A Study of Student Attitudes and Performance in an Online Introductory Business Statistics Class

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ABSTRACT

Due to economic constraints, more and more distance education courses are being offered at universities (Phipps & Merisotis, 1999). The success of students in the online setting is of importance to accrediting bodies and the administrations of universities as well as to teaching faculty (Eaton, 2001). This study provides evidence that learning outcomes for online students and traditionally taught students are not different for an introductory business statistics course. In addition, students in the online environment showed improvement in their attitudes toward statistics after instruction.

INTRODUCTION

States have been forced to reduce funding for higher education as the economy has declined (Potter, 2003). For this reason, many universities are increasing the number of digital and online courses (Phipps & Merisotis, 1999). Due to technology innovations, curriculum can be delivered in a variety of ways, including the Internet and multimedia, such as CD-ROM (Hofmann, 2002).

In developing their literature review, Utts, Sommer, Acredolo, Maher, and Matthews (2003) found there were so many studies reporting no significant difference between traditionally taught courses and courses using technology that there is a website named "The No Significant Difference Phenomenon." Pertinent to this study, research by McLaren (online, McLaren, 2004) linked on this website reports that among students who persist there is no significant difference in performance between business statistics students in traditional lecture classes and online classes.

Another aspect of statistics education research is the examination of student attitudes. Past research indicates negative student attitudes toward statistics (Fullerton & Umphrey, 2001; Schultz, et al., 1998: Waters, et al., 1998). However, Mills (2004) paints a more positive picture of student attitudes toward statistics in a study using the Survey of Attitudes Toward Statistics (Schau & Stevens, 1995). The author suggests the use of technology in statistics classes along with the reform movement in teaching statistics making it more activity oriented may have a positive impact on student attitudes. Because the current research in student attitudes toward statistics is focused on traditionally taught face-to-face classes, this study fills a gap in the body of research to date.

Purpose of the Study

The purpose of this study was to determine the effectiveness of online learning by comparing students' learning outcomes in a traditional face-to-face introductory business statistics course with students' learning outcomes in an online introductory business statistics course at a doctoral granting institution in the intermountain, western United States, as well as to examine student attitudes toward statistics.

To examine the issue of comparable learning outcomes, the following hypothesis was evaluated.

H_0: $\mu_{traditional} = \mu_{online}$ There is no difference in mean score on the final examination between the traditional course and the online course.

To learn whether students improve their attitude after online statistics instruction, the following hypothesis was evaluated.

H_0: $\mu_{pretest} \leq \mu_{post\text{-}test}$ The overall mean pre-test Survey of Attitudes Toward Statistics (SATS) score is lower or equal to the overall mean post-test Survey of Attitudes Toward Statistics (SATS) score.

Course Design and Delivery Characteristics

This researcher employed the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model of instructional design in developing the online course and materials. This instructional design model was chosen to ensure instruction was provided in an organized manner (see Appendix A for an example lesson) with measurable outcomes (Gagne, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. ,2005). In the analyze phase, the researcher profiled the students in order to better design materials to benefit the learner. In designing the course, the researcher implemented those strategies that increase active learning on the part of the learner. For example, streaming video instruction of statistics topics with the researcher as teacher was one technology innovation used to increase student engagement. To increase student involvement, the researcher required students to take notes while watching the streamed instruction. Lesson notes (see Appendix A) with blanks and white space to work problems were provided. To aid student learning of the statistical package, *Minitab*™, the instructor/researcher made a CD-ROM containing short video files showing how to navigate inside the software package to obtain specific statistical results. To implement the course, *WebCT*™, a course management tool, was used. The students had the following communication tools available: email, discussion board, chat room, and a white board. This instructor answered all email within 24 hours during the course. White and Weight (2000) discuss responsiveness of the instructor as an exceedingly important aspect for success of online instruction. In addition, feedback on lesson assignments (see Appendix A for an example assignment) was immediate with short answers available while students were working problems. Complete answers with all work were provided after the due date for each lesson assignment.

Both the traditional course and the online course had statistics tutors available. The same topics of statistics were taught by the same instructor and a single comprehensive final examination was used in both courses. Similar homework assignments were made as well as similar work with the statistical package, *Minitab*™. The instructor provided lesson notes (see example provided in appendix) for both courses. The traditional course met four days a week for one hour and 15 minutes each day for the eight-week period, while the online course was taught in a similar eight-week period in an asynchronous manner. The topics were addressed in both courses in the same sequence with the same time frame for homework assignments.

