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Web-Based Course Delivery: An Empirical Assessment of Student Learning Outcomes

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Abstract

This research reports on the student learning outcome of a course delivered over the Web and the knowledge demonstrated from this emerging instructional delivery medium. It measures the student's knowledge at the beginning of the semester and improvement during the semester for a control group which received the instruction in class and an experimental group which received over the Internet.

Introduction

Distance learning has emerged over the last hundred years from that of printed correspondence courses, to the television, and now to an interactive environment facilitated by the Internet. The benefits of web-based courses emphasize reduced cost and accessibility, along with strong learning outcomes. The strong learning outcomes of web-based delivery of course material is an ongoing research issue, as this new construct seeks validation as a teaching medium.

Lumsdaine's (1963) studies led him to conclude that the media used to deliver instruction has "no learning benefit." Lumsdaine, Clark, Schramm and Mielke were all early proponents of the concept that the media used is simply a delivery mechanism, much like a truck that delivers supplies but does not alter the cargo (Clark, 1994). This was clarified further by Solomon's identifying media as a complement to the instructional method, and demonstrating that different attributes of media can accomplish the learning goal (Solomon, 1979). Kozma (1994) described media by its surface characteristics and its symbolic expressions. The current literature posits that the instructional design (driven by the teacher) accounts for differences in learning (Clark, 1994) rather than the media used to deliver it.

While studies have been conducted regarding student opinions of web-based courses, the objective of this study is to evaluate the learning outcomes as indicated by the test scores. The hypotheses of this study are: 1. There is no significant difference in the learning outcomes (final exam scores) between those receiving the course over the web (experimental group) and those in the classroom (control group); 2. There is no significant difference in the incremental improvement (difference between pretest scores and final exam scores) between both the control group and the experimental group.

Methodology

This research was conducted in the Fall of 1998 at a private four-year liberal arts college serving primarily traditional and resident students. The course placed on the web was a general requirement for all majors - Introduction to Computers - which satisfied the technology requirement of the bachelor's degree. The students were asked to respond to a questionnaire on the first day of class and were presented with the possibility that they might be selected to participate in a web-based version of what they would otherwise receive in a classroom-based setting. The questionnaire contained a series of demographic and background questions (which are still being analyzed) as well as a qualifying question regarding the student's access to a multimedia computer with Internet connections. There were initially 62 enrolled in the class and, after drops and adds, 59 participated in the study. In addition to the questionnaire, all students were given a pretest on the first day of class, consisting of 75 questions compiled from the test bank provided with the course textbook. The questions represented the general concepts stated as the outcome objective for the course. Since these questions represented the outcome objectives, this was in fact the same test administered as the final exam for this material. Table 1 provides the descriptive data on the pretest and final exam for both groups.

Table 1

| Type of Class | Participants | Pretest Average | Pretest Median | Final Average | Final Median Score |
|-----------------|--------------|-----------------|----------------|---------------|--------------------|
| Web-based | 28 | 54.18% | 51.5% | 83.64% | 88.5% |
| Classroom-based | 31 | 48.10% | 49% | 85.06% | 86% |

A group of qualified students was selected for the experiment and sent an e-mail regarding the course work. The course was developed using “Web Course in a Box” (a complete course development software) and hosted on a local server. The content on the web site utilized PowerPoint slides as well as outlines and questions with hyperlinks to sites where the answers could be located. The *same* notes and PowerPoint slides were used in the teaching of the classroom based group. The web-based students were given a password that allowed them to logon to the distance learning web page. The web page was designed with a “learning links” section that used slides and outlines intermittent with questions. The questions included hyperlinks to web sites where students had to search for the answer. The answers were e-mailed to the instructor on a regular basis, prior to the test over that material. Both groups had the same assigned readings from the same textbook. The web-based group e-mailed their written assignments to the instructor, while the classroom based group turned in the assignments in hardcopy.

Both groups were given three tests during the semester, and a final exam. Prior to each test, a review sheet was posted on the course web site and the same review materials were covered in the classroom review. Both groups took the *same test*; however, the web-based

students were required to take the test on a computer in the college computer lab under supervision to insure no assistance was received. The Course Test Manager software provided by the text publisher made test available online and allowed students to review questions and change answers during the test, as would be the case in the classroom.

Results

The median and average pretest scores were higher for the web-based group, although not significantly. This was anticipated since these individuals, in many cases, owned their own computers and had more experience with them. Due to this disparity, it was deemed best to analyze the amount of improvement as well as the scores of the final exam. The average pretest score was 54% for the web-based, yet only 48% for the classroom. The average final exam scores was reversed with the web-based at 83.64% and the classroom at 85.06%. The median pretest scores were 51.5% for the web-based and 49% for the classroom while the final median for the web-based group was 88.5% and 86% for the classroom based group (see Table 1). A T-test on the final exams for both groups indicated no significant difference between the two groups. The magnitude of the T value of -.43 is too small to reject hypothesis #1 (see Table 2).

Table 2

| Independent Sample Tests of Final Exam Scores | | | | | | | | | |
|---|---|-----------|------------------------------|--------|-----------------|-----------------|-----------------------|---------------------------------------|----------|
| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | Mean Difference | Std. Error Difference | 99.5% Confidence Interval of the Mean | |
| | F | Sig. | t | df | Sig. (2-tailed) | | | Lower | Upper |
| Equal variances assumed | 6.3520023 | 0.0145495 | -0.439552 | 57 | 0.661923836 | -1.421659 | 3.2343383 | -10.8672858 | 8.023968 |
| Equal variances not assumed | | | -0.433746 | 50.559 | 0.666318098 | -1.421659 | 3.27763 | -11.0430333 | 8.199715 |

The ANOVA table (GRADECHG) below contains an analysis of the grade changes (from pretest to final exam) for all students in both the control and experimental groups. The significance (.009) associated with the F value (7.313) indicates that at the 99.5% confidence level, the second null hypothesis should be accepted, i.e. there is

no significant difference between the delivery methods. We also ran a T test on this same data using SPSS and, as anticipated the T value of 2.7 was equal to the square root of the F value, also indicating no significant difference between the delivery methods at the 99.5% confidence level.

ANOVA

| | Sum of Squares | df | Mean Square | F | Sig. |
|-------------------------|----------------|----|-------------|-------|------|
| GRADECHG Between Groups | 828.305 | 1 | 828.305 | 7.313 | .009 |
| Within Groups | 6455.932 | 57 | 113.262 | | |
| Total | 7284.237 | 58 | | | |

Conclusion

This study examined the learning outcomes of an Introduction to Computers course delivered over the Internet and delivered in a traditional classroom setting. The results of the pretest and completion test (final exam) indicated similar marginal improvement in both the experimental and controlled environment. Further analysis needs to be done on the learning improvement of the poor performers in both groups to determine if the web-based environment can support their needs as well as a classroom based environment.

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