A Study on Distance Education in Introductory Mathematics

Melanie Butler, Mount St. Mary's University

Abstract

Many colleges are introducing more online classes to compete with community colleges and other online programs. Introductory, general education classes are often candidates for conversion to an online format. In an effort to decide if online mathematics classes would be feasible at a small liberal arts college, a randomized study was conducted in an introductory statistics course. Students were randomly assigned to one of two groups: control or experimental. Students in the Control Group were presented with a lesson typical of the course. Students in the Experimental Group viewed the same lesson on their own via BlackBoard. The two groups were then compared on a posttest and survey. No differences were found between the two groups, although survey comments offer suggestions for those involved with designing online courses.

INTRODUCTION

Many small colleges are considering introducing more online classes to compete with community colleges and other online programs. This is especially true in introductory classes that are general education requirements. In many situations, students who wish to get ahead or catch up on credits, may elect to take general education requirements at other schools, such as community colleges or online programs. This situation has economic and other issues for colleges. It is possible that offering online versions of these classes can help colleges recoup some of these losses.

In the Mathematics and Computer Science Department at UNIVERSITY, a small liberal arts college on the east coast, there is currently only one online computer science course that has been piloted. There are two mathematics courses that would be likely candidates for online courses. The first is a statistics course which most students take to fulfill the core requirement in mathematics. The second is an intermediate algebra course, a not-for-credit course which students are placed into if they do not meet the prerequisites for the statistics course. Both of these courses have many sections each semester. What would be the ramifications of turning either of these classes into online courses? How would the students react to this change? This paper details a study attempting to answer these questions.

BACKGROUND

Research into higher education distance learning has been both positive and negative. Furthermore, this research has focused on both the impact of online programs on students and on the institutions. Some research cites the training needed for faculty members and other necessary institutional support as a major impediment to online courses (Abel, 2005). However, Abel (2005) describes reasons why distance education is important, including the increasing costs of education, the importance of accessibility of education, and the rising number of students seeking college degrees.

The U.S. Department of Education (2009) states that blended online and face-to-face models benefit students the most. A National Science Foundation Task Force (2008) cites the importance of using technology in teaching in STEM fields. Allen and Seaman (2008) state that online enrollments have been growing substantially and that this growth shows no sign of slowing, with 3.9 million students taking at least one online class in Fall 2007.

Much research on online courses supports that online students are as successful as their traditional counterparts. However, there have been calls for more research on distance education, especially randomized studies. This need for further research is also complicated by the fact that distance education is so varied in its delivery. A review of literature on distance education, Postsecondary Distance Education (2002), calls into question whether distance education research to date is reliable. Postsecondary Distance Education (2002) also calls for some sort of quality assurance in distance education.

METHOD

Participants

Participants in this study were 38 students enrolled in one of two sections of a statistics course taught by the author in the Fall 2009 semester. Students elected to participate and were offered a small number of extra credit points for doing so. Those students who signed up to participate were randomly assigned to one of two sections: control or experimental. Students in the Control Group attended a traditional face-to-face class and were taught a lesson as was typical of the course. Students in the Experimental Group did not attend class, but instead were instructed to view the lesson on BlackBoard on their own. The Control Group had 25 students total, while the Experimental Group had 13 students total.

The Lesson

A topic was chosen for the lesson which was outside the scope of the course, but related to it. After reading an interesting article, Math and the City, by Steven Strogatz (2009), it was decided that a lesson would be developed on this topic. A set of PowerPoint slides was written for the lesson, as PowerPoint slideshows were typically used for the course. A duplicate file was made that included a "voice-over" for students in the Experimental Group. The PowerPoint slideshow with "voice-over" was made available to students in the Experimental Group via BlackBoard.

Measures

A survey was written to be used as a pre and post measure. All the surveys were anonymous. The surveys were written to assess students' feelings about online classes. The complete survey is an appendix. All participants in the study were asked to complete the survey both times. Students in both groups completed the pre-survey on paper during the class before the lesson. All participants were then asked to complete the post-survey on BlackBoard within a week after the lesson.

It could not be assumed that students had no prior knowledge of the material in the lesson. For this reason, all participants were given a pre and posttest on the material contained in the lesson. Students in both groups took the pretest in class before the lesson. All participants were then asked to complete the posttest on BlackBoard within a week after the lesson.

Procedure

The lesson was planned for approximately midway through the Fall 2009 semester. Two weeks before the lesson, students in the two sections of the author's statistics courses were asked to sign up to participate in the study, after the study was explained to them. The students were offered a small number of extra credit points for participating. Students who signed up to take part were then randomly assigned to the Control or Experimental Groups.

In the class period before the lesson, all students were given the pretest and pre-survey on paper. None of the participants were given the results or any feedback on the pretest. On the day of the lesson, students in the Control Group attended class as normal. On the day of the lesson, students in the Experimental Group did not attend class, but were asked to watch the PowerPoint slideshow on BlackBoard on their own. All participants were then given a week to complete the post-survey and posttest on BlackBoard.

RESEARCH FINDINGS

Pre and Posttest

To assess whether baseline differences existed between the students in the Control Group and Experimental group prior to the intervention, an independent samples t-test was conducted comparing the groups on the pretest. Table 1 shows the means and standard deviations by group. There was no significant difference between the Control Group (M = 24.58, SD = 15.87) and the Experimental Group (M = 25.38, SD = 12.66) on the pretest.

