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A Framework for Distance-Education Effectiveness: An Illustration Using A Business Statistics Course

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ABSTRACT

Distance education is now an integral part of offering courses in many institutions. With increasing access to the internet, the importance of distance education will only grow. But, to date, the specific benefits that distance education brings to student learning objectives remain unclear. We first propose a framework that links student performance and satisfaction to the learning environment and course delivery. Next, we empirically evaluate our framework using data from a Business Statistics course that we offer in the traditional classroom setting and as a distance-education course. Our results show that a well-designed distance-education course can lead to a high level of student satisfaction, but classroom-based students can achieve even higher satisfaction if they are also given access to learning material on the internet. This indicates that material for an effective distance-education course can also be used to supplement in-class teaching to increase satisfaction with student learning objectives.

Key words: Distance Education, Distance Learning, Internet-based Instruction, Online Course, Web-based Courses, Comparative Study, Education Research

Distance education has created a substantial impact on students, faculty, and institutions. Distance education classes are now routinely available to many students. In a survey conducted by the National Center for Education Statistics, the percentage of 2- and 4-year degree-granting institutions offering distance education classes increased by 11 percent from 1995 to 1997. The number of courses being offered nearly doubled in the same time period [Sikora and Carrol, 2002]. The effect of distance education has also been significant on faculty. In a study conducted by Lewis et al., [1999], nearly 6 percent of all faculty in Title IV degree-granting institutions were involved in distance education classes, and about 9 percent offered courses using non-face-to-face mediums [Lewis et al., 1999]. Studies also indicate that distance education faculty bears a higher burden of teaching. Bradburn and Zimbler [2002] found that on average, faculty teaching distance education classes had more sections and more course preparations than faculty who only taught face-to-face.

Institutions are also at crossroads. While the trend to offer more distance education classes is clear, with increasing competition for limited resources, many institutions face questions concerning lack of fit with mission, program development costs, and technological infrastructure among others [Bradburn and Zimbler, 2002]. These questions need to be answered if distance education is to fulfill its potential.

Cost aside, it is clear that students, faculty, and institutions benefit from distance education. But, currently, the benefits of distance education are neither clearly defined, nor can be easily measured. A brief tally from 1992 to 2002 indicates that there were 22 papers finding significant positive effects and 26 not finding significant benefits in using distance education [Russel, 2003a; Russel, 2003b]. While these studies varied in subject and in the choice of performance metrics, it is still too early to conclude what specific benefits students and institutions can reap from distance education. Importantly, the role distance education plays in the overall attainment of student learning objectives remains unanswered.

Research efforts have continuously been extended to explain the effectiveness of distance education, and typically these comparisons are made with traditional classroom education. But, to clearly evaluate the effects of distance education, factors like student learning styles, delivery of content, course characteristics, and technology also need to be considered. Then, with increasing research, a clearer picture will emerge on factors that lead to a successful implementation of distance education. This study hopes to add to this body of research. We first propose a framework that links student performance and satisfaction with the learning environment and course delivery. Then, we empirically examine our framework, and provide more evidence to the growing body of research on distance-education effectiveness. As part of our empirical data, we also show how a Business Statistics course can be offered over the web.

The ubiquity of the internet has certainly been a key factor in the rise of distance education. Web-based classes especially occupy a special niche as their growth has been a result of this spread of the internet. In this paper, we review cases of instruction for two groups of students, those enrolled in a web-based class versus those receiving traditional classroom instructions. We propose a framework for studying distance education. We argue that the education environment, whether it is web-based or classroom, will govern how a course is to be designed, and that course design is a critical factor in the overall determinant of student satisfaction level. The primary intent in proposing such a framework is to force us to have a deeper thinking about the overall problem setting. That is, we need to first identify the key structural components leading to satisfaction, and how those components are interconnected. Then, after empirical findings are gathered from students, we can be in a better position to pinpoint the potential factors of student satisfaction.

The rest of the paper is organized as follows. The next section discusses our framework linking the learning environment and course design to student satisfaction. This is followed by a description and design of the undergraduate course that we use to study and illustrate our findings. The undergraduate course, Business Statistics, displays many characteristics to be successfully administered as a web class. In addition to discussing course structure in this section, we also present the tools and techniques specifically developed for the web-based class. Then, we present our results, followed by the Conclusion section.

A FRAMEWORK

From the learning environment to course design and delivery, web and classroom-based education provide faculty and students with different challenges. Figure 1 describes a framework that relates these challenges to student satisfaction in our study. To be effective, an educator must first have a clear understanding of the differences between the web and classroom-based learning environments. Courses must then be selected and designed to suit the learning environment. Student satisfaction is then largely the result of the implementation of the course design. This in turn leads to a better understanding of the learning environments, and hopefully to improved course offerings.

