**ORL 5521 - Introduction to Research Methods in Education**
(*Spring 2003*)

**Research Paper**

## TOPIC

**Web-based versus Traditional Classroom Learning: A Proposed Experimental Study.**

## INTRODUCTION

Technology is contributing immensely towards the enhancement of teaching and learning in educational institutions as new computer-based storage and communications technologies are making possible many progressive methods for the creation and delivery of educational resources (Barker, 1999). Whilst online libraries, databases, simulations and hyperlinked documents provide a wealth of information and multimedia learning resources, e-mail, bulletin boards, chat rooms etc. help in ensuring rapid and timely communication between instructors and students. With the adoption of new and emerging technologies by colleges and the corresponding increase in accessibility to high speed internet facilities, the educational potential of the World Wide Web (WWW) has become limitless.

Teaching and learning via the internet and WWW has thus become a common phenomenon in most higher education institutions, with instructional activities such as lecture delivery, student participation, discussions, feedback and evaluation taking place in "virtual" classrooms. Herther (1997) notes that over 350 accredited institutions offer entire bachelor's degree programs to students who rarely, if ever, visit campus. Advocates of constructivist, learner-centered and project-based learning proclaim that web-based instruction offers a convenient, easily accessible and more effective learning environment that satisfies the needs of the learner more, as compared to the traditional face-to-face classroom learning (Bonk & Cummings, 1998). Additionally, as

the cost of traditional education increases, market pressures are forcing more and more institutions to consider online offerings that do not incur the costs of dormitories, athletic programs, etc (Gubernick & Ebeling, 1997). Schulman & Sims (1999), report that the Florida State University system expects online programs to save about 40% of the cost of in-class programs.

As these web-based courses are increasingly gaining acceptance in the academic community, and the number of students choosing to take these courses are constantly increasing, some issues of concern naturally arise. These include:

i. Are students really learning and retaining the same information on the internet as they would in a classroom environment?
ii. Do students who obtain online degrees exhibit an equal level of achievement and performance as their traditional counterparts do?
iii. Should Universities and Colleges diversify from their traditional emphasis on classroom learning and incorporate these new technologies for the delivery of instruction in all their courses?
iv. Will the larger community accept e-learning as a credible alternative to classroom and laboratory based instruction?

Favorable responses to these issues can only be arrived at if and when it is proved beyond all reasonable doubt that a degree obtained exclusively online is equivalent to one obtained in the classroom. Whilst it is worth mentioning that some amount of research has been conducted with the aim of responding to these issues, there is little solid evidence in support of the effectiveness of web-based instruction on learning outcomes in all disciplines of undergraduate and graduate

studies. The problem lies partly on the lack of external validity of most of the findings, as the studies focus either on some limited variables (e.g. using only final exam grades to measure learning), or only on some particular disciplines such as the humanities and social sciences, whilst ignoring others. Lu *et al* (2000, online) call these "the im-precise and insensitive methods" of web-based instruction research.

It is therefore clear that more extensive studies need to be conducted on all aspects of internet learning and assessment so as to arrive at conclusions that will be applicable to most (if not all) learning situations. This paper thus seeks to design a comparative study of student performance and achievement between internet-based and classroom-based learning activities in a physical science subject.

## LITERATURE REVIEW

Based mostly on test scores, web-based courses have been proved time and again, to be either as effective as, or more effective than the traditional in-class courses. Bowman (1995), McCloskey (1998) and Schulman & Sims (1999) reportedly found no significant differences in student final grades between the two modes of instruction, whilst Gubernick & Ebeling (1997) report a study conducted by the University of Phoenix which demonstrated that standardized achievement test scores of its online graduates were 5% to 10% higher than graduates of competing on-campus programs at three Arizona public universities. Another study conducted by Gerald Schutte at Cal State, Northridge (cited by McCollum, 1997) showed that a randomly assigned group of students taking a statistics course through the web outscored their traditional counterparts by an average of 20%.

Going a step further, Marold et al (2002) examined not only test grades, but also interim test grades, homework assignments and projects submitted by students. Comparing an experimental group of internet students and a control group of classroom-based students taking an information systems course with the same instructor for three semesters, their analyses reveal a subtle difference in performance and achievement between the two sets of students. The internet students did better in exams whilst the in-class students were better achievers in hands-on homework assignments. Lu *et al* (2000) also found that relevant web content does improve learning significantly among a sample of 90 freshmen university students taking a Modern Physics course. Other findings indicate that individual student-teacher communications take place easily and more efficiently over the internet than in the traditional face-to-face situation, hence students participate more actively in discussions when classes are delivered over the web (McCloskey et al, 1998).

**RESEARCH QUESTION**

All the above mentioned findings point to the fact that web-based courses are working, and that students are acquiring the appropriate knowledge needed to pass exams in most courses especially in the humanities and social sciences. However, what cannot be confirmed is the situation of some of the physical science subjects (e.g. chemistry) where conducting laboratory experiments is an integral part of the learning process. It is true that most scientific experiments can now be simulated on the computer, but will a student conducting his/her experiments entirely using computer simulations acquire the same knowledge and skills as the counterpart who takes these lessons in the classroom and laboratory?

