

Ulysses: Creating a *Ubiquitous Computing* Learning Environment

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Sharing Knowledge and Experience in Implementing ICTs in Universities EUA / IAU / IAUP Round Table, Skagen, Denmark * 4 - 6 May 2001

Introduction

There is mounting pressure from our employer community to ensure that graduates of our university programs are well prepared for the challenges of an increasingly wired world. In light of this, the business school of Laval University in Quebec City, the *Faculté des sciences de l'administration* (FSA), decided to renovate and expand its physical facilities and rethink its academic programs with the introduction of information and communication technologies (ICTs) on a broadscale.

There were two goals to be reached by students in the project: 1) master the use of ICTs and gain an appreciation of how they can be effectively put to use within organizations, and 2) learn to learn with the help of ICTs.

How to meet these goals? It was believed that simply adding computer courses to the curriculum would not reach the objectives set forth. To do so, it was necessary to fully integrate the use of computer technology within the programs. The use of ICTs must become second nature to the students. And this can only happen if we create a learning environment where ICT use is pervasive and *ubiquitous*.¹

The project undertaken by the FSA in 1997 was named *Ulysses*. Whereas Homer's Ulysses was a navigator and explorer of oceans, students today must become navigators and explorers of new kinds of seas, vast expanses of information which they must learn to discover, analyze, synthesize and exploit appropriately.

In addition, learning no longer occurs in a fixed place. Students are mobile: they are in class, in common or study areas, in the library, in residence, at home, on internships, on international exchanges, at work, etc. Thus their tools also need to be mobile. For students, the laptop computer becomes an access portal to hardware, software and data resources, on and off campus. But this can only be accomplished if the laptop is integrated within the physical environment as well as into the curriculum.

¹ Brown, D.G, *Always in Touch : A Practical Guide to Ubiquitous Computing*, Anker Publishing, 1999, 84 pp, ISBN 0-9644070-2-7, http://www.ankerpublish.com/books/brown_ait.html.

This short paper describes Ulysses from three perspectives: organizational, technical and pedagogical. Based on the experience so far with the project, a certain number of discussion/research questions are raised.

Organizational perspective

Laval University's faculty of administrative sciences (FSA) was founded in 1924. It is now one of 17 Faculties on a campus of approximately 32,000 students. The FSA offers a PhD program, Masters/MBA programs, a bachelor of business administration (BBA) as well as a number of continuing education programs in management. In 1995 the FSA became the first non-English speaking business school to be accredited by AACSB International², the oldest and largest accreditation body of schools of management. The FSA has approximately 4,500 registered students and 90 full time faculty, as well as a number of part time and adjunct faculty.

In 1997 a decision was made to renew both the FSA's building and facilities as well as the undergraduate business program (BBA) in order to meet the educational challenges facing the school and its students. The two projects were undertaken in parallel, both targeting September 1999 as the delivery date. We will not go into the details of the physical transformation of the building, except to describe the new facilities as they relate to the Ulysses project.

Ulysses characteristics

The main characteristics of Ulysses are as follows. There is a recommended laptop computer required for all students and faculty. The possession of a laptop is mandatory for all entering full-time BBA students, as well as three streams of the MBA program, totaling approximately 600 students per year, including Fall and Winter terms. By year three of the program (2001-2002), there will be approximately 1800 students with laptops in the school.

IBM is a partner in the project as well as the manufacturer of the recommended laptop. A local credit union³ is the financial partner offering student loans to those requiring financial assistance; this is in addition to the loan program put in place for the purchase of a microcomputer by the Ministry of Education of Quebec for those students admissible to the Quebec student loan program.

It is important that students who have been required to invest an important sum of money to acquire such a piece of equipment understand why this is so, and how they will benefit from this investment. Also, given that the FSA offers full support to students during their studies, it is important that from their first day on campus, they have all the technical and logistical information required to make effective use of their computer and of the resources put at their disposal. It is for this reason that a *Ulysses Day* was created as

² AACSB International - The Association to Advance Collegiate Schools of Business, was founded in 1916: www.aacsb.edu.

³ Fédération des caisses Desjardins du Québec, <http://www.desjardins.com/ang/>

both a welcoming or orientation day, as well as the occasion for students to take possession of their laptop. During the Ulysses Day seminars and workshops are held to inform students on how to care for their computer, as well as how to use the services offered within the school. The computer costs approximately C\$3000, including taxes, software, accessories, a 3 year warranty and all services offered by the Faculty during their studies.



The campus student cooperative sells the computers to the students. Laptops are pre-loaded with all software and parameters needed to be operational out-of-the-box within the FSA environment. The school's own staff offers the technical support and warranty service within the school. A laptop will be loaned out to students if their computer needs to be repaired for any significant length of time.

