of the university. However, as far as integrating ICTs in their own teaching practice, these teachers display a profile similar to that of their colleagues in the humanities and social sciences faculty. They belong to those who use these teaching tools less frequently. Finally, a distinguishing element sets the faculty of education subsample apart. They have a clearly less favourable attitude than their colleagues about the pedagogical use of ICTs ($t = -2.74$ (215) $\alpha < 0.007$) and a feeling of anxiety which is significantly higher ($T = 2.13$ (250) $\alpha < 0.03$).

In closing we have attempted to determine if certain variables specifically affected this profile both in the faculty of education and in all the faculties. To do so, we carried out a multiple correspondency analysis integrating the following categorical variables: professional status (four categories), faculty of education membership (dichotomous category) and use of the stand-alone or networked computer, of email or Internet in teaching practice (dichotomous categories). The result is that teachers with precarious status use ICTs less systematically in their teaching practice. In the faculty of education it is mainly full professors who use computers, whether networked or stand-alone, in the course of their teaching. In the other faculties associate professors are the ones who use computers in teaching and who also tend to integrate computer communications in their courses more systematically.

Main Results of the Lexicometrical Content Analysis of Discourse for All Interviews

Most of the subjects who participated in the interviews seem to have a relatively "normal" user profile with regards to new information and communications technologies and networking. In general, these are people who have not had particular technical training, who are sensitive to the requirements of the adaptation process during the transition from one computer environment to another, and who fear the effects of choosing new or updated software.

As well, there seems to be a certain variability in their discourse. At one end, older and more experienced teachers seem to fear change and the problems it may cause, in particular when it comes to computer environments and software. At the other end, younger, newer professors seem to have a marked interest for innovation, without any negative bias towards change.

The fear of technical problems as well as a certain feeling of helplessness with regard to new computer technologies also distinguishes regular professors from

part-time lecturers. This result is highlighted when associative measures are calculated between the chosen answer on item 4 of the attitudes scale with regard to computer technologies and the variable "professional status." The two variables are highly related (L2 = 11, 37 (4) $p < 0,023$; $v = 0,456$ $p < 0,034$; tau = 0,21, standard error in distribution = 0,10 $p< 0, 037$, the response to item 4 being considered as a dependent variable).

For most subjects who took part in the interviews, computer technologies, email and Internet remain useful outside their teaching practice. Multimedia-type tools are considered useful, in particular for finding information. This could eventually be helpful in teaching to exchange (Internet), to communicate with colleagues (email), which is generally considered as external to the field of ICT integration in undergraduate pedagogy. The use of computers for such means is mainly perceived as being linked with the use of office software, a way to create and store information that could subsequently be used in teaching (use of word processing and spreadsheets to compile marks and manage the administrative aspects of teaching).

With regard to this, the main source of variability found in the analysis of the subjects' discourse remains their department of origin. The professors from the faculties of medicine, engineering, and administration seem to integrate more systematically other multimedia technologies, such as the Internet, in their teaching to undergraduate students. They appear to do so by identifying more or less interactive sites where the students can be confronted not only to static information, but also to a virtual context that enables them to try problem-solving activities, among other things.

The use of email, when not reserved for inter-colleague exchanges, is generally considered as a last resort, for backup, when compared with face-to-face interaction, help and follow-up provided to students during their practicum.

The limitation of the pedagogical usefulness of computer technologies, as observed among our subjects, can be grouped into two main categories. First, the subjects who took part in the study appeared afraid that the integration of computer technologies in higher education might eventually jeopardize the quality and frequency of teacher-learner relations, rapports and contacts. Second, the participants seem to think that the limited literacy or competence of the students in computer technologies impacts and undermines their motivation to teach as well as the quality of the relationship between them and the class.

The informal evaluation of the learners' expected abilities, to this effect, reflects the variability of the teaching contexts and the experiential basis of the teachers.

