A study on teaching courses both in class and at a distance

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Abstract *— This study presents the on-going project of teaching six courses in Human Factors Engineering both in class and at a distance. Each course comprises 14 3-hour periods of lectures with several interactions with the students. One lecturer and six groups of students (total = 210) participated in the project over the last two years. The software VIA (from SVIesolutions) was used for making the courses available at a distance while being given in class. It shows the course material, the live image of the professor, the voices of the professor and of the students, and includes several other functionalities. Main results show that the vast majority of students (85-90%) continue to attend the course in class each week. The students appreciate the accessibility of a course offered at a distance and the flexibility of a course offered synchronously or asynchronously. Very few students re-listen to a recorded course, and when they do so, it is only for short excerpts. The lecturer involved in the project is proud to make his courses accessible remotely, to offer much flexibility to students, and to support better academic achievement through the possibility of lecture revision. He appreciates having no extra workload for preparing and giving lectures in a mixed mode of teaching. The project is deemed so successful that in fall 2010, all courses (N=12) of the Human Factors Engineering program at Polytechnic School of Montreal will be offered both in class and at a distance.*

Index Terms*: E-learning, mixed mode of teaching, remote teaching, collaborative tool.*

INTRODUCTION

As several authors remind us, we have long discussed on the subject of distance in education, as well as learning and teaching asynchronously and synchronously [6]. As we may recall dichotomies were made between what was done at a distance and what was done in class. The early discussions have evolved with technological advances and with pressing institutional policy and managerial issues for adopting e-learning in universities.

Nowadays people can benefit from a large range of technologies enabling them to attend class anytime and anywhere. For the most part these technologies are conducive to collaboration among the actors of a course, namely lecturers and students. For instance, they often combine an array of tools and functions such as Web connection, Web camera, microphone, sharing applications, revision, etc. Potential disruptions and enrichment in learning and teaching experience are among the observations made in research works conducted on these technologies allowing ubiquity and collaboration [5].

Recent studies in the field have focused on three core research problems. Hence, some authors have described the implementation and integration of these technologies in teaching and learning [4]. After their introduction in a lecture, some researchers have investigated the soundness of collaborative tools, namely image, voice or other applications, on actors co-located in a classroom or dispersed in different settings asynchronously or synchronously [1]. While others found a renewed interest in making the dichotomy comeback, that is to say, comparing academic achievement of students in a class to those evolving in a remote setting [2]. Hence, we note that these studies deal with the depiction of a specific engineering topic or an assessment of a single task for a lecture. We describe our experience with a collaborative software, for which students could choose to be present in class, or attend a lecture at a distance synchronously or asynchronously, or review content at their whim, for more than a single event and topic.

PROJECT BACKGROUND

A few years ago, we realized an experience with a Human Factors Engineering (HFE) graduate course offered in a mixed mode of teaching at Polytechnic School of Montreal (Polytechnic). The experience lasted two years, it involved two groups of 15 students each, some students being located on-campus and some others being at a distance. The mixed mode of teaching consisted in giving lectures in class and at a distance in a videoconference room. In light of this successful experience, our motivations to maintain and expand our offering of a mixed mode of teaching (but with a different tool) were numerous and related to human, educational, managerial, environmental and societal considerations. Several of them are well documented in the e-learning literature [6, 7]. Here are the principal motivations:

- *Accessibility.* Course offerings in the disciplines of Cognitive Ergonomics, Cognitive Engineering and Human-Computer Interaction (all belonging to HFE) are concentrated in the metropolitan area of Montreal, mainly at Polytechnic, and are scarce in programs of other Universities of Quebec. This situation forces actual and prospective students living far from the university or in far regions either to travel to university, or move to Montreal for their studies, or renounce to studies and possibly to a career path in these disciplines. It was imperative for us that their needs be satisfied.
- *Flexibility.* In a proportion of about 50%, our actual (and future) graduate students are working part time or full time, often in an irregular basis. Often, they have to be mobile at work for meeting clients and partners, visiting work sites, presenting exhibits, etc. They also go through rush-work periods to complete projects, write reports, make presentations, etc. As a consequence, it is more and more difficult for them to attend courses on a regular basis and be present in a classroom every week during an entire academic term (14 weeks) at the same period. They need flexibility to be able to follow courses remotely and at their time convenience.
- *Family responsibilities* and *personal limitations* Students may have family responsibilities (e.g., young children, old parents), or personal limitations due to sickness, injury, handicap, etc. that prevent them to come in class or come on a regular basis. They need access to remote courses and great flexibility to follow courses at their time convenience.
- *Foreign students*. More and more of our students are foreigners and have elected to come to our university although the French language is not their mother tongue or their first language of usage. The university makes several efforts to support these students and reduce the language barrier. In addition to language courses, the possibility to re-listening to recorded courses, whenever it is judged necessary, is very reassuring for the students.
- *Academic achievement*. Some students may wish to re-listen to lectures or parts of them to make sure they correctly understood the content, or to catch up with explanations they could have missed in class, and/or to make revisions before exams. Recorded courses fulfill these needs and should support better academic achievements.
- *Quality of life*. This motivation is related to several of the previous ones. We can improve the quality of life of the students through the accessibility to courses that are not available in the areas where the students live and that allow them to acquire knowledge in what they like and choose a career path related to it, an easier accessibility for those who have personal limitations, a greater flexibility for those who work in parallel and/or who have family responsibilities and/or who like variations in the way they attend lectures, and the reduction of the driving time and of the carbon print.
- *Exploitation of technology*. The technology for remote teaching is available at low cost, effective, and easy to use. There is no reason not to exploit it if it can help, especially in an engineering school wherein there is strong bias in favor of more technology. Moreover, all our students already have a personal computer, equipped with good peripherals (e.g., Webcam, microphone) as well as a high-speed Internet connection, so they can easily get connected to remote courses. They more and more expect having the possibility to follow courses online, with much flexibility, i.e. anytime and anywhere.
- *Development of technological skills.* Alike observations made by teaching professionals in science [3], following remote online courses is a way to develop the technological skills of students. Most of our graduate students are working or will be taking a career path where the use of computer technology and the reality of distance work and collaboration work are omnipresent. Following a remote course is an opportunity to get more familiar with collaborative technologies.
- *Program visibility and university image.* The offering of remote online courses by Polytechnic gives more visibility to our HFE programs, and contributes to reinforce the image of a wired and progressive university. This should contribute to attract excellent students. Moreover, this offering has upped the ante for different programs of Polytechnic and other universities because of competition for good students.
- *Environment*. Considering that several of our graduate students elect or are constrained to drive to school to attend the lectures, sometimes for hours each week, the replacement of a lecture in class by a remote lecture is a way to contribute to the reduction of greenhouse gas and carbon print. We consider it as highly important even though there were only just a few students concerned.

Through the offering of mixed mode of teaching, we are in a good position to reach the following objectives:

- Improve program accessibility
- Increase enrollment of students
- Improve academic achievement
- Increase academic perseverance (lower drop-out rate, although minimal)
- Increase the quality of life of students.

Hence, we decided to keep the momentum with a mixed mode of teaching and launched a project in which students could follow courses in the aforementioned discipline either in class or at a distance, or in both ways alternatively.

EXPERIENCE WITH A MIXED MODE OF TEACHING

Since fall 2008, five different courses have been totally or partially offered in the mixed mode aforementioned. These courses are the following: two undergraduate courses in Cognitive Ergonomics consisting of respectively only two and

three 3-hour lectures each (IND1801, IND1901), and three graduate courses, one in Cognitive Ergonomics (IND6406) and two in Human-Computer Interaction (IND6402, IND6409). Each of these three graduate courses includes 13 3-hour lectures given on a weekly basis and a final exam.

Polytechnic chose the collaborative software *Via eLearning & eMeeting* (VIA) developed by SVI esolutions (SVIE) (http://www.sviesolutions.com). This enterprise concluded an agreement with RISQ, an advanced network for research and higher education and a reference for advanced Internet in the world. Moreover, VIA collaborative software is currently employed by major educational institutions in Quebec. The software allows the students, from their PC and at a distance, to view the course content and the live image of the lecturer, hear the voices of the lecturer and of other students in a live mode, exchange and edit information in real time, share applications, do peer collaboration, etc. For example, a student could have access on-line in a synchronous mode to a lecture and to his peers, and could review the content asynchronously. For each period of course, a microphone and a camera have to be installed in the classroom to allow students at a distance to see and hear the lecturer, and hear the students in class.