The faculty are also supplied with a laptop, which is paid 60% from the school's budget and 40% from the faculty's own discretionary budget; over 95% of faculty have joined in the program, with a little over 100 laptops distributed to tenure track and adjunct faculty.

In terms of outcomes from an organizational perspective, there has been a 30% increase in BBA enrolment in the Fall 1999, which was maintained in 2000 and 2001. There also has been enthusiastic support from the business community with a C\$4M contribution to the renewal of the FSA facilities. The community profile of the FSA has been raised, with good exposure in the press and media (print, radio, television) and two prizes won, the first from the Quebec federation for informatics, in the category *change management*, and the second, a national prize, from CIPA (the *Canadian Information Productivity Awards- category Institution*). The Ulysses project required an increase of 6% of the school's annual operating budget mainly for additional support staff.

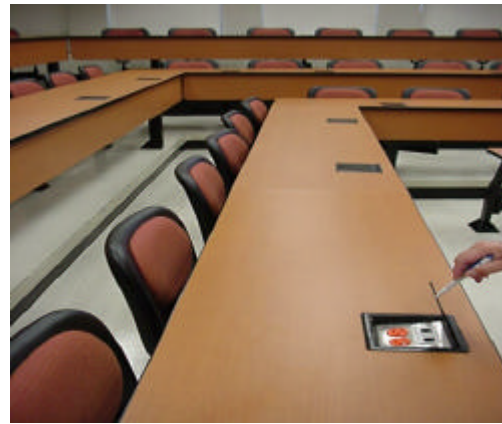
Technical and support perspective

After the laptop, the second key element of a ubiquitous computing environment is network access. In a project such as Ulysses, the laptop is to a large extent a communications tool, and thus there is a need to be able to connect to the network wherever students and faculty work; and this means to be able to connect not only in offices and study rooms, but also in classrooms, common areas such as the cafeteria, in hallways, etc.

Communications technology is evolving rapidly and there are new wireless technologies which are emerging. However, given that the FSA was gutting out the insides of its building and adding a new wing, it was less expensive to add wired connections than to install a wireless network. In addition, for the foreseeable future, the capacity of wired

networks will surpass the bandwidth of wireless networks. And the issue of bandwidth is of relevance. There have been experiences in schools with 10Mbps networks which have had to block the usage of certain applications, for example the popular ICQ used for synchronous communications, because the network couldn't handle the load. It is for this reason that a 100Mbps, ATM switched network was chosen for the FSA. Such a network is able to guarantee a level of service and it is able to effectively carry various forms of multimedia data.

In terms of network connectivity, 2500 network outlets were activated within the school. Given that laptop battery life is limited, 2500 power outlets were also installed. Network connections can be found in classrooms, study and common areas (such as the cafeteria) as well as in all offices. There are 17 wired classrooms, of which 11 are 'U' shaped with



fixed tables which are wired to the seat (including the 195 seat amphitheater). There are 6 classrooms with movable tables with network connections on the periphery of the room allowing for the grouping of tables for team work. Individual study rooms have wired cubicles, and group meeting rooms are also wired.

In every classroom, there is a console, which is a custom built desk (standup height) in which one will find a desktop computer, a VCR player, a sound amplifier, network connections, an analog cable connection to the University satellite TV network, laptop connections to the network and to the LCD projector. A projector is permanently fixed to the ceiling, and every classroom has a projection surface, generally above the chalkboard.⁴ LCD projectors were chosen for their reliability and light intensity, to ensure that room lighting can stay on during projections.



⁴ It should be noted that in general, the trend in new classroom design is to install chalkboards and not the more 'modern' white boards; this seems to be the preference of instructors and administrators alike.

An Intranet was developed to store all courseware materials, including course outlines, exercises, reading materials, references and tools. Among the tools there is e-mail, as well as threaded discussion forums (general, theme based, group based, etc.), course management utilities (for document transfers, grade postings, etc.) and a class interaction/survey tool developed by the FSA, called *Athena*.

Athena is a tool that takes advantage of the wired classroom environment. With Athena the instructor is able to poll the class and in less than a minute, get each student's opinion on a question in a few words or a sentence, get a yes/no answer to a question, get a



selection from a multiple choice question, etc. With the click of the mouse the compiled results of the poll or brainstorming are instantaneously displayed by the instructor on the projection surface in the front of the class, or on each student's laptop screen. The instructor can then react to these results, ask further questions, get a discussion going, or challenge the class verbally or via Athena once again. Responses are anonymous and optional, but experience has demonstrated a very high level of

participation by the class. This tool is much appreciated by students who see value in the ability for them to express their opinion, even in a larger classroom setting. Athena has been successfully used within the school's 195 seat amphitheater, as well as in smaller classrooms.