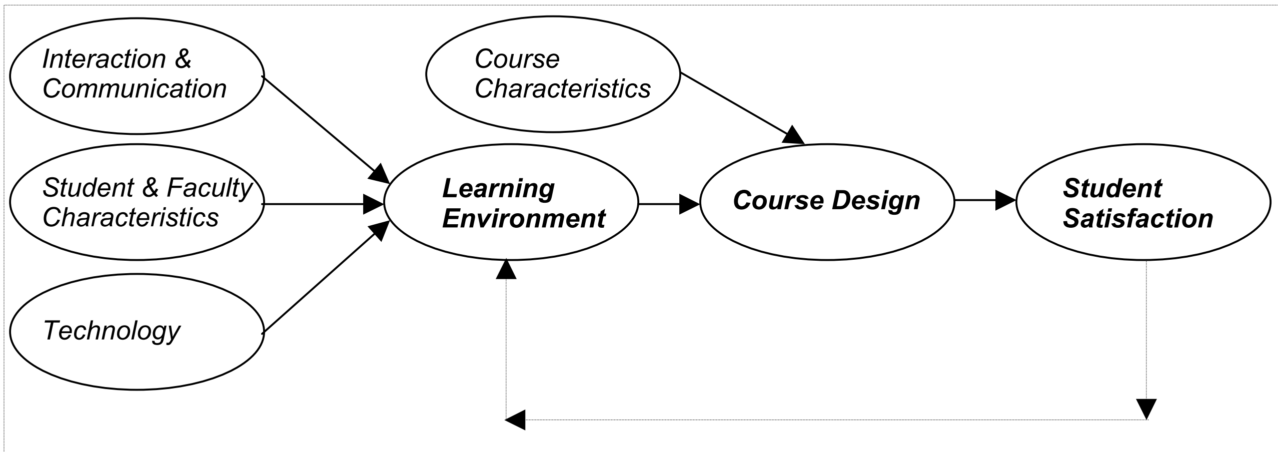

Figure 1: A Framework

As shown in Figure 1, the learning environment is influenced by several factors. Face-to-face interaction is a predominant part of classroom education, but plays a minimal role in web classes. This face-to-face interaction provides an environment where the delivery of instruction via audio-visual means is instantaneous and synchronized with interactions between students and faculty. This allows the instructor to know whether the intended message is clearly communicated to the students. The message-response-feedback is usually iterative and complete, and any breakdown in communication can be corrected immediately. Similarly, the pace and scope of course material coverage can be adjusted accordingly. Furthermore, factors like facial expression and body language all help to bring about more effective communication between instructor and student. Thus, courses that require constant interaction and effective two-way communication, like case-based classes, are ideally suited for classroom education.

Communication plays an important role in the learning environment. Both learning environments can use synchronous and asynchronous communication tools like chat, peer-to-peer, e-mail, video conferencing, and electronic blackboards. While certain distance-learning classes, like virtual classrooms using VTEL [VTEL], can duplicate the synchronous face-to-face communication of classroom environments, for most web classes similar to that illustrated in this paper, communication is usually one way, and any two-way communication is likely to be asynchronous. Thus, courses that require a constant flow of exchange of ideas and discussion are likely to be more difficult to implement in web-based education. The lack of instant feedback like in classroom instruction means that instructors need to plan in detail ahead of time on how course materials should be covered. Furthermore, many institutions allow students flexibility in the duration required to complete web classes. This requires significant up-front work from the instructor, as all course content, testing, and assessment modules have to be available at the beginning of the term. Thus, once the course starts, it becomes difficult to make changes to any of the modules. As such, web-based course content and delivery tend to be static for the term, but offer uniform course coverage across sections. Classroom instruction, on the other hand, is usually more dynamic, and has greater variability of course coverage as the instructor can adjust delivery and content during the term to shifting student needs. Therefore, designing an effective web-based course requires significant design effort to accommodate different student learning styles and abilities.

The up-front work required for a web class, and the flexibility in the duration allowed for students to take a web class, do provide some additional advantages. Students can now review course content at any time. This allows students to become active participants in their learning. While cooperative learning [Millis and Cottell, 1997] is usually stressed in traditional classes to increase student participation, to be successful in web classes, active student learning becomes a prerequisite. To facilitate this, learning tools, including course navigation, must be well designed in web classes.

Technology plays a greater role in web-based education. Instructors and students need to be comfortable with technology to fully utilize the web environment. While technology is used in classroom education, lack of technological competence there can usually be compensated for by face-to-face interaction. No such solution exists for web classes. As such, faculty and students who are uncomfortable with technology are likely to be intimidated by web classes.

Recent research also indicates that student personality traits affect performance in web-based classes [Schniederjans and Kim, 2005]. While classroom education by their more dynamic nature and greater interactivity can compensate for such traits, it is difficult to do so in web classes. Thus, the selections of students, in addition to faculty, become important considerations in offering web classes.

