Innovative Higher Education, Vol. 29, No. 3, Spring 2005 (© 2005)
DOI: 10.1007/s10755-005-1938-x

A Comparison of Student Achievement and Satisfaction in an Online Versus a Traditional Face-to-Face Statistics Class

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ABSTRACT: In this study we examined differences between online distance education and traditional classroom learning for an introductory undergraduate statistics course. Two outcome dimensions were measured: students' final grades and student satisfaction with the course. Using independent samples *t*-tests, results indicated that there was no significant difference in grades between the online and traditional classroom contexts. However, students enrolled in the online course were significantly less satisfied with the course than the traditional classroom students on several dimensions. This finding is inconsistent with the "no significant difference phenomenon," described in Russell's (1999) annotated bibliography, which supports minimal outcome differences between online courses and face-to-face courses.

KEY WORDS: distance learning; Internet; student satisfaction; statistics instruction; online course development.

No Significant Difference?

Interest in the World Wide Web has been rapidly increasing since its inception (Browning, 1999). Few innovations in the past century have captured the imagination and interests of educators around the globe more than the World Wide Web. With Web technology distance education can now be easily accessed by anyone in the world from anywhere in the world. Web-based instruction is emerging as a viable option to traditional classroom instruction for many colleges and universities which offer distance learning. Through the integration of

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technology and instruction, educators hope to prepare their students for what is to come in the workplace (Butik, 1998; Hadley, 1998).

Many people taking distance-learning classes are non-traditional students (e.g., single parents, older students) who are less able to take face-to-face classes than traditional students because of jobs and/or family obligations (Browning, 1999; Gallagher & McCormick, 1999; Paulsen, Higgins, Miller, Strawser, & Boone, 1998; Wilkins & Barrett, 2000). Distance education, especially Internet courses, reduces or eliminates the travel time of students and instructors (Gallagher & McCormick, 1999; Paulsen et al., 1998).

To date, one of the most supportive publications of distance education is Russell's *The No Significant Difference Phenomenon* (1999), in which he cited several comparison studies of distance education classes with face-to-face classes. Although the annotations included studies that span a significant portion of the last century and cite a variety of distance correspondence techniques and media communication devices used to deliver course material, many of the recent studies are direct comparisons of online classes with traditional face-to-face classes that deliver the same or similar content. While Russell's original intension was to root out sources that made an argument in favor of distance learning through communication media, he has instead made a solid argument for using technology without denigrating instruction as long as it is practically and economically feasible.

Russell's (1999) publication has come under some scrutiny, however, for a variety of reasons. One of the main problems cited regarding distance education is that instructors often adopt curriculum to fit the technology rather than choosing the technology to fit the curriculum (Bennett & Green, 2001). Often, instructors are approached to employ certain technological tools in their classrooms to meet economical or practical goals of the department or institution. For example, instructors may be encouraged to write a course specifically to serve students who cannot otherwise attend classes on the campus, thus serving institutional enrollment needs. The technology is usually packaged to serve this purpose, sometimes at the expense of the curriculum and/or instructional pedagogy (Bennett & Green, 2001).

As indicated in a report developed by Phipps and Merisotis (1999), "technology is not nearly as important as other factors, such as learning tasks, learner characteristics, student motivation, and the instructor (p. 8)." The report is a critical and comprehensive review of the literature that compares online distance education with traditional face-to-face classrooms, citing many errors in the studies highlighted by Russell that support "no significant difference" between student

outcomes of online learning and face-to-faces courses. According to the report, two of the key shortcomings of the studies mentioned in Russell's publication included (1) not controlling for extraneous variables and (2) not using reliable or valid instruments to measure student outcomes.