For most, the more systematic implementation of computer technologies in higher education requires, at the very least, that the students be able to start a computer and use the basic functions, know how to use a word-processing software and an Internet browser. In some cases, particularly that of professors with tenure, these abilities are considered a must. For others, particularly educators from the faculties of applied sciences and social sciences, the variability in the level of computer literacy is such that some training programs or sessions aimed specifically at making students abilities more homogeneous should be a prerequisite to being accepted at university.

In the context of the research project on the use of ICTs in higher education, undertaken by the GRIFE, two consecutive data collections were conducted with relatively large samples of students enrolled in an elementary or secondary school teacher training program. In 1997-98, 74% of the students enrolled in the first year of the B. Ed. Elementary School Program (N= 169) had a personal computer. Only 10% of them had Apple computers (Larose, 1998; Larose, Lenoir, Roy, Grenon and Lafrance, 1999). During the second data collection, which took place in the Winter semester of 1999 with a large sample highly representative of the students enrolled in either the B. Ed. elementary or secondary (N = 650), 89% of the students had a personal computer; for 94,5% of these it was an IBM or IBM compatible computer.

On the other hand, the majority of the first-year students had only recently acquired a personal computer, that is only since their admission to university. In this light, the opinion expressed by certain participants in this study that an important variability in computer literacy exists among students depending on the faculty, the program and especially the level of schooling achieved within a program, could very well be founded.

Integration and Discussion of Data

A comparison of the results obtained by processing data gathered both from the questionnaire study and during the interviews, indicates that the majority of educators involved in first-year instruction at the Université de Sherbrooke possessed a minimal but acceptable level of computer literacy. In terms of feelings towards computerized environments, a generally open attitude and a relatively low stress or anxiety level were observed. However, attitudes were more negative in terms of integrating network information technology to teaching practices than those pertaining to the use of computer technology for personal purposes. Thus, we can see computer technology as being perceived and accepted as a work instrument for class preparation and as a support tool for teaching

(Internet and email), as well as for research (email).

Educators' expectations in regards to which computer skills students should possess are relatively stable and similar for all of the sample subjects. The main variation comes from evaluating the clientele's degree of computer literacy as they enter the baccalaureate, as well as which measures should be adopted in order to remedy any technological deficiency. This variation, which mainly depends on the professor's age, is directly linked to their fears concerning the impact of imposing computer technology in all its forms, including the integration of specialized software, compulsory electronic assignment submission, making pertinent course information available through Internet truncation or electronic bulletin boards, etc. Educators' apprehensions are twofold; on the one hand, there is a possibility of time-consuming problems in managing the relationship between the professor and the learner group, and on the other hand, the risk of an increase in the stress experienced by students as individuals and the consequent decrease in their motivation, both in terms of the subject matter and of the learning process in specific classes.

Generally, pedagogical practices, expectations and fears manifested by the subjects in our sample confirm what the scientific literature concerning the integration of information technology and networks to university pedagogy reveals, in particular as it pertains to initial instruction. For example, one of the major fears expressed by those involved in the study was the possibility of having to face technical difficulties during the implementation and use of computer technology as a teaching tool. Indeed, recent scientific studies highlight the importance of technical support infrastructures for professors who wish to integrate computerized didactic tools and, more specifically, network technology tools. The quality and the swiftness of interaction between the technical support team and the teaching staff was particularly important, both in the preparation of a computerized teaching activity and in its actual implementation (Lackie, 1999).

In terms of possible advantages of new information technology in initial instruction, one of the expectations expressed by the respondents in our study was related to compensating the effects of an increase in the demands faced by professors and, concomitantly, the increase in the size and number of groups they will be teaching. However, the irregularity and inconsistency of learning support for functions and characteristics of new information technology, as well as the consequences of taking time away from regular teaching and research duties in order to acquire the required technical skills, present the greatest obstacles to the adoption of teaching practices involving computers or, more specifically, network technology.

