VIRTUAL EDUCATION: A VIEW FROM THE TRENCHES

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ABSTRACT

We describe our experience in teaching a "partially virtual" course in which the course is delivered partly in a traditional classroom setting and partly online. We discuss both the successful aspects of our experience and the obstacles that we faced. The greatest challenge has been to mesh emerging pedagogies of active learning with newly available technologies.

1 INTRODUCTION

While the technology that supports distance learning has developed extremely rapidly in recent years, pedagogical techniques that make the best use of this technology to create effective learning environments have been much slower to mature [4]. At Brooklyn College, we are experimenting with a "partially virtual" course structure. In a project funded by FIPSE, faculty in every part of the College's Core Curriculum are developing and offering partially virtual Core courses. In these experimental classes, 1/2 to 2/3 of the course takes place in the traditional classroom setting while the remainder is entirely mediated by the Web. This "wholly virtual" component of the course takes a variety of forms, from, for example, online discussions to virtual laboratories. As part of this project, we have developed and delivered a partially virtual curriculum for the Computer Science and Mathematics Core.

2 THE COURSE AND THE STUDENTS

Brooklyn College is one of the nine senior colleges of the City University of New York, with an undergraduate enrollment of about 10,000 students. Our course, Core Studies 5, is a combined Mathematics/Computer Science introductory course for non-majors. The course, entitled *Introduction to Mathematical Reasoning and Computer Programming*, is a 3-hour 3-credit course. All undergraduates are required to take the course, with the exception of those who have taken more advanced courses in both mathematics and computer science. Core Studies 5 is part of Brooklyn College's nationally recognized Core Curriculum [2].

In the Spring 1997 semester, we introduced a new (non-virtual) version of the course in which we capitalized on the high visibility of the Internet by using the Internet as a motivating theme to introduce students to fundamental concepts of computer science and methods of mathematical reasoning [3]. The first part of the course focuses on the nature and development of the Internet. The second component of the course concerns number theory and its relevance to information assurance, particularly in the context of the Internet. The final third of the course involves programming in JavaScript.

The virtual curriculum that we have developed overlays the course in three main areas: self-guided lessons on the history of computing and the Internet, using resources available on the Web; a discussion of basic number theory (bases, modular arithmetic, and prime numbers) augmented by JavaScript-driven exercise-generation tools; and a series of online lessons on writing simple JavaScript code fragments.

3 DIFFERENT TYPES OF ONLINE EXPERIENCES

In planning our "virtual sessions", we made use of various types of online experiences, designed to help students make the transition from the traditional classroom to the virtual one.

Our first virtual session required the students to do Web-based research, and to submit their results on paper (handwritten or typed), the old-fashioned way. This gave the students a chance to become comfortable with Web-based material, without getting sidetracked by the submission process. Later sessions required the students to submit their results via email or online submission forms. For these sessions, both the learning and the submission processes were virtual, but the type of learning experience—readings and questions—was traditional.

Other online activities were designed to give students immediate feedback. We used JavaScript to produce interactive tutorials on number theory and WebToTeach [1] software for programming exercises which gives automated results to the students and instructors. These activities use the Web to enable a different type of educational experience.

Finally, the last "virtual sessions" required the students to produce Web pages incorporating JavaScripts on their own and to upload them to be posted on the Web. These sessions required the most technological sophistication on the part of the students, and as such, were positioned at the end of the semester.

4 PRACTICAL SUCCESSES

There were several aspects of our experience that worked very well:

Controlled Introduction. Each online activity (e.g. web page design) was introduced in a closed lab setting. The task assigned to the students was similar to the activity they were asked to do later fully virtually. However, the closed lab setting afforded the students the opportunity to begin working on their own while at the same time having the instructor immediately available to help when needed. More importantly, the closed lab session provided the instructor with an opportunity to gauge the class's response to the task, and to determine how difficult it would be for the students to accomplish that task in an asynchronous mode. In some cases we found it necessary to modify the exercises that we had planned as "virtual sessions".

One-Third Virtual. The virtual sessions accounted for no more than one third of the total class meetings. We feel that this arrangement provides an optimal balance: the virtual component of the course may encourage deeper thinking and more active participation on the part of the students in the learning process [5]; at the same time, we are able to retain the advantages of direct personal contact between the instructor and the students and among the students themselves. In a survey of the students at the end of the semester, 74% of the students felt that the number of virtual sessions was "just right". The remainder of the students indicated that there were "too many" virtual sessions. Surprisingly, none of the students felt that there were "too few" virtual sessions.