Although our study was limited by using a small convenience sample of students, we hypothesized that a significant difference in student outcomes does exist, using instruments with good psychometric properties and controlling for extraneous variables as much as possible. Specifically, we were interested in investigating differences between students' knowledge of statistics and attitudes toward their statistics class for an online and face-to-face class. We expected that our measures might detect some significant difference, despite the conviction of Russell's (1999) publication, perhaps due in part to critical factors mentioned by Phipps and Merisotis (1999) such as learning tasks, learner characteristics, student motivation, and the instructor. The following sections provide an outline of the literature as it applies to these factors.

Learning Tasks

According to Sharpe and Hawkins (1998), "The technology must serve the subject matter, and not the other way around" (p. 28). Regardless of this suggestion, many instructors who develop a distance education course, especially those who do it for the first time, are caught up in the activity "translating" their current curriculum into an online format without consideration of how to utilize the technology in the most effective ways (Sharpe, Harper, & Brown, 1998). For example, many instructors will take their lecture materials and copy them to their course website, thus simply presenting course content without considering new and innovative ways to facilitate learning using an electronic medium.

As suggested by Gillespie (1998), the tasks of online learning should be designed to help learners develop higher level thinking skills and evaluate their own understanding, mediated by sharing ideas and problems with the content using interactive or collaborative online formats. With the use of the Internet to host distance classes, interaction can take on an entirely different meaning (Mclsaac, Blocher, Mahes, & Vrasidas, 1999). Some claim the lack of face-to-face interaction can leave students feeling isolated from each other and from their instructors (Browning, 1999; Gallagher & McCormick, 1999; Mclsaac et al., 1999; Morelos-Borja, 1999). Extreme doubt exists

among educators who believe that technology is averting attention away from the student-teacher interaction, perhaps the most critical aspect of the educational process, and is in effect creating a lack of engagement among otherwise interested students (Rintala, 1998; Sharpe & Hawkins, 1998).

Supporters of online learning suggest that constructivist theory may offer the best framework for student learning online (Bennett & Green, 2001; Dabbagh, 2000) where constructivism is generally defined as the "coconstruction" of knowledge that develops as a product of student–student and student–instructor interactions. This is a dramatic shift from the classic "instructivist" pedagogy, characterized by instructor-generated resources and delivery of content in a very uniform manner (Dabbagh, 2000). Online instruction can be designed to foster collaboration among peers in the form of bulletin boards, chat rooms, and threaded discussions, thus following a constructivist design of content delivery.

Learner Characteristics

Since the interaction between the student and the technology becomes a critical factor when learning content online, a lack of computer knowledge may in fact hinder an online student. While some claim that computer skills have little effect on student participation in an online class (Mclsaac et al., 1999; Rumpradit, 1999), others suggest that student comfort with technology is a factor that should be taken into consideration when designing and executing an online course (Phipps & Merisotis, 1999).

In addition to having the necessary technological skills, online students must also take a greater responsibility for their own learning since they have limited access to instructional support (McMahon & Oliver, 2001). While some students claim to value the freedom and flexibility of online courses, these are usually testimonials of students who are already self-regulated learners (O'Hanlon, 2001). Those students who may not have developed appropriate strategies for self-regulation may find that online courses do not meet their needs and may subsequently drop the course; as a consequence, online courses have been associated with much higher rates of attrition than face-to-face courses (McMahon & Oliver, 2001; Phipps & Merisotis, 1999). Instructors can make efforts to incorporate self-regulating tools in their online courses by integrating learner activities, learner supports, and learning resources in an online environment (McMahon

& Oliver, 2001) or by supplementing instruction with tips for increasing student motivation, interest, task value, use of cognitive strategies, and resource management (Cennamo & Ross, 2000; Cennamo, Ross, & Rogers, 2002). However, despite all the instructor's efforts to design an online course that meets the needs of the curriculum, the content, and the students, he/she may still encounter some resistance from students who are not comfortable with a learner-centered experience (Gillespie, 1998).