FINDINGS

The findings are divided into two parts: the experience of the students and the experience of the lecturer.

Experience of students

Number of students using the VIA software

Table 1 shows the number of students who made use of the VIA software for a course and their distribution according to the number of times they did so. Notice that the enrollment of students is much higher in undergraduate courses (2 first columns of numbers) than in graduate courses (4 last columns).

Results show that i) for all groups, 69 students out of 210 (33%) used VIA; ii) the percentage of students using VIA is much higher in graduate courses (39 students out of 53, average = 74%) than in undergraduate courses (30 students out of 154, average = 19%); iii) the percentage of students using VIA varies widely from one group to another (from 11% to 100%); and iv) more than two third of the students (average = 68%) who used VIA used it between 1 and 3 times. Notice that in two graduate courses (IND6406-2009 and IND6407-2008), 100% of the students resorted to VIA. Students mentioned that they employed VIA for three main reasons: when one would be out of town, when one would have to compose with daily situations preventing his or her presence in class (e.g., sickness), and for revising content.

	Undergraduate		Graduate			
	IND1801-2008	IND1901-2009	IND6406-2009	IND6406-2010	IND6407-2008	IND6409-2010
None use	63	64	0	7	0	7
1 -3 times	21	9	4	5	4	4
4 -6 times	1	0	5	1	0	2
7 -9 times	0	0	1	1	0	1
10 -12 times	0	0	4	1	0	1
13 -15 times	0	0	2	3	0	0
Total number of single users	22	8	16	11	4	8
% of use to enrollment	**26**	**11**	**100**	**51**	**100**	**53**
% of none use to enrollment	74	89	0	39	0	47
Total enrollment	85	72	16	18	4	15

TABLE 1
NUMBER OF STUDENTS WHO USED THE VIA SOFTWARE FOR A COURSE

Number of times connecting to the VIA software

We investigated the number of times students i) got connected to VIA during a lecture, i.e. synchronously, ii) employed a specific collaborative tool or function in VIA: the Web camera, the microphone, use multimedia documents, and/or share applications (N.B.: the numbers are not exclusive to each other), and iii) got connected to VIA after a lecture, i.e. asynchronously.

Results of Table 2 show that i) the students got connected 277 times to the VIA software, synchronously and asynchronously (see Total number of connections); ii) the vast majority of the connections to VIA (72%) happened after a lecture, i.e. asynchronously; iii) undergraduate students got connected to VIA to a much lesser extent (45 out of 277 contacts, 16%) than graduate students (232 out of 277 contacts, 84%); and iv) In five groups, the Web camera tool was employed by the students and almost each time they got connected to VIA. This collaborative tool is used when a student wishes to be seen by his/her peers and the lecturer during a lecture in class. Interestingly, students making use of a Web camera did not always resort to a microphone to voice questions or comments during a lecture in real time. Hence, some students may have anticipated asking a question or making a comment during a lecture and made none. Perhaps, for some students attendance to a lecture is linked to visual presence. Conversely, in one course (IND6407-2008), the four

students did not adopt this tool either because their PC was not equipped with a camera or because they saw no need of a web camera to enhance their collaborative experience.

	Undergraduate		Graduate			
	IND1801-2008	IND1901-2009	IND6406-2009	IND6406-2010	IND6407-2008	IND6409-2010
Connection to VIA- During	**6**	**8**	**20**	**23**	**4**	**16**
- Web Camera	5	8	17	23	0	16
- Microphone	0	0	0	12	0	4
- Multimedia document	0	0	0	0	0	0
- Sharing applications	0	0	0	0	0	9
Connection to VIA - After	**30**	**1**	**95**	**45**	**4**	**25**
Total nb of connections	36	9	115	68	8	41
Total enrollment	85	72	16	18	4	15

TABLE 2
NUMBER OF TIMES STUDENTS GOT CONNECTED TO VIA DURING AND AFTER A LECTURE

In only two graduate courses (IND6406-2010, IND6409-20101), students employed a microphone. Thus, not only does visual presence at distance may prove to be relevant for some graduates, some also seek to enrich their learning experience by adding speech interaction.