Dimension	***Web-based***	***Classroom-based***
Interaction and communication		
Type	Virtual, 1-way	Virtual, Direct, 2-way
Mode	Audio, Visual	Audio, Visual, Direct
Timing	Asynchronous	Synchronous
Technology	Required	Optional
Course Design and Characteristics		
Structure	Static	Variable and dynamic
Content repeatability	May be reviewed repeatedly	Class times are predetermined
Content variability	Consistent and identical for all classes	Varies from class to class
Assessments	Restricted. Suitable for questions that are easy to generate and grade	Flexible
Navigation	Flexible	Predefined
Student-faculty contact	Irregular	Regular

Table 1: Differences in Learning Environments

Clearly, the learning environments influence the success of courses. But, for a web class to be successful, it is equally important to consider course characteristics. Courses that can be easily adapted to the web-learning environment are likely to be well received as a web class. For example, because of the need for constant two-way interaction, case-based courses are generally not well suited for the web environment. But, courses where concepts and examples can be easily constructed and presented using software tools may be better suited for web-based education. Such courses allow students to learn through interactivity and repeatability at their own pace, thus satisfying diverse student learning capabilities. Table 1 summarizes our observations of the two learning environments.

For a web-based class to be successful, it should exploit the characteristics of the learning environment. The Business Statistics course that we discuss in the next section has many characteristics that make it suitable to be offered as a web class. This course was also offered in the classroom, thus allowing us to compare the satisfaction between the two classes.

COURSE DESIGN: BUSINESS STATISTICS

The business statistics course considered in this study is an introductory course open to all majors but required for business majors. This course covers basic concepts and applications, with emphasis on intuitive statistical thinking. Topics include descriptive statistics, observational studies and experiments, sampling distributions, hypothesis testing and confidence intervals, and regression analysis.

Students have the option of taking this course in a classroom setting, or as a web-based course. Every semester, multiple classroom sections are offered, but the web-based section is only offered once a year. Average enrollment for each classroom section is around 150, and for the web-based section, around 56. Classroom sections meet twice a week with the instructor for 75 minutes sessions each time. There is no face-to-face interaction between the instructor and the web-based students. Communication between the instructor and classroom section students is predominantly face-to-face, and through e-mail. That between the instructor and web-based students is through instant messaging, e-mail, and electronic bulletin boards. Both groups of students were welcome to see the instructor for additional help.

The course material was divided into 10 chapters. In addition to the textbook, multimedia content was created for this course. This content, available on CD or on the internet, contained animated presentations of all topics, interactive exercises, practice problems, class notes to print, copies of old exams, and the syllabus. The only requirements to access this multimedia content were a web browser with Flash [Macromedia Flash] and Java [Sun Java] plugin enabled, and access to the free Adobe Acrobat reader [Adobe Acrobat] for printing the class notes. All students had equal access to all course materials.

In addition to common course materials, both classroom and web-based students were assessed similarly. Students were required to take 8 quizzes and 6 examinations, which were administered through WebCT [WebCT]. Each quiz had 15 questions and took approximately 40 minutes. Examinations had 25 questions and were 75 minutes long on average. Question types for both quizzes and examinations included multiple choice, calculated, and short answer. All questions were drawn from a central database of questions. There was one difference between how the testing was administered between classroom and web sections. For classroom based sections, the quizzes and examinations could only be taken during specific time periods. Quizzes for a topic were usually administered after the topic was covered in class. As web-based students could cover topics at their own pace, no restrictions were placed on when they could take the tests. All quizzes and examinations were available on the first day of the semester for these students. They could take the quizzes and examinations in any order, with the only requirement that all testing be completed before the end of the semester. While the technology existed to restrict students to certain IP addresses, it was impractical to do so for web-based students. In the end, no restriction was placed on the location from where students could take their tests. All tests were open book, and the final grading scale was the same for all students. In any given year, a single instructor is responsible for all sections of this course. The results in this paper all come from sections taught by the same instructor.

Although classroom and web sections used the same material, and were tested similarly, the manner in which the classes progressed differed. Cooperative learning was encouraged for classroom students. Class notes provided the outline of the day's lecture. The instructor would give a brief lecture explaining the concepts. This was followed by examples. Data for examples were usually drawn from the class itself, so students were involved in the data collection process. Students were then given additional problems that they solved in groups. Sometimes, group activities took the entire class. In such cases, the instructor functioned more as a facilitator rather than as a lecturer in a typical classroom setting. As such, the classroom setting provided students with an interactive learning environment where they could explore both the theoretical and practical aspects of statistical thinking.