Student Motivation

Another issue that may be associated with the lack of traditional interaction common to most distance education classes is student motivation and achievement (Mclsaac et al., 1999). When the course content is found to be equal, student achievement is comparable between traditional and distance education classes, even when students do not have immediate access to an instructor or each other (Paulsen et al., 1998). Students who are characterized as the most successful in an online learning environment tend to be motivated, independent, and organized (Phipps & Merisotis, 1999) with good self-regulation strategies (McMahon & Oliver, 2001).

Issues regarding the efficacy of teaching courses with difficult or advanced content at a distance are also of concern. Many students already view statistics as one of the most difficult disciplines to learn for several reasons. For instance, students who are required to take statistics as part of their major frequently relate this topic to things they do not enjoy like mathematics, probability models, and calculators (Gordon, 1999; Oathout, 1995; Sutarso, 1992a, 1992b). While some students feel that statistics is a boring subject (Oathout, 1995), others may actually fear the subject because they do not feel competent in related areas such as math. They are consequently labeled as having "math anxiety" (Bessant, 1992) or "statisticophobia" (Sutarso, 1992b). Regardless of their area of study, students who hold negative attitudes or who are anxious about statistics tend to achieve significantly lower grades, including students majoring in education, in business (Sutarso, 1992a), and in advertising (Fullerton & Umphrey, 2001). For these reasons, it is common for students to avoid taking a required statistics course as long as possible (Oathout, 1995). When they finally do enroll, many students choose to use surface level strategies to learn the material because they do not perceive statistics knowledge as useful or meaningful (Gordon, 1999).

To remedy problems associated with students' lack of interest or anxiety in statistics, instructors have turned to the Internet to make information more interesting and accessible. For example, Wisenbaker and Douzenis (2000) supplemented their face-to-face class by posting a series of readings that applied statistical concepts in "real life" situations on the Internet to help make statistics more meaningful for their students. Others have used the Internet to deliver ancillary tutorials to help students work through problems, with consequent positive effects on students' understanding of statistics as well as their attitude towards the content (Aberson, Berger, Healy, & Romero, 2001; Collis, Oberg, & Shera, 1988; Scanlon & Morris, 2000). Dereshiwsky (1998) made the argument that it is possible to deliver a statistics course entirely online with students feeling appreciative of the freedom and flexibility to work at their own pace. He suggested two main instructional strategies directed to increase the likelihood of student understanding and positive student attitudes with an online statistics course: (1) "Ensure that the learning modules have numerous, additional extra examples, replete with visual inserts and real life applications. . ." and (2) "Create multiple avenues of instructor accessibility" (p. 5). This last suggestion seems particularly important for online learners of statistics since they do not have regular interaction with their instructor as they would in a traditional face-to-face class. Dereshiwsky (1998) and others also supported student learning by encouraging them to develop study groups. For instance, according to Dunn (2001), "Students should not learn statistical concepts in isolation" (p. 2), suggesting that collaborative learning is one of the most optimal methods for students to learn and understand statistics.

The Instructor

Before making instructional decisions in an online environment, it has been suggested that an instructor should first have a pedagogical foundation for content delivery. According to de Boer and Collis (2002), it is critical that pedagogical motivation steer the instructor's decisions with regards to using online technology. Like those who support the notion of constructivist learning in an online course, de Boer and Collis (2002) recommend a pedagogical model that supports participation as opposed to acquisition. In order to meet these pedagogical standards, instructors must have a sense of confidence in both the content and in themselves as teachers. Cyrs (1997) identified six specific competencies that instructors should strive for if they are designing or

mediating an online course: (1) course planning and organization, (2) verbal and nonverbal presentation skills, (3) collaborative teamwork, (4) questioning strategies, (5) subject matter expertise, and (6) involving students and coordinating their activities at field sites. In addition to these instructor competencies, the American Association of Higher Education has suggested that instructors apply their "Seven Principles for Good Practice in Undergraduate Education" to current communication and information technologies that enhance the teaching and learning process (Chickering & Ehrmann, 1996).