METHOD

For these convenience samples, there were 16 participants in the traditional course and 15 participants in the online course. Because these courses were taught in summer school, students might be described as more motivated since their entry into the College of Business required passing the course with at least a C-. Since all students entering the course must have a minimum of College Algebra, no pre-test was administered as there would be an expectation of generally the same skill level. The traditional course had 10 female and 6 male students; of these, 13 were Caucasian and 3 black. In the online course, there were 4 female and 11 male students and all students were Caucasian. Additionally, both samples had a mix of traditional and non-traditional students. The final examination was administered at the end of the course in both cases. The online students took the pre-Survey of Attitudes Toward Statistics at an introductory face-to-face meeting prior to any instruction. At an end-of-term meeting (face-to-face) of the online class, the post-Survey of Attitudes Toward Statistics was administered. Reliability and validity for the Survey of Attitudes Toward Statistics have been established by its authors (Schau & Stevens, 1995).

RESULTS

To evaluate the first hypothesis, a two-sample t-test was conducted after checking all assumptions. As expected based upon previous research, there was no significant difference in mean score (see Table 1) on the final examination between the two groups of students (p=0.15). This would indicate that course delivery method is not a factor in student learning outcomes for this course.

Table 1

Descriptive Statistics for the Final Exam Scores

	Mean	Standard Deviation
Traditional	80.2	13.3
Online	70.9	20.8

To evaluate the second hypothesis, a paired t-test was conducted. Descriptive statistics for both pre-SATS and post-SATS may be found in table 2. The results indicate that students in the online section of introductory business statistics have improved attitudes toward statistics after having instruction (p=0.016).

Table 2

Descriptive Statistics for Pre-SATS and Post-SATS

	Mean	Standard Deviation
Pre-SATS	126.0	14.7
Post-SATS	136.9	22.2

To determine where improvement was made, the researcher examined the four subscales within the survey. The four subscales are: 1) affect, 2) cognitive competence, 3) value, and 4) difficulty. The means and standard deviations for both pre-test and post-test subscales are displayed in table 3. Of the four subscales, improvement was shown by the increase in means of pre- and post-test scores for affect, cognitive competence, and value. The means for the difficulty subscale remained about the same at 3.78 and 3.79.

Table 3

Descriptive Statistics for the Four Subscales of the Pre-SATS and Post-SATS

	Mean	Standard Deviation
Affect (pre)	4.42	0.46
Affect (post)	4.81	0.60
Cognitive Competence (pre)	4.99	0.61
Cognitive Competence (post)	5.33	0.80
Value (pre)	4.63	0.75
Value (post)	5.51	0.34
Difficulty (pre)	3.79	0.45
Difficulty (post)	3.78	0.89

CONCLUSIONS

The last step in the ADDIE model is to evaluate the instructional design. Prior to course delivery, the researcher/instructor did several forms of formative evaluation using both colleagues and students from previous classes to evaluate and give suggestions. However, this study accomplishes more by examining both student attitudes and learning outcomes. It is informative for both the instructor/researcher and the administration of the university where the course is taught to learn that this technology based instructional delivery method is equally effective in learning outcomes for students when compared to traditional face-to-face course delivery.

To learn that student attitudes toward statistics improved in the online setting was a surprising result even though current research with traditionally taught statistics courses indicates this may be a trend (Mills, 2004). Further study should be conducted into how and why the improvement in attitude occurs so that the research may be used to inform teaching practices in both the online and traditional settings. Additional questions raised include: 1) is the attitude change due to instructor? 2) is there an advantage to video streaming? and, 3) were there specific assignments that improved student attitudes? Also, a comparison of student attitudes toward statistics should be conducted between online and traditional courses since there may be some inherent differences due to student choice of mode of learning.

Contributor

Dr. Sue B. Schou *is statistics coordinator for the College of Business at Idaho State University. Dr. Schou has taught introductory and advanced business statistics for 15 years and received awards for teaching at both college and university levels. Her research interests include statistics education and reform as well as instructional design.*