The data related to the type of computerized teaching material also accurately reflects the state of university pedagogical practice, at least in industrialized countries, and specifically in terms of the material made available to the students by the subjects of our study. As is the case in Sherbrooke, those few studies that look at the type of teaching material developed for or made available to the baccalaureate clientele in Anglo-Saxon areas report that there has been very little development in terms of creating interactive, virtual learning environments. Most of the teaching material being developed reproduces or copies the structure and the content of the printed material traditionally used by professors (Boshier, Mohapi, Moulton, Qayum, Sadownik and Wilson, 1997; Browning and Williams, 1997).

The fears expressed by the professors and lecturers in our sample, in terms of the impact of a systematic application of computer technology on student stress and motivation and on a potential gap between the type of technological support (the Internet, for example) and the clientele's use of information technology, seem, at least in part, to be well-founded. Indeed, one of the rare studies in this area, published within the last two years, systematically analysed the impact of implementing virtual courses on students' attitudes and learning practices. It confirms that students modified their practices very little or not at all (Crook, 1997). Students simply download and print the information made available on the Internet and remain dependant on the professor for the use of network resources, to explore sites other than those identified in class and to search for related Web sites (Ward and Newlands, 1998). While students and educators generally consider that using computer technology allows for greater flexibility in terms of access to information and that it reduces the cost of access to bibliographical material required for class, the authors ascertain that the transition to computer–assisted teaching requires a considerable investment in terms of acquiring the necessary skills and adapting teaching material, as well as professors' teaching habits. Hubbard (1998) draws the same conclusion in light of a critical analysis of online teaching practices in the United Kingdom, Australia and the United States.

In both existing scientific literature and our study, the pedagogical use of email in baccalaureate education seems to be perceived by professors as being rather restrictive. Its use is generally limited to three aspects. First, email compensates for the decrease in the frequency of interaction between the professor and students in specific contexts, such as internships. Second, email allows for an increase in contact between the professor and students in a relatively anonymous setting (the interaction is just between a student and the professor and not observed and interpreted by others). Finally, email may be seen as a way to

familiarize or give students an entryway to a virtual learning environment (Goddard, 1996; Mitra, Hazen, LaFrance and Rogan, 1999).

Conclusion

Generally the data from our research are coherent with the scientific literature on the profile of ICT use in university teaching. The level of computer literacy of the teaching staff is satisfactory but there is little transfer of these competencies to teaching practices. The disparity between faculties about the speed of adaptation of computerized teaching tools also conforms to what the literature suggests: it is superior in the faculties of applied sciences and inferior or minimal in the social science faculties. One particular phenomenon that stands out is the omnipresence of ICT use and of electronic support measures of teaching in the faculty of administration. This data confirms the importance suggested by the scientific literature about the presence of technical and logistical support to allow faculty to integrate computer use in their professional practice.

Considering the arguments given by our subjects, particularly when they preach for the systematic integration of technology and networks in higher education, does not imply the modification of profiles or of educational intervention models for the teaching staff. The adoption of educational practices that use virtual environments optimally is not a function of the degree of the technological sophistication of the networked and technological teaching material offered to learners. Nor is it a simple function of the interaction possibilities offered by certain means that permit communication in that mode.

On the contrary, the data analysis at hand leads us to believe that this new use of technologies can be achieved in a variable manner, according to a certain number of factors that determine the relation to knowledge of the teacher as well as the educational intervention model consequently decided upon.