Technical and pedagogical support

One cannot expect that in such a technologically rich environment that something will not go wrong. In fact one must plan on the assumption that something will go wrong. Nevertheless, our dependency on the technology is such that it is important that means be put into place to minimize *downtime*, for students and faculty alike, whether it be because of hardware or software problems, or simply the inability to get the job done for lack of experience or expertise.

To support students and faculty two help desks were set up. The first is a technical help desk which will repair the computers and replace parts, configure systems, set network connection parameters, fix system and application software problems, and reinstall systems and applications (the most common solution). This desk is open seven days per week, has its own Web site and will offer support over the phone and via e-mail. The staff have been trained and are certified technicians able to service equipment under the manufacturer's warranty (IBM). One could argue that such an operation would not fit within the general mission of a business school in a university, but making sure that students and staff were well supported technically was of sufficient importance to the

success of the project that it was deemed necessary to have the best control possible over this issue. The FSA technical support staff is well appreciated by students as well as by IBM which regards it as an effective professional team.

The second help desk is for pedagogical support. Its goal is to answer *how-to* questions from students or faculty regarding the use of the technology in a pedagogical setting. Students can get support at the desk, from the web site, via e-mail or over the phone. Faculty may also get *just-in-time* help whereby a support person will answer their questions in person at the help desk, over the phone, or if need be, go to their office to explain a feature or help solve a specific problem. The pedagogical help desk will also work with faculty on new or innovative means of using the technology in a course or in a classroom. Training sessions on the tools are offered during summer months and during lunch hours in the Fall and Winter sessions. Workshops are held for students and there are some for faculty. Except for a small fee for those held during the summer, workshops are free.

A budget is put aside each year to hire and train a group of student assistants who will be assigned to specific faculty and courses according to a program implementation plan. First year courses were the first targets for investment prior to the first year of Ulysses, then second year courses were attended to in the following year, etc. We have discovered that even if a course was the beneficiary of an investment in one year, most likely faculty will want to modify or improve their course to better integrate the technology the year after. Therefore it would seem that once such an initiative is undertaken, there has to be a continuous investment in the course materials, albeit at a lower level than was initially required.

Pedagogical perspective

Once we have taken care of the organizational, technical and support issues, *learning* must become the focus of a project such as Ulysses. Control over those other issues is a necessary but not a sufficient condition for success. It is important to focus the attention and resources on pedagogy, teaching and learning.

Initially what the student sees in a project such as Ulysses is the computer, not surprisingly, since it is the object of his/her investment. What we see in Ulysses, is communications, connections, and community building.

Learning is fundamentally a process of communication. This technology is fundamentally a means to enhance communication. The focus of the project therefore has to be on transforming how we communicate in a learning environment where ICTs are ubiquitous.

Observation of students shows that there is extensive use of the computer outside of the classroom, in individual study rooms, teamwork rooms, and in the cafeteria. There is heavy use of communication tools, such as the threaded discussion forums (for course work and student bulletin boards) and e-mail. Not surprisingly the mode of

communication which is very (if not the most) popular within the student community (but less so with faculty and staff) is the synchronous communication mode using tools such as ICQ.

With ICQ any student can communicate instantaneously with any other student connected to the Faculty network (or the Internet). However, this form of communication does not seem to replace face to face contact, given the observed behavior of students who tend to cluster in groups within the cafeteria, many with their laptops opened and connected to the network, while doing group work or simply conversing. In fact, adding additional cafeteria network ports is one the repeated requests students have made over the past two years. Given the density of connections required and the limited surfaces available to install them, wireless networking is becoming a complementary service that is being considered.

Beyond communications, the Ulysses project has had a large impact on the renewal of course materials. Since all Ulysses courses were to have, at a minimum, a course Web site, faculty took the opportunity to renew their course documents. Many also took the opportunity to rethink how best to take advantage of the technology within their course. Course Web sites can include the course outline, course reading materials, a bibliography with links, discussion forums, links to Athena, exercises, quizzes, and multimedia materials which can be delivered on a CD or via the network using streaming video technology.

Faculty-student contact

Ulysses has modified the nature of faculty-student contact. There were fewer office hours spent with professors. Contact is generally on-going via discussion forums and e-mail. Whereas in the past, the class met once or twice per week and the rest of the week students worked individually with little or no contact between each other, in the context of Ulysses, the class is continuous, with students participating in discussions via the course Intranet. In addition, it has been noticed that students support each other much more extensively. Whereas they may have called each other up over the phone in the past if they were stumped on a problem, in the context of a highly networked communications environment, it becomes easier if not expected to post questions related to course work in the course forums. Answers to these question will generally come from fellow students but also from faculty. Which leads us to an important issue, that is the extent of faculty involvement in on-line student support.