In only one course (IND6409) students used the sharing applications function of VIA to share files and documents with the lecturer or peers. However, this number does not fully reflect the reality because several lecturers intervening in the course presented audio clips and video clips from their own PC instead of downloading them into VIA.

Connection time to VIA

Table 3 shows the average duration of the connection time to the VIA software during and after a lecture. Results show that i) the average duration of connection time to VIA during a lecture is 31:35 m and varies widely between groups (from 13 sec to 1:01:34 h); ii) the average duration of connection time to VIA after a lecture is 48:51m and varies widely between groups (from 3:24 min to 1:34:24 h); an important observation that can be made from these results is that the examination of content after a lecture was a popular learning activity for several students; iii) in both cases, the average connection time to VIA during a lecture (31:35 m) and after a lecture (48:51 m) is much shorter (respectively 21% and 33%) than the duration of the lecture itself (2:30 min when one excludes the pause time during a lecture); so the students at a distance do not attend the full lecture at the moment of the lecture, and they do not re-listen to a full lecture after ; iv) the average duration of use of the Web camera is 29:25 min and is very close to that of VIA during a lecture. The microphone was only used for a few seconds (less than one minute) in two groups, thus it is likely to be only for short questions or comments (there is not enough time to enter into a discussion). Nobody used multimedia documents (i.e., audio- and video clips) during a lecture, and students of only one group (IND6409) used the sharing applications functionality of VIA for a little bit more than 1 minute.

	Undergraduate		Graduate			
	IND1801-2008	IND1901-2009	IND6406-2009	IND6406-2010	IND6407-2008	IND6409-2010
	Average (Std Deviation)	Average (Std Deviation)	Average (Std Deviation)	Average (Std Deviation)	Average (Std Deviation)	Average (Std Deviation)
Connection to VIA - During	10:22 (33:44)	44:25 (55:30)	14:32 (40:24)	58:22 (1:24:09)	0:13 (0:16)	1:01:34 (1:18:03)
- Web Camera	10:14 (32:67)	43:26 (54:20)	14:24 (40:04)	58:11 (1:23:38)	0	50:13 (1:11:25)
- Microphone	0	0	0	0:54 (2:14)	0	0:30 (1:38)
- Multimedia Documents	0	0	0	0	0	0
- Sharing applications	0	0	0	0	0	1:12 (1:54)
Connection to VIA - After	1:23:23 (2:09:42)	3:25 (10:15)	1:34:24 (2:26:14)	1:05:44 (1:22:55)	3:24 (4:49)	42:46 (63:30)

TABLE 3
AVERAGE DURATION OF CONNECTION TIME TO VIA DURING OR AFTER A LECTURE (unit: hour, min, sec)

Patterns of use of the software

Figure 1 illustrates the patterns of use of the VIA software in different courses all along the academic term; more specifically, it shows the number of times the students employed VIA for each lecture that composes a course. To understand the data, it should be mentioned that: 1) there were respectively only 2 and 3 periods of teaching during the term for the undergraduate courses IND1801 (weeks 8 and 9) and IND1901 (weeks 9, 10, 11); 2) the students were informed of the offering of mixed mode of teaching only in the first week of each course; 3) the exam took place in week 14 for each course and there was no academic activity in week 15.

The results of Figure 1 illustrate that i) the number of times per week the students used VIA varied all along the term; in three graduate courses, the usage of the software trickles down slowly after the start of the course; ii) there is no peak of use in week 13 just before the final exam; this reveals that a course recording may not be considered by a majority of students as an efficient way to revise the content of a course; iii) the undergraduates in IND1801 (2008) concentrated their use of VIA on two weeks of the academic term (weeks 8 and 9).