Animated presentations were created to capture much of this interactive learning atmosphere of the classroom environment and transfer them to the virtual classroom. Thus, animation was used to depict the concepts graphically, and voice over was used to explain what was being shown. As it was impractical to collect data in real time, predefined examples with data collected from previous classes were used to illustrate concepts. Interactive exercises were created to mimic the group activities that students do in a classroom. For example, Figure 2 shows a simulation experiment to illustrate probabilities. In class, students would use a random number generator to do this experiment, with one student generating random numbers, while the other performing the experiment. For the animated presentations, the random number generator is built into the system, so a single student could perform the simulation. Additional exercises were created to allow web students to explore the topics further. Figure 3 shows an example that relates *p*-values, Type I, and Type II errors. Students can interactively change the decision point to see what happens to the errors. During the course of listening and seeing these presentations, students have access to all navigations buttons that one typically finds on a DVD player. They could Stop, Play, Fast Forward, Rewind, or move to the next topic at any time. Figure 4 shows a typical Flash presentation with navigational controls. The presentations also automatically pause at predefined points and present students with practice questions. Thus, these animated presentations were meant to serve as a substitute for the in-class lectures, and interaction between instructor and student. Figure 5 shows the front page to access all web-based materials.

As discussed above, significant effort was spent on the design of the statistics course for it to be offered as a web-based course. Being predominantly quantitative, students' understanding of the material was explored mainly through numerical examples and problems. Examples to illustrate concepts can therefore be created with web-friendly programming tools like Java, or Flash. Assessment can also be easily done, as a question on a single concept can be administered to many students just by changing the numerical values of the problem. As such, while each student can be tested on the same concept, they receive different questions.

Our research objectives are multi-fold. In the previous two sections, we examined the differences between the web-based and classroom-based learning environments, and discussed characteristics that we feel are essential to consider if web-based courses are to be well received. The design and the suitability of the Statistics course for web students were also discussed. In the following sections, we empirically evaluate our framework and observations by answering two questions: First, what is the satisfaction of students taking the web based class, and secondly, how do web-based students' satisfaction compare with those taking the traditional classroom sections.

The next section presents our results. We first discuss student characteristics in our empirical study.

There are three doors. Behind one door is a car. Behind each of the other two doors is a donkey. As a contestant, you are asked to select a door, with the idea that you will receive the prize that is behind that door. The game host knows what is behind each door. After you select a door, the host opens one of the remaining doors that has a donkey behind it. Note that no matter which door you select, at least one of the remaining doors has a donkey behind it for the host to open. The host then gives you the following two options:

1. Stay with the door you originally selected and receive the prize behind it.
2. Switch to the other remaining closed door and receive the prize behind it.

What is the probability of winning the car if you stay? What is the probability of winning the car if you switch? Will switching increase your chance of winning the car?

Try the simulation below to see which is the winning strategy.

How the simulation works:

1. Click on one of the doors. The computer will then open one of the remaining doors with a donkey behind it.
2. If your strategy is to remain with the original choice, click on that door again. That is, for example, if you clicked on door 2 first, click on door 2 again. If your strategy is to switch, click on the other door which is closed (not door 2).
3. The computer will keep a tally of each choice.

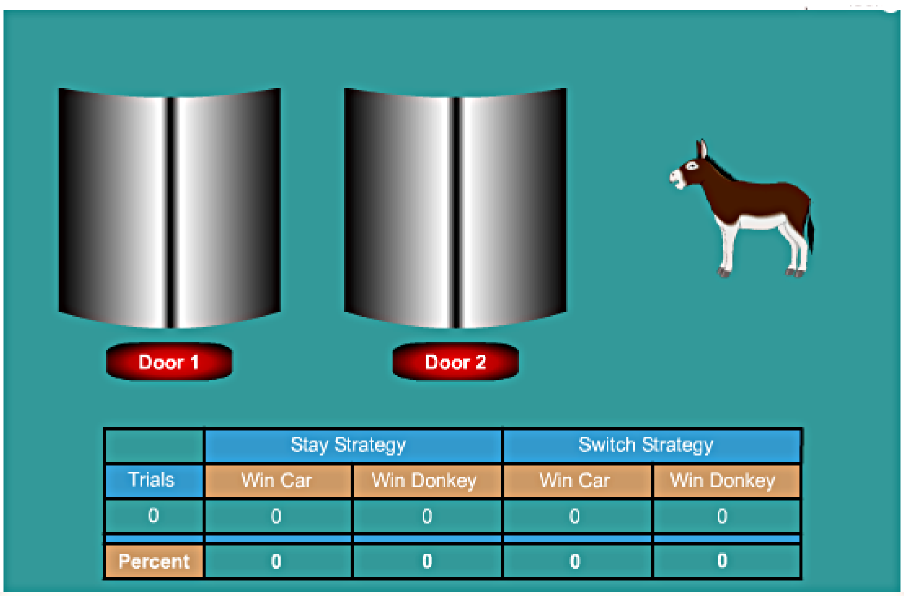

Figure 2: An Animated Simulation Experiment

Decision Making and P-Values for a Right-Tailed Hypothesis

Below is an interactive exercise that you can use to calculate *Type I* and *II* errors, and *p-values*. Just to jog your memory, here are some definitions:

- *P-values*: The chance of observing the sample result or something more extreme under the null hypothesis
- *Type I error* (a): The chance of rejecting the null, when in fact it is true.
- *Type II error* (b): The chance of concluding the null hypothesis when the alternative is true.