In light of this, the question of the profile for integrating ICTs in higher education does not differ much from that which prevail among teachers at other levels of education. For instance, Jaillet (1997) states that elementary school teachers who favour so-called active teaching methods are those most likely to resort to communications technologies and networks in their practice. Similarly parallel and non-contradictory beliefs and teaching practices relating to the integration of ICTs can be observed at the pre-university and university levels. The manner in which teachers perceive an approach centered on the development of competencies, and the choice of one function or another of various technological environments. Thus, certain teachers of social studies, adhering to a socio-construtivistic perspective, will favour the integration of interactive

dimensions of simultaneous group communication such as "Chat" or "multiple users dungeon" (Tremblay and Lacroix, 1998, 1996). Other same-level teachers will feel that the knowledge and abilities particular to their field require behavioural stability and specific reasoning from the learners. Therefore, their resorting to ICTs may lead more towards tutorial-intelligent types of ICTs in which the definition of interactivity is somewhat limited to the sort of guidance provided for the learner through his progression in a relatively rigid learning environment (Quarteroni, 1996).

This model of integrating ICTs goes hand in hand with a neo-behavioural perspective on the teaching-learning relation, whereby knowledge is considered as external to the learner but through which the latter is asked to play a more active role than in the traditional approaches centered on "revelation." The "intelligent tutorial" is a form of organization of electronic learning environments that effectively support the progressive discovery by the learners of ways to do or reason that are socially perceived as effective or adequate. It also generally corresponds to the curricular structure centered upon on the prioritization of pedagogical objectives and, in so doing, can prove to make students feel more secure in light of its coherence to the organization of prior learning, at the elementary, high school, or pre-university level.

Finally, others will maintain that the demands of the profession awaiting the student will dictate the degree of emphasis to be placed on the development of intellectual autonomy for the learner rather than on the stability of the knowledge or the abilities acquired during the period of formal training. This trend is particularly apparent, not only in Canada, but in all industrialized countries as a whole, in the basic health professional training programs (medicine, nursing, and other professions generally linked to the field of applied sciences). In this area, and the examples in medical pedagogy are abundant, the integration of ICTs as teaching tools is usually achieved through the creation of virtual problem solving zones in which the student, in collaboration with his peers, must face the study of realistic cases, suggest procedures to identify, to select a proper course of action and to solve problems, and to experiment virtually with them (Field and Sefton, 1998; Rendas, Pinto and Gamboa, 1999).

Hidden behind the opinions of individuals more or less in favour of the pedagogical integration of technologies, particularly those of networks, an array of epistemological perspectives seems to reflect, by its diversity as well as its nature, the variety of educational and teaching models that coexist not only in our university, but in the world of higher education as a whole. These models are present in curricular structures as well as in teaching practices that vary from one

teaching model to another. This model may be classical, traditional, whereby learning is based upon memorization and repetition of behavioural sequences or cognitive procedures, or, on the contrary, of a socioconstructivist nature, using cooperative learning strategies whereby the relativity of scientific knowledge is admitted and intellectual autonomy becomes the major competence aimed for by the training process (Day and Suri, 1999; English and Yazdani, 1999).

The transition from one model to another implies changes in the beliefs about the type and role of the teaching material relevant to training. Nevertheless, the use of one type of electronic teaching aid does not necessarily imply a change in the relation to knowledge.

This transition, if indeed it takes place globally, implies both the existence of an epistemological debate on higher education and that of leadership regarding training for the educational models linked to these new approaches, at the very least within the faculties condoning the integration of ICTs in teaching practices.

In this area, the scientific literature is quite clear. Without such reflection, the integration of ICTs in higher education will not have a significant impact other than the temporary increase of students traditionally targeted by distance education. This technological wind of change will not solve the problem brought on by the transition toward a type of teaching centered on the development of competencies truly transferable in the professional world (Privateer, 1999).

The present context for teaching is one of constant budget cuts from the beginning of the 1990s. University teaching seems characterized by the autonomy and the diversity of teaching practices of educators as individuals and of faculties as entities. In this context, is it reasonable to believe that there will be a debate leading to the evolution of educational and teaching models shaping the manner in which ICTs are used in higher education? Our data, in line with the literature on the evolution of the integration of ICTs in higher education for the past 10 to 15 years, leads us to believe that the question remains unanswered... and highly relevant.

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