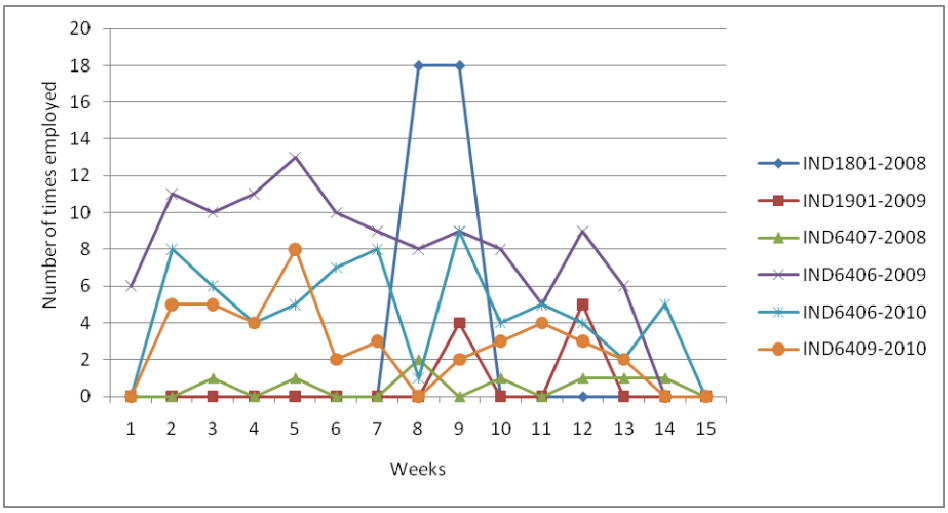

FIGURE 1
NUMBER OF TIMES STUDENTS EMPLOYED VIA FOR EACH LECTURE DURING THE TERM

Comments of the students

The students who used the software either to attend a lecture at a distance or listen to (parts of) it expressed their enthusiasm towards the offering of a mixed mode of teaching and wished it would be made available for other courses of the program. Indeed, they appreciated being able to choose the mode of attendance for a lecture, i.e. in class or at a distance.

Nevertheless, in the three graduate courses where there is a low number of students per group and where the lecturer knows precisely who is present in class each week, an average of 85-90% of the students continued to attend the lecture in a classroom setting. Moreover, foreign and exchange students preferred being present in class instead of in a virtual space; their position was that they did not come to Montreal to follow courses remotely. Albeit video images, voice, or application sharing functions were provided by the collaborative software, students expressed their appreciation for real interactions with their peers and the lecturer rather than virtual ones. Group membership, sense of community, building a network, direct interactions with other students and the lecturer, the dynamics of the class, and the greater richness of a real class environment figure among the many comments provided by students. Their complaints about the VIA software dealt with the poor quality of sound for the questions asked by students in class, and the difficulty to see correctly what the lecturer wrote on the blackboard and showed in class from time to time.

Experience of the lecturer

The lecturer who participated in the project got a sense of pride from “innovating” in his university by using a mixed mode of teaching, in class and at a distance, on a regular basis and in several courses. He appreciated having no extra work to do for preparing course material and giving lectures with this mode of teaching. Indeed the format of presentation remained the same for a lecture given in class or at a distance, synchronously or asynchronously. Above all, he was proud to offer greater flexibility to students for listening to lectures anytime during the term and anywhere; this allowed the students to recover lectures that they had missed for any professional or personal reasons, and helped them to balance their work, study, and family activities. Furthermore, he was satisfied to make his courses available to students

living far from University, and to allow students to use course recordings for better academic achievement. In brief, he believed that the students were better served with this mode of teaching and that the university was better fulfilling its educational mission. Interestingly, in an era of social media where any type of content can be downloaded and viewed on popular sites, he did not have much concern about the possibility that students show excerpts of lectures outside.

As for his user experience with the VIA software, the lecturer expressed a few grievances about the poor user interface and about the time (a few minutes) for downloading the files of the course at the beginning of each lecture. Furthermore, when a student located at distance asked a question or made a comment, he was informed by a sound indicating that a question was raised or a comment was made. At that moment, from his position in front of the class, s/he had to go to the computer in class, open a window, read the question or comment or listen to the question posed verbally. This created disturbance in the flow of the lecture and would rapidly become difficult to manage if a student would be asking several questions, or if more than more than 2 or 3 students attending at a distance would be asking questions.

CONCLUSION

In light of 2-year experience with a mixed mode of teaching for several courses, we have come to the conclusion that it is a quite positive both for all stakeholders: the student, the lecturer, the university, and the society in general. The conclusion holds even though the results show that a vast majority of students (85-90%) continue to prefer being present in class while the course is available at a distance. According to us, satisfying one or a few students per group is sufficient for pursuing the experience considering it is part of our mission to offer the best services to students. As a consequence, we decided for the fall 2010 to extend the experience to all HFE courses at Polytechnic.

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