The problem is based on the following hypothesis:

H_0: Bag A
H_1: Bag B

Remember that larger values support Bag B, the alternative hypothesis. Therefore, the direction of extreme is to the **right**. This is an example of a *right tailed hypothesis*.

- So, when calculating the Type I error, we will be calculating the area to the right.
- As the *p*-value calculations are also based on the null hypothesis and direction of extreme, that area is also calculated to the right.
- As the *p*-value represents the chance of observing the sample result under the null, the smaller the p-value, the more it supports the alternative hypothesis.
- If the p-value <= a, we reject the null hypothesis in favour of the alternative.

How to use the interactive exercise:

- The red line represents your decision rule. All values to the right of the red line represent the areas where you would reject the null hypothesis in favour of the alternative hypotheis. That is, you would choose Bag B instead of Bag A. Therefore, when calculating the Type I error, we are calculating this area under the null hypothesis (the number of values under Bag A that is to the right of this line). As you move the line, you will see the change in the Type I error.
- Once a decision rule is made (i.e., you have moved your red line), the area to the left represents the region where you would conclude Bag A. As the Type II error is when you conclude Bag A under the alternative, you can calculate this from the graph. Just count the number of values under Bag B to the left of this line.
- Finally, *p*-value is the area to the right of the selected sample point under the null. Move your cursor so that it points to a value under the null hypothesis, and you will see the *p*-value. Note that whenever *p*-value > a, your conclusion is not to reject the null hypothesis. Try it.