Specific to the instruction of statistics, McMillan (2001) suggested a framework called "backward instructional design" in which the instructor is encouraged to think first about student outcomes of a statistics class, like understanding the material and applying statistical skills, before selecting an appropriate pedagogical framework. Once a framework is established, McMillan (2001) encouraged instructors to gain students attention by helping them overcome fear and anxiety and by motivating them with a positive learning climate that is supportive of a deep and meaningful comprehension of statistics.

In our particular study, the instructor was invited to teach his already highly evaluated introductory statistics course on the Web without any student interaction except for communication via e-mail. Because he had had so much past success with the delivery of the material in a face-to-face environment, he literally translated all of his face-to-face lectures, activities, and homework assignments to the online format. This online class was delivered the same semester as a face-to-face class taught by the same instructor, and these courses were the subject of comparison. Although one might not expect there to be any significant difference in student outcomes between the courses since the content was exactly the same, this study was designed as an exploratory analysis to detect if there was in fact, "no significant difference" with regards to students' grades and attitudes toward the courses.

Method

Participants

Thirty-eight undergraduate students enrolled in the School of Nursing at a large midwestern university were selected for inclusion in this study. Most were upper-division students who were taking the statistics class to meet a major requirement for nursing. Seventeen

students elected to take the Web-based statistics course, while 21 chose the traditional face-to-face statistics course.

The Course

During the fall of 1998, the University of Missouri had created MU Direct. The mission of this academic division was to explore and expand possibilities for distance education. MU Direct utilizes Course Information Technology, a delivery method for courses off campus via the Internet. After three months of preparation, the introductory statistics course for nursing majors went online using the delivery system WebCT, and students were allowed the option of taking their required basic statistics course via the web or in the traditional face-to-face course offered on campus. The same instructor was assigned both courses, and the courses were equivalent in content. Examinations, also the same for both classes, were designed to measure equal academic outcomes. Additionally, students in both courses were required to fill out an instrument designed to evaluate attitudes towards the course.

Students taking the online statistics course were expected to have daily access to Internet and e-mail. Using WebCT technology, the course was structured to look like a website with a row of buttons down the side. To access different parts of the course (i.e., syllabus, assignments, and supplementary materials), students were required to click on one of the buttons on the side. The course was organized on a weekly basis, meaning students had approximately a week to complete readings in the textbook, complete and send (by e-mail) any assignments to the instructor. Threaded discussion, where online student-to-student and student–teacher interaction occurred, took the place of what occurred in a face-to-face classroom. In this case, students read instructor's regular questions and responded by e-mail.

Instruments

Measure of Statistics Knowledge. In this study, statistics knowledge was measured by establishing a cumulative score for students based on the sum of their performance on three class exams and a final exam in introductory statistics. The exams for the online class and the face-to-face class were exactly the same, totaling 175 items, and tested students' statistical knowledge in content areas such as graphing techniques, measures of central tendency, variability, correlation, simple regression, Students *t*-test, one-way ANOVA, and chi-square analysis.

For students taking the face-to-face class, exams were administered during regular class time. For students taking the online class, exams were administered at a location close to them as part of the university's MU Direct Distance Learning Program. The students were supervised by an approved proctor for each exam and given the same amount of time to complete their exams as the face-to-face students.

Measure of Student Satisfaction With the Course. The second instrument was derived from evaluation forms developed at the University of Washington's Office of Educational Assessment (1998). According to the report, the coefficient alphas ranged from 0.85 to 0.91, indicating fairly good reliability for each item. In addition, the report indicated that several studies have established content validity by using the University of Washington form in comparison with other evaluation forms, although no statistical estimate of validity was provided. Two items were added to the University of Washington instrument by the University of Missouri's Assessment Resource Center. These items concerned the instructor's language proficiency and use of technology, for which there was unfortunately no local reliability or validity data available. Because slightly different versions of the evaluation form were used for the online class and the face-to-face class, items that were most similar were matched and labeled in one of two categories: Category 1, which had eight questions related to the instructor, and Category 2, which had eight questions related to the course.