## HYPOTHESIS

There is no significant difference in average achievement in chemistry between students who undergo the traditional classroom/laboratory instruction and their counterparts who undergo web-based instruction.

## OPERATIONAL DEFINITIONS

**Students:**

Individuals who have offered to take the General Chemistry course (C1404, Fall 2003) at the Department of Chemistry, Columbia University.

**Traditional Classroom Instruction (independent variable):**

For the entire semester, students attend classes, listen to lectures, hand in homework assignments, do laboratory practical assignments and take examinations.

**Web-based Instruction (Experimental variable):**

Students take an online version of the same course delivered by the same instructor. They access course content on a website, post questions and comments to an electronic discussion forum, meet with the instructor in an Internet chat room, do practical assignments using computer simulations and finally take examinations online.

**Average Student Achievement (dependent variable):**

The average final grade of each student computed as follows:

(class participation: 10%, homework assignments:20%, weekly practical assignments: 20%, mid-term exams: 20%, end-of-semester examination: 30%)

These will then be used to compute the overall average of score of students for each method of instruction.

**Other Variables:**

**Student Background and Characteristics:**

1. ***Age, Gender and Ethnic Background***
2. ***Enrolment Status*:**

   Full-time or Part-time enrolment

3. ***Socioeconomic Status*:**

   Determined from Annual family income, Educational levels of parents

4. ***Computer Literacy Level*:**

   Bodker Computer Literacy Scale:

   (1 = Beginner, 2 = Novice, 3 = Competent, 4 = Proficient, 5 = Expert)

5. ***Academic Major*:**

   Course or subject student expects to major in.

6. ***Previous performance*:**

   Determined from student's previous records of high school grades, as well as grades in SAT.

7. ***Credit Hours*:**

   The total number of credit hours that the student is taking for the semester

8. ***Previous Experience with a Web-based Course***

**METHODOLOGY**

**Sample**

About 60 undergraduate students who will be offering the General Chemistry course (C1404, Fall 2003) at Columbia University.

**Sample Treatment**

- Demographic data (name, age, gender, enrolment status etc), as well as data on the independent variables will be obtained from all enrolled students using a self-reporting form (see Appendix).
- Each student will be assigned a code number.
- A statistical program e.g. SPSS will be used to randomly sort the students into two groups A and B.
- Group A will be assigned to classroom instruction (i.e. the control group) whilst Group B (the experimental group) will be made to offer the course over the internet.
- Assignment is final and no transfer of students between groups will be accepted.
- Instructor will keep records of each student's grades in all assignments, mid-term and final exams.
- Data will be analyzed at the end of the semester.
- Procedure will be repeated for at least two more semesters.

**Analysis of Data**

- Students who officially drop the course after submitting their forms will have their data deleted.
- Students who are unable to complete the course due to unforeseen circumstances will also have their data deleted.
- A statistical package e.g. SPSS will be used to analyze all the data to obtain;
    - A plot of frequency distributions of all demographic data.
    - Means, standard deviations and inter-correlations for all the variables.

- Regression coefficients that can be used to predict the effect of the independent variables on the dependent variable whilst holding the influence of all other variables constant.
- The difference in means of student grades between classroom and web-based instruction, and whether this difference is statistically significant.

**Discussion**

Based on the analysis, the hypothesis will either be accepted or rejected, and plausible interpretation of the results will be made. Findings that are in line or inconsistent with previous research will be discussed, conclusions drawn and recommendations as to the future direction of similar research will be made.

**References**

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**Appendix**

**C1404 - General Chemistry**
**(Fall 2003)**

**Student Survey Form**

Code # ……..

*First Name*: ……..… *Last Name*: …..……. *Age*: …….

*Gender*:
□ Male □ Female

*Ethnic Background*:
□ Asian □ Black □ Hispanic □ Other
□ Multiracial □ Native American □ White

*Academic Major Area*:
□ Humanities □ Sciences □ Social Sciences □ Other

*Enrolment Status*:
□ Full time □ Part time

*Total number of credit hours you are taking this semester*…….

*Computer Literacy Level*:
□ Beginner □ Novice □ Competent □ Proficient □ Expert

*Do You Have Access to a Computer at Home*?
□ Yes □ No

*Have you ever taken an internet delivered course*?
□ Yes □ No

*Annual Family Income* ('000 $):
□ Below 20 □ 20 - 40 □ 40 - 60 □ 40 - 80 □ Above 80

*Educational Background of Father*:
□ High Sch. □ College □ Graduate □ Other

*Educational Background of Mother*:
□ High Sch. □ College □ Graduate □ Other

*Name of Standardized Test*: …….. *Score*: …… *Year* : …….