There are no generally accepted norms regarding service levels that faculty are to provide to students in an on-line environment. We have experienced both extremes, where a faculty member was spending an inordinate amount of time on-line answering every entry in the class discussion forum; this resulted at the end of the session in a tired faculty member, but with fabulous student evaluations. At the other extreme, faculty have been known to ignore their class forums and let that 'space' belong to students.

The issue raised in a context of distance learning via the Internet, as well as in a context such as Ulysses, is faculty time management and the degree of support⁵ that is to be offered to students. The metaphor is that of a thermostat, you can run your course on cold, or you can run it warmer; the warmer the more time you will need to spend with students, and the more energy will be required, but most likely you will have a more *comfortable* relationship with your class.

In terms of learning outcomes related to the use of information technology, Ulysses students acknowledge that they are much more skillful in the use of ICTs than they were when they entered the program. Prior to launching Ulysses, the common expectation of faculty was that the *Nintendo Generation* of students would come to class with a high degree of technology mastery. Surprisingly that turned out not to be so. Today's students may be very skillful in playing Nintendo, but they are not adept with the commonly used productivity tools of business such word processing, spreadsheet modeling, presentation and database management.

Resetting expectations

One of the most profound outcomes of Ulysses has been the effect it has had on student expectations with regards to the role of the instructor and use of classroom time. As one student put it "...now that the course materials are online, I don't quite see the value the instructor brings to class, if all he does is repeat what is on the course Web site".

If we believe that the education of first-time/undergraduate university students is best accomplished in a campus setting; if we believe that a ubiquitous computing environment with a rich communications infrastructure and well constructed pedagogical materials available on-line add value to the education of our students; what then is the role of the instructor/professor and what are the impacts on classroom activities?

This question, being asked by many students, is unsettling to some faculty. Many were able to take Ulysses in stride; they were most likely using participative approaches to teaching and learning, with healthy class dynamics. Others, more comfortable with the one-way transmission of facts to students than with the shared deepening of understanding and discovery of the various shades of truth, are uncomfortable with the new context. This requires on the part of school's administration, understanding, pedagogical guidance and support to help faculty members adapt to the new environment and new student expectations. In a nutshell, we need to find means to transform the role of the faculty member, from *a sage on the stage to a guide on the side*.

A project such as Ulysses also blurs the distinctions between classroom learning and distance learning using ICTs. Although one would expect different pedagogical approaches between distance and classroom teaching, what can we learn from distance education using ICTs when we create an ICT rich environment on-campus? Is it easier to

⁵ The French term *encadrement* seems to best express this concept; that is how closely the faculty member needs to *frame* his students, that is to support and guide them in their learning.

implement problem based learning, learning by doing, active learning in a campus setting when we introduce ICTs?

These are some of the questions which two years of Ulysses have lead us to formulate. Not only are they interesting questions from an educational research perspective, but they are being addressed on a daily basis by the support staff in our Faculty who are faced with instructors and students who must live with the answers.

Conclusion

Ulysses was part of an important project to transform a business school to better meet its goals and mission. This transformation lead to a rebuilding of its physical facilities, the installation of a technological and support infrastructure, but more importantly, it lead to a transformation of its service offering by integrating ICTs within the curriculum and daily life of its students and faculty.

Two years after the launch of Ulysses we can conclude that students have enthusiastically adopted the concepts and goals of the project. Surveys indicate that they believe the mastery of ICTs is important to their careers. The increase in admission applications to our undergraduate program also confirms this. Students appreciate the quality of the infrastructure at their disposal and the quality of service offered to them by the support staff. They appreciate the Intranet containing the course Web sites and tools. But they are more critical of our ability to meet their expectations with regards to the integration of the technology within the classroom. Tools such as Athena combined with a transformation of classroom activities to complement what is available on-line will address these concerns. But these changes in faculty behavior and skill sets take time to implement. However challenging changing *things* can be, it is generally easier than changing people or behaviors.

The adoption of instructional technology by the FSA faculty has been *normal*⁶ with some faculty members being early adopters at one end of the normal curve and others being laggards at the other end, with the vast majority being somewhere in the middle. One difference between early adopters and the large majority of faculty is the amount of personal time that they are willing to invest in retraining themselves. For most faculty this effort will be spread over a longer period of time and will require more institutional support.

Over the past three years, our business school has undertaken a bold initiative to transform itself to better train and educate its students. This paper has shown what has been accomplished in implementing a *ubiquitous computing learning environment*; it concludes by stating that over and above the complexity of technology and its implementation, if true and long lasting innovation is to occur, it is the people and pedagogical issues which will require the careful and on-going attention they deserve.

⁶ Knutel, Phillip G., *Adoption of an innovation : the process through which faculty decide whether to use instructional technology*, Ph.D. Dissertation, University of Michigan, 1998 (Call No: DISS 28039).