Analyses

The research analysis focused on two main questions. (1) Were there any differences in statistics knowledge as measured by student scores on the examinations, and (2) were there any differences in student attitudes as measured by course evaluations? Independent-samples *t*-tests were used to determine whether significant differences existed between groups in terms of statistics knowledge and on the items related to student satisfaction. Because some students chose not to answer every item, the *n* and subsequently the degrees of freedom for each analysis was slightly different.

Results

Statistics Knowledge

Students were pretested to assess baseline data discrepancies related to entry-level mathematics/statistics proficiency with basic and

algebraic math problems raging in difficulty. No significant differences were found between the two groups on entry-level math/statistics skills ($t(36) = 1.25$; n.s.). At the end of the 15-week course, students were evaluated on their statistics knowledge by using their cumulative test scores from the class. No significant differences were found between the groups on statistics knowledge at the end of the course ($t(36) = 1.42$; n.s.).

Course Satisfaction

To assess differences in satisfaction between the two presentation methods, 16 questions relating to the instructor and the course were evaluated. Descriptive statistics for student responses are found in Tables I and II. Students were allowed to rate each question on a scale of 1–5 (1 being *lowest* and 5 being *highest*). Each question was treated as a dependent variable.

To determine if there were group differences, independent-samples *t*-test were conducted on all 16 items related to student satisfaction. Significant group differences were found on seven of the items, four of which were instructor related and three of which were course related.

Table I
Descriptive Statistics and *t*-Tests for Student Satisfaction Related to the Instructor

Item	Face-to-face			Web			*t*-Tests		
	Mean	SD	*n*	Mean	SD	*n*	*t*	*df*	*d*[a]
1. Instructor organization	4.8	0.37	19	4.4	0.84	14	2.01	17[b]	
2. Instructor preparation	4.8	0.92	19	4.5	0.76	14	0.96	31	
3. Instructor's explanations	4.9	0.24	18	3.6	1.28	14	3.76**	14[b]	2.03
4. Instructor's enthusiasm	5.0	0.00	19	4.3	0.90	11	2.67*	10[b]	1.75
5. Instructor's openness to students	4.8	0.38	18	3.7	1.16	10	3.00*	10[b]	1.98
6. Teaching effectiveness	4.7	0.58	19	4.2	1.14	12	1.41	29	
7. Use of Class Time	4.7	0.45	19	3.5	1.38	6	2.16	5[b]	
8. Instructor's interest in student learning	4.7	0.45	19	3.9	1.16	12	2.33*	13[b]	1.32

[a]*d* is a measure of effect-size and was calculated using the *t*-values.
[b]Adjusted *t*-values and degrees of freedom (*df*) were used to determine statistical significance due to the violation of the homogeneity of variance assumption.
*$p < 0.05$; **$p < 0.01$.

Table II
Descriptive Statistics and *t*-Tests for Student Satisfaction Related to the Course

Item	Face-to-face			Web			*t*-Tests		
	Mean	SD	*n*	Mean	SD	*n*	*t*	*df*	*d*[a]
1. Class discussion	4.6	0.60	19	3.6	1.24	12	2.74*	14[b]	1.50
2. Quality of questions/ problems	4.7	0.45	19	4.3	0.63	13	2.25*	30	0.84
3. Course as a whole	4.2	0.71	19	3.8	1.05	14	1.38	31	
4. Course content	4.1	0.74	19	3.8	1.12	14	0.99	31	
5. Amount learned	4.1	0.85	19	4.0	0.91	13	0.17	30	
6. Relevance/usefulness	4.1	0.78	19	3.7	0.89	12	1.27	29	
7. Evaluation and grading	4.4	0.69	19	3.8	1.09	13	2.07*	30	0.77
8. Reasonableness of work	4.5	0.70	19	3.9	1.12	13	1.72	30	

Note. Significant differences were found between students in an online versus face-to-face statistics class with regard to course satisfaction.
[a]*d* is a measure of effect-size and was calculated using the *t*-values.
[b]Adjusted *t*-values and degrees of freedom (*df*) were used to determine statistical significance due to the violation of the homogeneity of variance assumption.
*$p < 0.05$; **$p < 0.01$.