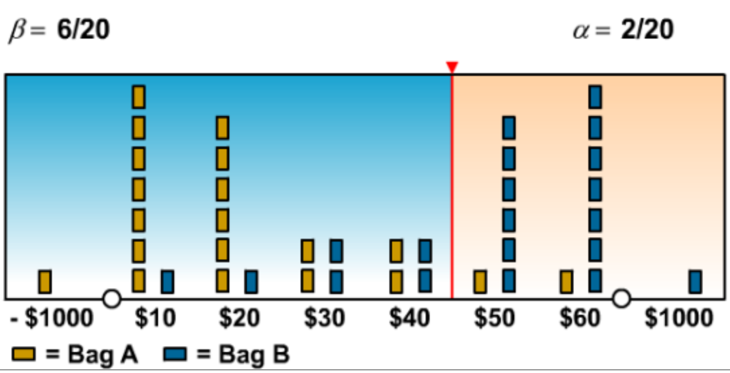

Figure 3: Relating p-values to Type I and II Errors

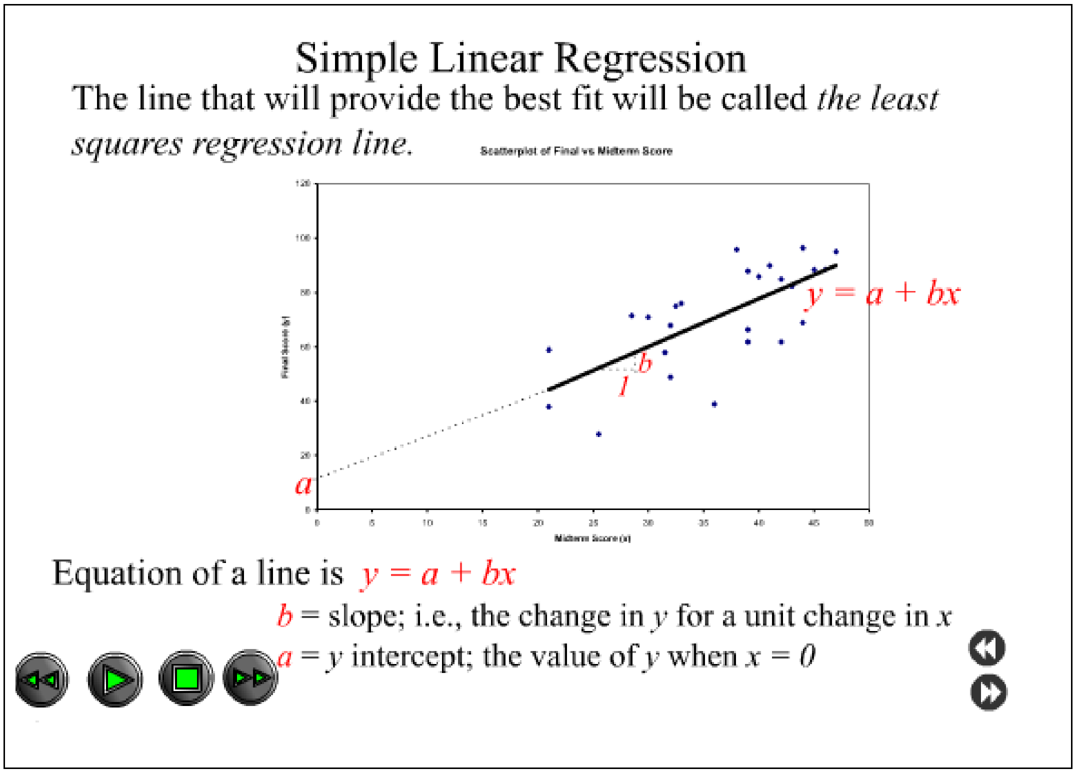

Figure 4: Navigation Controls in Interactive Exercises

Fundamentals of Business Statistics

myWebCT Home
Lectures Home
Home
Chapters

Chapter Links
None Go

Other Links
Syllabus Go

Feedback

Last Edited 01/2003

Welcome to your online course. This page will provide links to all parts of your course. To ensure smooth navigation, please take the following steps:

Before you begin

Make sure your computer system meets requirements by clicking here.

Software

This class makes extensive use of Flash for online multimedia files, and Adobe Acrobat for printing copies of old exams, etc. You can download the relevant software by clicking on the links below. You must be connected to the Internet to access the download sites.

Marcromedia Flash
Adobe Acrobat Reader

Course Material

You can download copies of your syllabus, class notes, and old exams here. Just click on the relevant link below.

1. Syllabus
2. Lecture Notes
3. Sample exam questions
4. Please download copies of Tables II, III, and IV from your WebCT site. You will also find chapter problems from the book there.

Quizzes and Examinations

Dates and times for your quizzes and examinations can be found on your WebCT site. They can also be found on your syllabus.

Navigation

Here is a quick introduction to symbols you might find on this site:

Indicates an interactive exercise. Always explore these.

Audio — Indicates a lecture using Flash animation and audio. These lectures correspond to your notes, with added explanation (in the form of audio and text).

Overhead Lectures — Indicates that you can download a copy of my overhead lectures in .pdf format. Please ensure that you have the free Adobe Acrobat Reader installed.

Navigational buttons used in Flash animation. From left to right, they are, Rewind (go back), Play, Stop, and Forward (or to the end of that lecture).

Navigational buttons used in Flash animation to get the previous or next lecture, respectively. Within a chapter, you can use these buttons to hear all lectures for that chapter.

Quizzes — These buttons take you to your WebCT site. To take the self test or quiz, you need to know your username and password for the site. Remember that you will be able to take the quiz only during assigned times. Check your syllabus or your WebCT site.

Figure 5: Front Page to Access the Course

RESULTS

Student Characteristics

A total of 8 sections of classroom courses were offered over a period of 2 years. As the effectiveness of the web-based courses was still being tested, only one web course was offered each year over the two-year period. During these years, there were no policy changes that would have affected the characteristics for either the classroom or web students. All course materials and sections were developed and taught by the same instructor, thus removing the instructor as a source of variation between the two courses. Students in both courses were exposed to identical course content. As such, for the purposes of this study, all classroom students will be considered as one group and the web-based students as the second group.

A total of 113 students participated in the web-based class, and 1027 in the classroom setting. At the beginning of the each semester, a questionnaire survey was administered to assess the demographic profile of the students taking the web-based and traditional classroom courses. The questionnaire contains questions relating to age, gender, distance from home to campus, average number of work hours per week, and the average number of hours spent on their computer per week. The last question pertains to a measure of proficiency level in the use of computers. It is expected that students taking the web-based course are more proficient than those taking the traditional lecture courses.

Results in Table 2 show that the average age of students taking the web-based course is 22.71 years versus 21.41 for the other group. There is a larger percentage (56.96%) of males taking the traditional class than the web-based course (49.40%). At the same time, 32.13% of the students taking the web-based course live more than 20 miles away from campus as compared to only 25.73% for the other group. Students in the web-based course spent more time in their work than the other students, 21.10 hours each week versus 17.23 hours. As for computer proficiency level, 64.70% in the web-based course spent more than 10 hours each week on their computers at home as compared to 42.19% in the other group of students.

These results agree with results in the literature about the profile of students taking distance-learning classes. Many of them take it because it is convenient, and are usually more comfortable with technology than traditional students. The relatively higher age and greater proportion of female students in the web sections again support the contention that flexibility and convenience in taking the class overrides the disadvantages of not having face-to-face student-faculty interaction.

The next section empirically examines the satisfaction of web-based students. We then examine the differences in satisfaction between web-based and classroom-based sections.

