Evaluation of the Effectiveness of a WebCT Course

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Many academic institutions across the country are incorporating computer and internet technology into classrooms. The purpose of this research was to examine student reactions and learning in a molecular biochemistry undergraduate course taught using collaboration and internet technology. Student reactions to the course, the technology, and working in groups were fairly positive. Students liked using the technology, felt it helped them to learn the material, and thought that the groups worked well together to answer the exercises. Students were motivated to do well in the course, and the more confident they were in their ability to do well, the higher they scored on the standardized knowledge test.

1. Introduction

Academic institutions are fast becoming technological academic institutions, with computers and web technology taking us into the millenium. With so many academic institutions implementing computer and internet technology in the classrooms, it seems imperative to evaluate the effectiveness of its use, as well as evaluate perceptions of students.

The purpose of this research was to evaluate a molecular biochemistry course taught with web technology and student collaboration. Student reactions and learning were two criteria used to evaluate this course.

2. Student Collaboration

There is some evidence to suggest that students may gain from working cooperatively using computers, since they are able to elaborate on the material being learned (Webb, 1992). Susman (1998) conducted a meta-analysis to compare collaborative computer-based instruction (CBI) to individual computer-based instruction. Her quantitative review suggests that collaborative CBI may increase achievement, and presumably group interaction, over individual CBI when there is cooperative learning training and a tutorial.

3. Evaluation

In order to evaluate this innovative course, students were asked about their reactions to the course, the technology, and the collaboration (i.e., group work) fostered in the course. In addition, student learning, an important educational criterion, was also assessed. Student reactions included such things as liking for the course, and how students perceived the organization and objectives for the course. It was also important to assess students' reactions to using technology as a tool for education. Technology in education is fast becoming the norm, with institutions across the country adopting its usage in many fields of study. However, the perceptions of students using the technology is largely ignored, or at best, measured in some qualitative fashion. One purpose of this research was to quantitatively examine students' reactions to the course, and more specifically, the technology used in the course.

Student teams and group work were also a significant part of this course, and therefore, evaluation of perceptions of group work was essential. Collaboration, or working jointly with

others to perform a task, has been used for many reasons in education. It may be argued that working in collaborative groups brings together individual differences, which may promote more effective group task performance. Working collaboratively may also foster proactive learning, where some students are explaining concepts to other students, which may help both the "teacher" and the other student (Susman, 1998). The "teacher" may learn better because she is elaborating on the material. The student may learn better from another student who explains it in more "student-friendly" ways. Working collaboratively may also help to prepare students for working in groups in organizations, where team work is emphasized.

Learning is considered an important evaluation criteria in most academic institutions. Learning was assessed with a standardized molecular biochemistry test administered at three time periods: at the beginning of the fall semester (pre-test), at the end of the fall semester (post-test 1), and at the end of the spring semester (post-test 2). This enabled the authors to examine the amount of change in learning of the course material.

4. Individual Differences

According to Bandura's (1986) social cognitive theory, learning is a continuous process in which behavior is motivated and regulated by one's cognitions, such as self-efficacy. Self-efficacy is the belief one has in his or her "capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, pp. 3). Self-efficacy beliefs are task specific, and regulate behavior by determining task choices, effort, and persistence. In educational settings, examples of self-efficacy include self-efficacy of learning course material or understanding course concepts. Self-efficacy evolves from a variety of sources, including prior personal accomplishments, verbal persuasion, vicarious learning (i.e., watching others perform the behavior successfully), and physiological arousal. It has been shown to influence level of task performance (Bandura, 1986), and academic performance (Wood & Locke, 1987). Wood and Locke (1987) found that college students with higher self-efficacy beliefs tended to perform better in academic courses.

5. Procedure/Methods

Undergraduate students enrolled in a two-semester molecular biochemistry course participated in this study as part of the course. There were 75 students in the fall semester, and 20 in the spring semester. Students generally worked alone or in groups of two, depending on the assignment, to complete in-class work assignments. They manipulated molecular figures and worked on problems.

Students were administered a standardized molecular biochemistry knowledge test at three time periods. The knowledge test consists of 60 multiple choice questions.

Students were asked to complete reaction measures at the end of each semester. A survey was specifically developed for this course to assess perceptions of the course, of the use of the technology, of working in groups, and to assess individual differences. Students responded to each item using a 4-point Likert scale from "strongly disagree" (1) to "strongly agree" (4).