Results from these analyses are presented in Tables I and II. Most of the significant group differences were detected within the instructor-related items, including instructor's explanations, instructor's enthusiasm, instructor openness to students, and instructor's interest in whether or not students learned the material. Significant group differences were detected for three of the course-related items, including class discussion, quality of questions/problems, and evaluation/grading techniques.

Discussion

Although the students in the Web course learned statistics as well as students in the traditional classroom, the results of the Wests indicated that the Web students were generally less satisfied with the course than those in the traditional classroom, despite the fact that the instructor, a statistics professor with 20 years of experience, was the same professor for both the face-to-face class and the Web class. Specifically, Web students expressed less satisfaction than the face-to-face students in the following areas.

Instructor Variables

Instructor's Explanations. There were significant differences between the Web and the traditional students in their satisfaction with the instructor's explanations although the Web students felt as though the instructor was effective at teaching the material. This could be due to many factors: discussion was not real-time in the web course, so students had to wait to get their questions answered; statistics is aided by actually seeing an example worked out, a benefit the web students did not have; and finally, answers to their questions were provided electronically, so Web students did not get the opportunity to witness their professor's expertise in-person.

Instructor's Enthusiasm. Although the Web students felt the instructor was effective at teaching the material, they were not as satisfied with the instructor's explanations. Enthusiasm for a discipline is especially hard to portray electronically.

Instructor's Openness and Concern Towards Students. There was a significant difference in satisfaction with the instructor's openness to students. The Web students did not feel as satisfied with the approachability to the instructor, most likely because questions were posed on a bulletin-board format and answered electronically with a delayed e-mail response. There was also a significant difference in the levels of satisfaction concerning whether or not the instructor appeared concerned that the students learned the concepts.

Instructor's Interest in Student Learning. There was a significant difference in students' satisfaction for the instructor's interest in student learning. The Web students did not feel as satisfied as the face-to-face students, most likely because instructor's interest is typically conveyed by personal contact in the classroom and in office hours. The Web students did not have the opportunity for this type of instructor contact.

Course Variables

Class Discussion. The web students were significantly less satisfied with the class discussion than were the traditional classroom students. This was most likely due to the fact that discussion between a student and his or her fellow students and the instructor took place on a bulletin board.

Quality of Questions/Problems. Although the questions and problems presented by the instructor were nearly identical for both the Web

students and face-to-face students, the Web students were significantly less satisfied with the quality of questions and problems presented in their version of the course. Perhaps this stems from issues of clarity, because the Web students may have perceived fewer opportunities to ask the instructor to explain the problems and questions personally, instead depending on an electronic medium for communication.

Evaluation and Grading. The Web students were less satisfied with evaluation and grading techniques than were the traditional classroom students. There was no significant difference in the amount of work assigned, in the clarity of student responsibilities and requirements, or in the grades achieved by students in either class. So, although the students knew what they had to do and accepted that, they did not feel as though they were satisfied with the evaluations of what they had done. This difference could again, in part, be due to the level of clarity expressed for how assignments were being scored. Perhaps in a web course, an increased need exists for explicit explanations in the scoring methodology of the instructor. In a traditional course, the instructor can give verbal explanations to supplement his written instructions that may or may not be explicitly stated in the web assignments.

Conclusion

Distance learning via web instruction is a viable opportunity to increase availability of statistics instruction. The results of this study indicate that students taking statistics on the web learned as much as students in a traditional face-to-face course. However, results indicate that web students were less satisfied with the method of delivery as compared to traditional students, contrary to the claims made in Russell's publication, *The No Significant Difference Phenomenon* (1999).