Demographics	*Web-based*	*Classroom-based*
Age	$\overline{X} = 22.71, n = 83$	$\overline{X} = 21.41, n = 841$
Gender	% Male = 49.40	% Male = 56.96
Distance from University		
< 20 miles:	57 (67.87%)	632 (74.27%)
≥ 20 miles:	27 (32.13%)	219 (25.73%)
Work hours per week	$\overline{X} = 21.10$	$\overline{X} = 17.23$
Course primarily taken at:		
at home:	55 (65.48%)	81 (9.53%)
at place of employment:	4 (4.76%)	2 (0.24%)
at the main university campus:	22 (26.19%)	760 (89.41%)
at a distance learning site:	2 (2.38%)	0 (0.00%)
at a remote campus:	0 (0.00%)	4 (0.47%)
other:	1 (1.19%)	3 (0.35%)
Hours spent on computer:		
≥ 10	55 (64.70%)	362 (42.19%)
< 10	27 (31.77%)	464 (54.08%)
0	3 (3.53%)	32 (3.73%)

Table 2: Beginning of Semester Survey Results

Student Satisfaction of Web-Based Instruction

As discussed in the previous sections and shown in Table 1, for a web-based course to be well received, it has to satisfy student expectations along multiple dimensions. Course delivery refers to the experience of the student with respect to the quality of the delivery of the course content. For even a well-designed course, technical problems are likely to detract for the educational experience and provide poor student satisfaction. As the web-based course is provided completely over the internet, the quality and speed of connection is therefore paramount. While most students on campus have access to broadband connections, 32% of all web-based students live more than 20 miles from campus. Many of these students still log onto the campus network using dial-up connections. To ensure that all students receive a good quality of delivery, the interactive exercises, and related course content was optimized for dial-up connections. Using video sparingly also minimized transmission overhead. Audio was converted to mp3 files, and Flash modules were optimized for 56K modems. In addition, each Chapter was broken up into several Flash modules with an average file size of less than 100K.

To determine student experience with course delivery and experience, a second survey was administered at the end of the semester (EOS). Every attempt was made to ensure the anonymity of the students. As such, the two sets of responses, that from the beginning of the semester, and then from the end-of-semester surveys cannot be paired at the student level.

Two sets of items were identified and selected from the formal battery of items used by researchers in distance learning. First set of four items related to the quality of delivery, and the second set of six on content. Both sets entail a four-point Likert scale varying from "Strongly Disagree" to "Strongly Agree". Table 3A shows the results of the responses of web-based students to these questions in the

EOS survey. It is clear that the vast majority of web-based students found the delivery of course content satisfactory. Students were also generally satisfied with the speed of access to the network, and for getting help when needed.

Question	***Strongly Disagree***	***Disagree***	***Agree***	***Strongly Agree***
A: Quality of Delivery				
I spend too much time accessing the institution's network	18 (29)	35 (56)	8 (13)	1 (2)
The use of WebCT for online examinations worked as it should	0 (0)	5 (8)	29 (48)	27 (44)
The use of Multimedia Lectures and Interactive Exercises worked as they should	3 (5)	6 (10)	32 (52)	21 (34)
It is easy to contact the site administrator when I have a problem	3 (5)	5 (8)	34 (55)	20 (32)
B: Satisfaction with Course Content				
The course was well organized		8 (17)	19 (41)	20 (43)
The instructor gave clear explanations		4 (8)	21 (45)	15 (32)
I learned a great deal from this instructor	1 (2)	8 (18)	26 (55)	12 (26)
Students were kept informed of their progress			16 (34)	31 (66)
The instructor stimulated independent thinking		6 (12)	27 (58)	14 (30)
The instructor synthesized, integrated, or summarized ideas effectively	1 (2)	6 (13)	29 (62)	11 (23)

Table 3: Web-students' Responses to Quality of Delivery and Course Content
Note: Number of students (row percentage in brackets)

Quality of course delivery is only one of the characteristics for successful distance education. Course design is also key to success. Without the teacher-student face-to-face interaction, tools must be provided to simulate and test students' critical thinking abilities. As part of the EOS survey, students were asked to rate the instructor's ability to provide such an environment along several dimensions.

A large percentage of students agreed that the instructor was successful in providing an environment that stimulated independent thinking (88%), and that the ideas in the course were effectively summarized (85%). Furthermore, 81% of the students reported that they learned a great deal from this course (Table 3B). In distance learning, communication of results also plays an important role. Nearly all students were satisfied with being informed about their progress. Clearly, by the dimensions measured here, most students were satisfied with the delivery and content of the web-based course.

Web versus Classroom Student Satisfaction

Five additional items were recorded relating to various aspects of a course. These items were anchored with a four-point Likert scale. One additional item addressing the overall satisfaction levels was also included in the EOS survey. For the web students, these six items were included in the EOS survey. Separate surveys containing only these six items were administered at the end of the semester to classroom students.