Online Office Hours. Each virtual session replaced one regularly scheduled class meeting. The students were obviously free to complete the online work wherever and whenever they chose. However, we announced to the class that the instructor would be on campus, in his or her office, during the usual class time. If a student chose to work on the virtual session during the regular time slot allocated to the class, he would be assured that he could reach the instructor in real time, either via email or by telephone. Many students took advantage of this arrangement for the initial virtual sessions. As they became more confident working alone online, they began to take advantage of the asynchronous nature of the experience. Knowing that the instructor was available at a set time which did not conflict with other classes provided the students with a smoother transition from the traditional to the virtual settings.

Student Response to Technology. The students responded uniformly positively to the use of technology. They were intrigued by the idea of being able to work at their own pace and on their own schedule. One student noted, "The links provided for explanation made finding the answer much simpler than flipping through books and notes pages." Another student commented, "I feel that it was an interesting way to learn other than the traditional school experience."

Student Tolerance of Technology. The students were remarkably tolerant of technological problems. The instructors were concerned that if the students would have trouble during a virtual session they would become confused. The students were much more resilient than expected. They became comfortable emailing the instructor to report problems and using the course mailing list to warn other students about potential pitfalls.

Incremental Introduction of Technology. Our virtual sessions were designed to guide students gently in the use of Web technology, by introducing new features incrementally. By starting with online research, moving on to online submissions and interactive sessions, the students were able to work independently in a less structured format by the end of the semester.

Flexibility. When a course is heavily dependent on supporting technology, it is important to be flexible and to have backup plans in case of technological snafus. We had planned to use third-party software for teaching HTML and programming. However, the software was not working properly at the time we had planned to use it. By reorganizing the lecture schedule and making use of alternate online material, we were able to proceed.

Programming as Incremental Modification. According to the course syllabus, one-third of the course is to be dedicated to programming; yet it's difficult to teach a substantial amount of programming to a general population of students in 4-5 weeks. Since our goal, then, was essentially to teach *about* programming, the experiential aspect was not building programs from scratch but making modifications to fairly

simple sample programs. This allowed students to begin to grasp concepts such as object-oriented and event-driven programming.

5 STRUCTURAL OBSTACLES

Nonetheless, we encountered some significant obstacles (some of our own making). While we have learned to work around them to some extent, we expect they will continue to influence our teaching.

Too Virtual Too Early. During one term we attempted to increase the proportion of virtual sessions to nearly half the course. To do this, we needed to begin holding virtual sessions much earlier in the semester, which had a strong negative impact on the class. Office hour utilization was exceptionally low, as was the level of discussion and questions in the classroom—essentially, it seemed that the "chemistry" of the class never had a chance to develop. Scaling back the virtual portion of the course a few weeks into the term somewhat mitigated the negative impact.

Access. The question of access is one often asked in the context of distance learning. Certainly, student access to computers is improving, at least by some measures. In the 3 years this course has been offered, the proportion of students willing to admit they have no experience with email and/or the web has dropped from 15-20% to less than 5%. Many students report having access to computers (and the Internet) at home; Brooklyn College of course has a number of student computer labs. But for students without home access, the campus laboratories are often inadequate for reasons such as the one-hour time limit imposed when labs are full (which is often). In our experience, the rate of withdrawal or failure is much higher among students who indicate access difficulties early in the semester.

Non-standardization. With a higher proportion of home users comes a dramatic loss of control over the computing environment. We no longer had the luxury of needing to check only that our materials were compatible with the campus labs; moreover, much of the testing that needed to be done was difficult to do from campus. For example, many of the problems we discovered had to do with AOL, which a majority of our students use as their ISP. The AOL browser(s) had limited support for the HTML mailto directive; their JavaScript interpreter also demonstrated some unusual deviation from standard behavior.

6 CONCLUSION

In general, we have found the "partially virtual" curriculum to be an attractive alternative to both traditional classroom-based courses and to exclusively asynchronous courses. Transferring an existing course to a virtual setting requires a considerable investment of time and effort in order to address various technical and pedagogical issues.

While our students were more comfortable with technology than we initially expected, a significant minority of students were hindered by insufficient access to campus computing resources. Students that had alternative access or had sufficient free time and flexibility to use campus resources effectively generally responded positively to the structure of the course.

Instructors coming from a traditional or closed-lab experience need to anticipate the impacts of a significantly more heterogeneous computing environment. These problems can generally be overcome in a term or two.

More sustained effort is required to deal with the transition in pedagogy: Many authors have connected teaching with technology to the potential for "active learning." The potential is indeed undeniable, but we must remember that the presence of technology does not automatically engender active learning (an observation that should be particularly self-evident in computer science)—nor does its absence prevent active learning. In our experience, the primary contribution of technology is that it has provided an excuse for us to rethink teaching and to move consciously toward active learning. In so doing, we have learned that active learning requires active teaching—particularly in the virtual context. If anything, the presence of technology has increased the amount of work we have put into teaching our classes.

7 REFERENCES

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