Some possible reasons why there may have been differences between the face-to-face class and the online statistics class could be due to the disregard of critical factors that were explicitly outlined by Phipps & Merisotis (1999) as considerations for change when developing course technology, namely task characteristics, student characteristics, student motivation, and characteristics of the instructor. In our study, there was very little if any change in the delivery of content via the Internet from the face-to-face class: the lesson content was the same, the homework was the same, and the exams were the same. The only difference between these courses was that the instructor was not

present for the delivery of content online. Although the instructor was available to answer questions via e-mail, this is hardly comparable to being able to answer questions in real-time or in person. The benefit of having minimal differences between the online class and the face-to-face class is that we were able to minimize extraneous variables in our study. However, the differences were most likely significant because we did not make our class more amenable to an electronic format.

On the basis of the outcome of this study as well as the literature in online education, the following suggestions may help to minimize those differences for future students: (1) establish a pedagogical framework before course development, preferably one that lends itself to constructivist theory; (2) explicitly state grading procedures when assigning homework, projects, and tests; (3) hold office hours on the phone as well as online so that students have increased access to the instructor; (4) make a concerted effort to portray enthusiasm for the content and make it as meaningful as possible so that students are genuinely interested in learning the content; and (5) utilize real-time, on-line discussion periods for student and instructor interaction to help make students engage with each other and feel like an important part of the class.

For online courses in general, the suggestion for a constructivist pedagogical framework may be the most important: many of the significant differences in course satisfaction between the face-to-face and online statistics students found in this study may have stemmed from pedagogical issues more than logistical problems. For the purposes of this study, we were able to evaluate significant differences by controlling for extraneous variables. However, we also feel it is important to use this information to improve courses that have the potential to deliver the information in ways that are more satisfying to students. As Bennett and Green (2001) suggested, it is difficult to overcome the traditional pedagogy of lecture-style classrooms and adapt to contemporary ideas of an interaction-rich model using online technology. At times, the technology itself can be an instructor's worst enemy by providing overly complicated "courseware" systems that offer features beyond the scope of the course (Firdyiwek, 1999).

Fortunately, there are existing publications that suggest appropriate pedagogical frameworks for developing online courses that support a more constructivist, interactive model. For example, Knowlton (2000) provided a framework that encourages instructors to use a student-centered approach to learning online, stating that students need to interact with the instructor and each other electronically to gain a

personal sense of organization and interpretation of content. Similarly, Schrum (1998) believes that electronic communication is a natural platform for collaboration and group interactions; and instructors should take advantage of this by designing projects and lessons that foster this type of communication. A real example of how the interactionist pedagogy framework has been applied is evident in Bell and Kaplan's (1999) design of a graduate course with tools used to foster a sense of community, including features such as an electronic resource space, discussion space, and collaboration space. Finally, it is suggested that the summative and formative evaluation of pedagogical effectiveness is just as important as implementation (Sonwalkar, 2002; Vrasidas & Mclsaac, 2000).

In our study, it was unfortunate that we did not have the foresight to ask questions specific to the development and usefulness of the online course. Future development efforts could investigate more deeply what specifically led to the lessened satisfaction in the web course. For instance, did they not like the web design? What about the organization of the course led them to be less satisfied when they were satisfied with the professor's teaching preparation and effectiveness? Can anything be done to increase the feeling of community for students enrolled in an online class? How can we make possible effective, real-time, online discussions that are not seen as obligations, but as tools that encourage deeper analysis of the concepts? Additionally, questions concerning the technology itself were not posed in this study. For instance, did students have slow Internet connections, or did they try to access the site during peak hours? Did they find the web site easy to navigate? Was the language easy to read? All of these variables could have hampered student satisfaction with the course as well.

Of this we are certain: our society is racing towards a global community, and by providing statistics education via the Web, we have the opportunity to serve some of those persons we could not have previously reached. Perhaps with further research and new advances in technology, we can provide future distance education courses that are just as accessible and enjoyable as face-to-face classes.

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