5.1 Perceptions of the Course. There were 4 questions representing perceptions of the course, including "The course is well organized," "The objectives for the class are clear," "The material is being covered too quickly," and "I like alternating lecture and group exercise."

5.2 Perceptions of the Technology. There were eight questions to assess perceptions of working with the technology, such as "The technology used in this course increased my liking for the course," and "The technology used in the course made the class more interesting."

5.3 Perceptions of Working in Groups. Students were asked three questions related to working in groups, such as "Working in teams has helped me to better learn the material."

5.4 Individual Differences. Students were asked about their confidence and motivation to do well in the course. The two questions were "I am confident I will do well in this course," and "I am motivated to do well in this course." In addition, a measure of student self-efficacy was given at the time of the first post-test (adapted from Wood and Locke, 1987). Self-efficacy of learning the material, understanding the material, and explaining the material were assessed with confidence and magnitude ratings. For example, students read the statement, "I believe I can learn 60% (70%, 80%, 90% or 100%) of the course material," and either agreed or disagreed with the statement. If they agreed, they were asked to rate their level of confidence from 0 to 100. The responses on each subscale were aggregated to form a total self-efficacy score.

6. Results

6.1 Student Reactions. The means and standard deviations for each item in the student reactions survey can be found in Table 1. Means and standard deviations are presented for the fall semester and the spring semester.

Perceptions of the Course. The fall semester students indicated they thought the course was well organized and that the objectives for the course were clear. They also liked alternating lecture and group exercise. Agreement dropped somewhat for those students who continued into the second semester for the statements that the objectives for the course were clear. They also were not as positive about alternating lecture and group exercise as they were in the fall semester.

Technology Questions. Students had overall positive perceptions of the technology used to help teach molecular biochemistry. They felt the technology did not inhibit their ability to learn, and that it made the class more interesting and easier to learn the material. They liked using the technology and felt it was relevant for the course (however, relevance was perceived as less so in the spring semester).

Group Questions. Students were also fairly positive about working in groups. They thought their team worked well together, that working in teams helped them to learn the material better, and that they had a deeper understanding of the course due to working in teams.

Individual Differences. Students were much more confident and motivated in the fall semester than in the spring semester.

6.2 Molecular Biochemistry Knowledge Test

The means and standard deviations for the pre-test and post-tests can be found in Table 2. The range of scores from the pre-test and post-test were quite similar, and yet the class did improve significantly from the pre-test to post-test 1. Students improved an average of 3 points for post-test 1 and almost 10 points for post-test 2. It was anticipated that there would be a greater improvement from the pre-test to post-test 2, than to post-test 1, since many questions on the standardized test represented material covered in the spring semester.

6.3 Relationships Between Reactions, Individual Differences and Learning

Reactions and Learning. The relationship between reactions and performance on the post-tests (i.e., learning) can be found in Table 1. Many of the correlations are essentially zero, which is consistent with psychological research on between training reactions and learning (Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997).

Individual Differences and Learning. The relationship between these variables can be found in Table 1. Confidence to do well in the fall semester was significantly related to

performance on post-test 1 and post-test 2. That is, those students who felt more confident received higher test scores. Motivation to do well was related to post-test 1, but only when the students who performed better on the post-test than on the pre-test were considered. Students who reported higher motivation tended to receive higher test scores.

Self-efficacy for understanding and explaining course material was significantly related to post-test 1, as was overall self-efficacy (see Table 3). These results suggest that students who had stronger beliefs in their ability to understand the material and explain it, tended to do better on the post-test.

Discussion

Student reactions towards the course, the technology used as part of course exercises, and working in groups were fairly positive. However, some of these ratings were somewhat lower in the second semester. Perhaps a Hawthorne effect may have been operating. That is, people tend to be very receptive to novel situations and perform better, but then the novelty wears off and performance returns to baseline levels. It is difficult to determine with a small sample size and short period of time. Future research should look at the long-term effects of implementing technology into courses to determine if any improvements are due to the technology or to the novelty of the technology.

Students were also confident and motivated to do well in the course, but only in the fall semester. The returning students for the second semester were not as confident that they would do well and indicated they were not as motivated. This is somewhat surprising since they were the students that choose to return.