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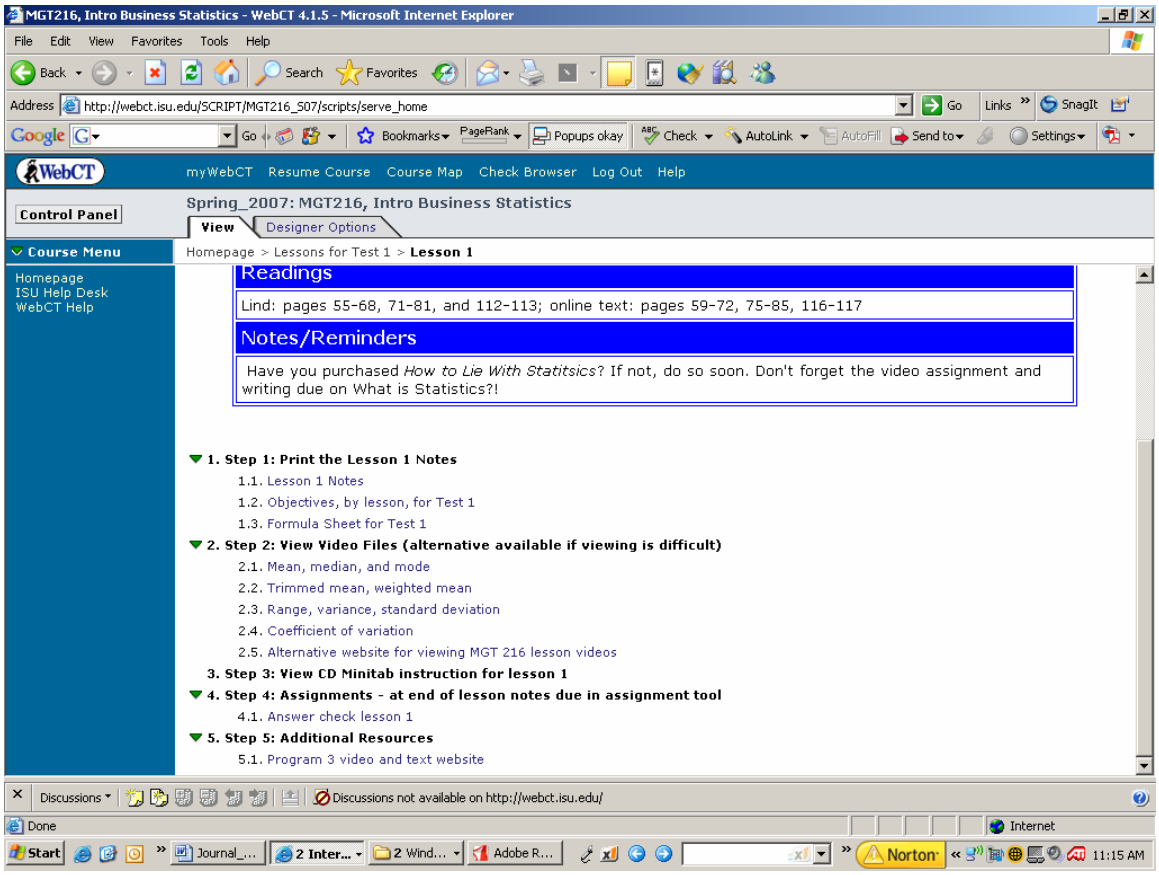
Appendix A

Example of lesson page in *WebCT™*



Example assignment (this is the assignment for lesson 1)

READ TEXTBOOK: pages 55(59)-68(72), pages 71(75)-81(85), pages 112-113(117-118)

WRITTEN ASSIGNMENT (to be hand-calculated):

ALL WORK INCLUDING THE FORMULA MUST BE SHOWN FOR CREDIT!!!

Part 1: page 60(64) 1,4,8,10
page 62(66) 13
page 65(69) 17
page 68(72) 21
page 76(80) 41a
page 79(83) 46
page 88(92) 65
page 89(93) 72a,c
page 113(117)20

NOTE: any sample statistic may be checked using Minitab or Excel

Part 2: Computer work (to be done using the computer--give all output in word processed form **using Courier New font**)

1) USE MINITAB and EXCEL to get descriptive statistics for problem #63 on page 88(92). Is there any day where there is unusual productivity? If so, which day(s)?

2) USE MINITAB and EXCEL to get descriptive statistics for problem #23 on page 137(141).
Answer questions a, b, and c.

Example page of lesson notes

LESSON 1

MEASURES OF CENTRAL TENDENCY

1. **MEAN:**

sample statistic *population parameter*

$$\bar{x} = \frac{\sum x_i}{n} \qquad \mu = \frac{\sum x_i}{N}$$

example: What is the average score on the statistics test using a sample of 8 scores?

25,67,98,76,84,73,10,81

2. **MEDIAN**: the value of the _____ term of an ordered array

example: five households have an annual total income of:

$21,500 $13,000 $24,500 $10,000 $15,000

Find the median annual total income.

example: find the median for theses test scores

25,67,98,76,84,73,10,81