A majority of students felt positively about the course they are taking (Table 4). Table 4 also shows that a higher percentage of the students taking the traditional courses express stronger agreement (Table 4A). These findings are also consistent with the overall satisfaction level (Table 4B). Students enrolled in the traditional courses are more satisfied with their experience in the course than those enrolled in the web-based course.

Satisfaction and experience of both groups of students is important from all perspectives. For institutions to provide comparable learning experiences on the web, it is necessary to understand and implement good practices for distance education. At the same time, it is important to see if tools and techniques geared towards distance learning could also be successfully used in a more efficient manner in a traditional classroom setting.

Question	Section	Strongly Disagree	Disagree	Agree	Strongly Agree
A: Experience					
I am more comfortable participating in discussions in this course than in other courses $\chi^2 = 51.63, p = 0.0001$	Web	6 (12.50)	20 (41.67)	16 (33.33)	6 (12.50)
	Class	72 (8.35)	285 (33.06)	436 (50.58)	69 (8.00)
I feel comfortable telling the instructor of this course when I disagree with something he/she said $\chi^2 = 50.83, p = 0.0001$	Web	3 (6.38)	16 (34.04)	23 (48.94)	5 (10.64)
	Class	53 (6.21)	221 (25.88)	506 (59.25)	74 (8.67)
I am better able to understand the ideas and concepts taught in this course $\chi^2 = 17.72, p = 0.0018$	Web	4 (5.88)	22 (32.35)	36 (52.94)	6 (8.82)
	Class	28 (3.11)	138 (15.33)	571 (63.44)	163 (18.11)
I am better able to visualize the ideas and concepts taught in this course $\chi^2 = 17.51, p = 0.0015$	Web	3 (4.48)	24 (35.82)	35 (52.24)	5 (7.46)
	Class	27 (3.00)	154 (17.13)	554 (61.62)	164 (18.24)
Because of the way this course uses electronic communication, I spend more time studying $\chi^2 = 6.16, p = 0.1876$	Web	3 (4.48)	25 (37.31)	29 (43.28)	10 (14.93)
	Class	34 (0.00)	238 (27.77)	513 (59.86)	106 (12.37)
B: Overall Satisfaction					
		Very Dissatisfied	Dissatisfied	Satisfied	Very Satisfied
Overall, I have been $\chi^2 = 7.81, p = 0.05$	Web	3 (4.41)	10 (14.71)	28 (41.18)	27 (39.71)
	Class	34 (3.74)	68 (7.49)	511 (56.28)	295 (32.49)

Table 4: Course Comparison
Note: Number of students (row percentage in brackets)

CONCLUSIONS AND DISCUSSIONS

Distance education is here to stay. It will take on a greater role in the delivery of higher education as colleges look for ways to serve as many students as possible in light of scarcity of resources. As information technology becomes a way of life, both students and faculty will become more attuned to this new environment. But, this proficiency in the new environment is still tempered with the understanding that distance education will not completely replace traditional classroom instruction. To what extent distance education can and should be used, and how it can be used to supplement classroom education are the basic intents of this study.

Most studies in this area directly compare classroom and web-based learning in terms of their effectiveness. As stated previously, performance outcomes are mostly a function of the learning environments and course design. Without laying out the course structure in each of the learning environments and course design, it would be difficult for one to establish any cause and effect relationships. Furthermore, special care needs to be exercised in selecting courses and faculty as potential candidates for web-based education. Recent results also indicate that web-based education may not benefit all students, and that student personality traits have a significant impact on achievements scores in web classes [Schniederjans and Kim, 2005]. In contrast, currently, most students often follow a self-reflective procedure in way of deciding whether to sign up for web-based or classroom courses.

This study first proposes a framework linking the learning environments with course design and performance. Then, student performance as measured by their satisfaction can be traced back to the learning environment and course design.

On the whole, students taking the web-based business statistics courses devoted more time to their work, lived farther away from campus, and were more computer literate. Given these characteristics, students found the delivery and course design of the web course satisfactory.

Comparing the web-based course students with the traditional classroom students, it is somewhat surprising to note that traditional students are even more satisfied with the course offerings. This higher level of satisfaction can likely be attributed to face-to-face interaction in the classroom. This environment possibly motivates the students to be more involved and engaged in their learning.

In order to be successful in the web-based environment, a student has to exercise a high degree of self-discipline. Simultaneity of stimulus and response play the role in holding students' attention in the classroom. It is clear that a well-designed web course can provide a satisfactory learning environment for students. For the particular course that we consider in our study, augmenting a traditional classroom setting with web enhanced lectures provided an even greater satisfaction. Clearly, this is an impetus to consider how web-based tools could be used to improve current classroom education.

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