Alliger, G.M., Tannenbaum, S.I., Bennett, W.Jr., Traver, H.A., & Shotland, A.B. (1997). A meta-analysis of the relations among training criteria. Personnel Psychology, 50(2), 341-358.
Bandura, A. (1986). Social foundations of thought and action. Englewoods Cliffs, NJ: Prentice-Hall, Inc.
Bandura, A. (1997). Self-efficacy: The exercise of control. New York: W.H. Freeman and Company.
Susman, E.B. (1998). Cooperative learning: A review of factors that increase the effectiveness of cooperative computer-based instruction. Journal of Educational Computing Research, 18(4), 303-322.
Webb, N.M. Testing a theoretical model of student interaction and learning in small groups, in Interaction in Cooperative Groups: The Theoretical Anatomy of Group Learning, R. Hertz-Lazarowitz and N. Miller (eds.), Cambridge University Press, New York, pp. 102-119, 1992.
Wood, R.E. & Locke, E.A. (1987). The relation of self-efficacy and grade goals to academic performance. Educational and Psychological Measurement, 47(4), 1013-1024.

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Table 1

Means and Standard Deviations for Student Reactions

	Fall	Spring	Fall		Spring	
Perceptions of the Course	Mean (SD)	Mean (SD)	r^1	r^2	r^1	r^2
The course is well organized.	3.56 (.46)	3.25 (.65)	-.05	.09	-.27	-.35
The objectives for the class are clear.	3.41 (.50)$_a$	3.06 (.64)$_b$	.14	.36*	-.22	-.43
The material is being covered too quickly.	2.75 (.50)	2.79 (.73)	.08	.19	-.26	.00
I like alternating lecture and group exercise.	3.24 (.87)$_a$	2.67 (.92)$_b$	-.07	.11	-.12	-.29
Technology Questions						
The technology used to deliver this course is hampering my ability to learn.	2.11 (.92)	2.03 (.81)	.05	.04	.53*	.43
The technology used in this course increased my liking for the course.	2.93 (.81)	2.44 (1.04)	-.18	-.09	.09	-.05
The technology used in this course made the class more interesting.	3.06 (.76)	2.62 (1.04)	-.09	.07	.08	-.11
Because of the technology used in this course, I am less motivated to take another course using this technology.	2.01 (.88)	2.44 (.99)	-.08	.05	-.04	-.16
The technology used in this course made it easier to learn the material.	3.04 (.84)	2.52 (.93)	-.15	-.08	.00	-.11
The use of technology was relevant for this course.	3.13 (.75)$_a$	2.44 (.95)$_b$	-.08	-.03	.05	-.09
I have a deeper understanding of molecular biochemistry due to the technology used in this course.	3.02 (.81)	2.58 (.70)	-.14	-.09	.37	.59*
I liked using the technology in this course.	3.04 (.82)	2.50 (.81)	-.16	-.06	.26	.42
Group Questions						
My group and I work together well to come up with answers to the exercises.	3.22 (.74)	3.09 (.55)	-.17	-.04	-.44	-.31
Working in teams has helped me to better learn the material.	2.85 (.99)	2.82 (.79)	-.08	.09	-.40	-.48
I have a deeper understanding of molecular biochemistry due to working in teams.	2.89 (.98)	2.59 (1.06)	-.11	.10	.04	-.08
Individual						
I am confident I will do well in this course.	3.03 (.70)$_a$	2.00 (.87)$_b$	.30*	.33*	.56*	.47*
I am motivated to do well in this course.	3.32 (.56)$_a$	2.32 (.83)$_b$	.25*	.31*	.13	.23

[1] This represents the correlation between the reaction measure item and the posttest 1 score.

[2] This represents the correlation between the reaction measure item and the change score from the pre-test to the post-test 2.

$_{a, b}$ Different subscripts within a row of means indicates a statistically significant difference, $p < .05$.

* $p < .05$

Table 2

Mean Total Points for the Pre-Test, Post-test 1 and Post-test 2

	Mean	SD	Range	N
Pre-test	18.68	5.35	9-35	75
Post-test 1	21.72	6.53	9-41	69
Post-test 2	28.25	6.46	19-40	20

Note: The mean difference between the Pre-test and Post-test 1, and between Pre-test and Post-test 2 were both significant.

Table 3

Relationship Between Self-Efficacy and Pre-Post Test Performance for Fall Semester

	Post-test 1	Change (post 1 - pre)	Post-test 2	Change (post 2 – pre)
SE-Learn	.16	.19	.17	.17
SE-Understand	.27*	.33*	.19	.21
SE-Explain	.34*	.26*	.09	.03
SE-Total	.28*	.28*	.16	.15