A Comparison of the Performance of Online versus Traditional On-Campus Earth Science Students on Identical Exams

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ABSTRACT

In this paper I compare the performance of online versus traditional on-campus students on identical exams in an earth science class. The number of college level distance learning classes offered online continues to increase as they offer greater scheduling flexibility to students, they appeal to students who like to work independently, and allow colleges to increase enrollment without building new classrooms. Hillsborough Community College (HCC) is a two year urban community college in Tampa, Florida. An online earth science class was first offered in Fall 2005. Most students enrolled in Earth Science are non-science majors fulfilling a science requirement for graduation and both online and on-campus classes average about 30 students. As this is a traditional earth science course it covers topics in geology, oceanography, meteorology, and astronomy. This material is divided into four units with an exam at the end of each unit. The exams are short answer, predominantly multiple choice with diagram identification and contain about eighty to ninety questions. All classes used the same study guide and textbook and all of the classes in this study were given exactly the same exams. This process was repeated over four semesters from Fall term 2005 to Spring term 2007. Statistical analysis comparing exam grades indicates that there was no significant difference in student performance on exams between the online and on-campus students.

INTRODUCTION

The number of college level distance learning classes offered online is increasing every year and part of that increase is driven by demand. At Hillsborough Community College online science classes fill within several days of registration. Online classes offer greater flexibility to students whose work and family demands make it difficult or impossible to follow an on-campus schedule and they appeal to students who like to work independently and at their own pace (Lorenzetti, 2005). However, that very advantage of flexibility can be a disadvantage to students who need the structure and discipline of weekly class meetings. On-campus classes can also provide the social interaction, encouragement and support of instructor and students that may be lacking in online classes (Dutton et al., 2001; Beard et al., 2004).

The number of studies comparing student performance in online versus traditional on-campus classes continues to grow. The majority of these show no significant difference in performance of online versus traditional on-campus students (Russell, 1999; Fredda, 2000; Dutton et al., 2001, Lorenzetti, 2005). Studies in the field of geography show similar results (Jain and Getis, 2003; WinklerPrins et al., 2007). In the field of geoscience there is great interest in teaching at a distance (Butler, 1997; Childress, 1996; Caprariis, 2000). At the Geological Society of America (GSA) annual meeting in Philadelphia, 2006, Session Number 27 was devoted to "Effective Online Strategies for Teaching Geoscience at a Distance" producing twelve presentations. However, there are few studies in geoscience education comparing the effectiveness of online learning versus traditional class learning. In two such studies the results are inconclusive. One study found that online earth science students performed poorer on exams producing fewer students attaining a grade of A or B (Branlund, 2006). Another study compared a web-enhanced entry level geoscience class to traditional classes. While not a true online class, results showed an improvement in exam grades and overall an increase in class passing percentage for students using the web enhanced class (Durbin 2002).

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BACKGROUND

In the Fall 2005 term I offered an online earth science class for the first time. The platform used was WebCT. Online exams were not offered so students came on campus four times to take the exams. At the same time I was teaching two traditional on-campus earth science classes. One on-campus class was an 8:00 AM class while on alternate semesters the other class was either 9:30 AM or 11:00 AM. I wanted to compare the performance of the online students to their on-campus counterparts. All classes used the same textbook, Earth Science by Tarbuck and Lutgens, and a study guide written by me. All classes were given exactly the same exams. I repeated this process over the next four semesters, from the Fall 2005 term to the Spring 2007 term. As each class took four exams, there were sixteen exams to compare. This paper is a summary of the data I collected over those two years.

TRADITIONAL ON-CAMPUS CLASSES

Hillsborough Community College is a two year urban community college in Tampa, Florida, with an annual enrollment of about 31,000 credit students (about 14,000 FTE) making it the fifth largest community college in Florida. The average student age is just over 25 with females comprising about 56 % of the population. Ethnic demographics show that the student population is comprised of about 56 % white, 21% Hispanic, and 20 % African-American (HCC Factbook, 2007).

Most students enrolled in Earth Science are non-science majors fulfilling a science requirement for graduation. Earth Science classes, both online and on-campus, average 24 to 30 students. Table 1 shows a demographic breakdown of my online and on-campus classes versus the college wide student population. The data shows that both my online and on-campus classes have about the same percentage of white students as the college wide population. African American students are

TABLE 1: DEMOGRAPHIC DISTRIBUTION OF ONLINE VS. ON-CAMPUS STUDENTS

	% Female	% African American	% Hispanic	% White
College-wide	56	20	21	56
On-campus	61	15	23	56
Online	71	23	16	57

under-represented in my on-campus classes but slightly over represented in the online classes. Just the opposite is true for the Hispanic population. A noticeable difference occurs when comparing male and female populations. The percentage of female students in both my on-campus and online classes is higher than the college wide populations and significantly higher in the online classes (71% vs. 56%). The reasons for these disparities and the influence on the results is unknown but could be the topic for future research.

I would describe my teaching style as lecture peppered with many questions posed to students. I show transparencies, write and draw diagrams on a whiteboard, use models and samples, and do some demonstrations. I have written my own study guide to accompany the class which students are required to buy along with the textbook. The study guide is an outline of my lectures, with some diagrams, charts and tables. It is designed so students can follow along with me in class and take notes efficiently. As this is a traditional earth science course it covers topics in geology, oceanography, meteorology, and astronomy. I divide this material into four units covering about four chapters each and give an exam at the end of each unit. The exams are short answer, predominantly multiple choice, with diagram identification, and contain about eighty to ninety questions. These are the exam grades for my online and on-campus classes that I compare in this paper.