An independent samples t-test was also employed to compare the performance of the groups on the posttest. Table 1 shows the means and standard deviations by group. It should be noted that some students who participated in the pretest and pre-survey chose not to participate in the post-measures and are thus not used in the analysis. There was no significant difference between the Control Group (M = 68.50, SD = 28.70) and the Experimental Group (M = 63.33, SD = 30.00) on the posttest.

Table 1. Mean and standard deviation for pretest and posttest by group.

Measure	*Group*	*N*	*Mean*	*SD*
Pretest	Control	25	24.58	15.87
	Experimental	13	25.38	12.66
Posttest	Control	20	68.50	28.70
	Experimental	9	63.33	30.00

Pre and Post-Survey Quantitative Questions

The pre and post-surveys were identical and anonymous. The complete survey is included as an appendix. The first two questions had Likert scale responses with a one corresponding to strongly agree and a five corresponding to strongly disagree. The first question asked if students would like to take an online class, while the second question asked if they would like to take an online math class. Table 2 shows the averages for each of these questions by group on the pre-survey and post-survey.

Table 2. Means on first two questions on survey by group.

Measure	*Group*	*N*	*Mean*
Pre-survey – Like online class?	Control	25	3.08
	Experimental	13	2.77
Post-survey – Like online class?	Control	21	3.29
	Experimental	10	3.00
Pre-survey – Like online math class?	Control	25	3.48
	Experimental	13	2.92
Post-survey – Like online math class?	Control	21	3.62
	Experimental	10	3.44

One of the survey questions asked if the students would be interested in taking an online class over the summer from UNIVERSITY. Table 3 shows the number of students who answered yes, no, or maybe to that question on the pre-survey and post-survey by group.

Table 3. Answers to online class in summer by group.

Measure	*Group*	*N*	*Answer*	*Number*	*Percentage*
Pre-survey	Control	25	Yes	9	36%
			No	7	28%
			Maybe	9	36%
	Experimental	13	Yes	4	31%
			No	6	46%
			Maybe	3	23%
Post-survey	Control	11	Yes	5	45%
			No	6	55%
			Maybe	0	0%
	Experimental	6	Yes	3	50%
			No	3	50%
			Maybe	0	0%

Pre and Post-Survey Qualitative Questions

Responses on the short answer questions on the pre and post-surveys for each group were read and common idea blocks were identified. No clear differences between short answer responses were noticed between pre and post-survey or between groups. In particular, on both surveys students in both groups noted a lack of time constraints as the biggest advantages to online classes. Many students mentioned a lack of communication as the biggest disadvantage to online classes. One student in the Experimental Group wrote on the post-survey, "When I didn't understand exactly how to cross multiply I could have just asked the professor to her face to clarify, whereas since I am at home, I would have to e-mail her the question and that takes too much time."

When asked what support they would need if they took an online class, students in both sections on both surveys offered answers about an ability to quickly communicate with the instructor, including a very quick response to email. Several students mentioned specifically that they would want an "around-the-clock tutor" available to them. Along these same lines, when asked to design a hybrid class, many students wrote about wanting face-to-face time with the teacher, for examples and questions, and assignments online.

CONCLUSIONS

Overall, the research findings support that students did comparably whether they received the lesson in class or online. The post-survey results support a similar level of satisfaction among both groups as evidenced by the number of students who would be interested in taking online classes. As UNIVERSITY moves toward offering more online classes, pressures may mount for instructors to offer such classes. In this way, these results are helpful in understanding how students in general education courses will react to the online environment and what kind of support they will expect and need. Students at small, liberal arts schools are used to one-on-one interaction with their instructors and it seems that they will still need this support in online classes. While this lesson used only PowerPoint slides with narration for the distance education, it is clear that this will not be sufficient instruction for general education mathematics students at UNIVERSITY. Thus, more time and resources will need to be devoted to developing online materials and purchasing the hardware needed to support other types of more interactive online instruction, if effective online courses are to be offered. The knowledge that studies such as these provide can help course designers and administrators decide how money and time is best spent. Furthermore, these findings could be valuable to online instructors at other colleges and universities.

One obvious weakness in the study is that only one lesson was used as a treatment. A longer term study should be completed, which will make it more difficult to achieve the randomized design. Another weakness of the study is that in both the Control and Experimental Groups, a good number of students dropped out of the study at some time after taking the pre-survey and pre-test. From the instructor's perspective it seems that most of these students dropped out only because they forgot to go online and complete the post-measures. In the research design, it was hoped that this would not be an issue because students take online assessments on their own as part of the regular course. Further research should also be conducted which includes larger samples of students.

References

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APPENDIX

Survey

I would be interested in taking an online class in any subject.
1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable

I would be interested in taking on online MATH class.
1. Strongly Agree 2. Agree 3. Neither Agree nor Disagree 4. Disagree 5. Strongly Disagree 6. Not Applicable

What is the biggest advantage to online classes?

What is the biggest disadvantage to online classes?

What is the biggest advantage to face-to-face (not online) classes?

What is the biggest disadvantage to face-to-face (not online) classes?

What sort of support would you want or need if you were to take an online class?

Would you be interested in taking an online class from the Mount over the summer?

If you were to design a class as a hybrid of face-to-face and online, what course components would you make online and which would you make face-to face?

Do you think there is a greater likelihood that some students would be academically dishonest in an online class?