ONLINE WEBCT CLASSES

The online class was offered through a WebCT platform. I used the same textbook and study guide as I used in my traditional on-campus class. To replace the on-campus lecture for the online students I prepared a PowerPoint presentation on each chapter we covered. I used the study guide as a framework. Slides consisted of text along with diagrams and photos from the textbook. These were enhanced with dozens of other photos obtained from various sources to demonstrate processes and features. I then used the narration feature in PowerPoint to add my voice to each slide. Consequently, students had me lecturing to them without me being there. Much of what I say in the PowerPoint lectures is the same thing I say in my classes. In both the online and on-campus classes each unit had a set of 25 to 30 learning objectives that students had to answer and submit and several online virtual field trips to complete. While all assignments were completed online and submitted via WebCT, exams were taken on-campus. On four Saturday mornings on pre-defined dates written in the syllabus the students came on-campus and I gave them the exams. The tests were exactly the same tests given to my on-campus classes, they had the same amount of time to complete the tests, and the rooms were similar.

RESULTS

Table 2 shows the class average, or mean, on each exam for each semester from Fall 2005 to Spring 2007. To test the hypothesis that the online students performed as well as the on-campus students on the exams, I used a t-test between two independent samples with a significance value of 0.05 to test the equality of means. The two samples compared were the online students versus the on-campus students for each exam in each term. The null hypothesis to be tested was that the online students and on-campus students do not differ statistically with respect to mean test scores. In the row labeled "Reject null hypothesis", 'yes' indicates there is a significant difference between the means on that test and 'no' indicates no significant difference. The data shows that the averages of the two samples were statistically different on only two of the sixteen exams. Therefore, I conclude that my online students have mean exam grades that are statistically equivalent to my traditional on-campus students.

Online education has garnered much attention as an alternative method of teaching and learning to traditional on-campus face-to-face methods. There have been inevitable questions on how well online students perform versus their on-campus counterparts. Only repeated research in many subject areas can answer this question.

TABLE 2: ONLINE VERSUS ON-CAMPUS AVERAGES ON EACH EXAM FOR EACH TERM

	Exam 1	Exam 2	Exam 3	Exam 4
Fall 2005				
On-campus	76.3	78.8	73.1	77.4
Online	73.0	75.0	67.3	74.4
Reject null hypothesis	no	no	no	no
Spring 2006				
On-campus	75.3	78.6	69.7	81.2
Online	69.0	71.0	69.6	78.8
Reject null hypothesis	no	no	no	no
Fall 2006				
On-campus	75.3	72.7	70.3	75.8
Online	70.4	69.9	66.2	75.3
Reject null hypothesis	no	no	no	no
Spring 2007				
On-campus	77.0	77.3	70.2	76.0
Online	65.0	73.8	60.7	68.7
Reject null hypothesis	yes	no	yes	no

My research shows that in my earth science classes, the online students perform as well as the on-campus students on my exams.

DISCUSSION

In this experiment all students used the same test instruments, used the same textbook and had the same assignments. While the results show that statistically my online students performed as well as my traditional on-campus students on the exams, I would like to suggest areas of further research when comparing these two student populations. There may be some selection bias of students choosing online classes. What different characteristics do they have (if any) from their traditional on-campus counterparts with respect to GPA, motivation and self discipline, basic study skills, computer skills, basic reading, writing, and math skills, and learning styles? Are online students more academically prepared for college level classes given that fifty five percent of all students entering Florida's public postsecondary colleges and universities require remediation in math, reading, and/or writing (OPPAGA, 2007)? Are they taking classes in an online environment that is more (or less) consistent with their learning styles since studies show that distance and traditional students have different learning styles with distant learning students being more independent learners while traditional students more dependent (Diaz and Cartnal, 1999; Tucker, 2000)? What effects do the time of day the on-campus class is offered and attendance have on class performance? There are also some obvious demographic differences in the student population taking my online classes compared to the on-campus classes. The most significant difference is in the percentage of female students enrolled in the online classes (see Table 1). The reasons for this difference and the potential influence on outcomes could be further explored.

CONCLUSION

The demand for distance education continues to grow as students, hard pressed by family and work demands, find the flexibility of online classes allows them to continue their education. Colleges and universities see distance education as a means to grow enrollment without the additional expense of building more classrooms or adding staff. However there remains that question of whether online students perform as well as traditional on-campus students. In this study, student performance was measured by comparing the grades on objective tests of one online class versus two traditional on-campus classes every semester over a two year period. Each term all classes were given identical exams. Exam scores were analyzed using a t-test to determine the equality of means between the online students and the on-campus students. The results indicate there was no statistical difference between these two populations. My conclusion is that my online students perform as well as my on-campus students on my exams.

Distance learning delivered via the web is not new but is certainly in its infancy as an educational vehicle. The long term success of online teaching and learning as an alternative means of education should be measured by how well students perform over time. Therefore, research needs to continue in order to compare traditional versus non-traditional methodologies so that we may better serve our students. To that end I hope this research can contribute to the larger body of work on this subject.

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