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Distance Learning and Student Satisfaction in Java Programming Courses

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Abstract: Student satisfaction with distance learning is impacted by a variety of factors, including interaction with the instructor and the structure of the course. Satisfaction with distance-learning courses also has a strong impact on retention. In an earlier article, we determined that student satisfaction as measured by course evaluation scores in an online discrete mathematics course taught by the first author was not statistically significantly different from that of students in traditional versions of the same course, supporting some previous studies on distance-learning student satisfaction. However, the model of distance-learning studied in our initial work is not the dominant model used for distance learning at the institution in question. In this article we obtain statistically significant results different from the earlier article when a distance-learning course that uses the dominant model is considered. In particular, the course evaluations for online and traditional sections of introductory Java programming courses varied in some notable ways.

Keywords: Computer and Information Science Education
Categories: K.3.2

1 Introduction

Distance learning is an increasingly important way of delivering content for educational institutions. As a result, it is important to understand how the experience that students have in distance-learning courses differ from the experience of more traditional students. A number of studies have shown that performance in distance-learning courses are comparable to traditional classes [Carr, 00], [Rivera, 02], [Schoech, 00], [Sonner, 99], [Spooner, 99]. Work on student satisfaction with distance-learning courses shows less consistency. Some studies have shown comparable satisfaction in distance-learning courses [Petrachhi, 00], [Schoech, 00], while others indicate that the distance learning format may not be satisfying to students [Carr, 00], [Rivera, 02] for a variety of reasons. It is important to understand student satisfaction with distance-learning courses, as it has been shown that retention in distance-learning classes is heavily influenced by satisfaction with the course [Levy, 07].

In our earlier work, we investigated the issue of student satisfaction in computing-related courses by comparing course evaluations for distance-learning and traditional sections of a graduate discrete mathematics course taught by the first author. In agreement with previous work [Petrachhi, 00], [Schoech, 00] we determined that responses to both instructor- and course-related course evaluation questions did not differ in any statistically significant way between traditional sections and distance-learning sections [Settle, 05]. Our hypothesis was the superior organization of the distance-learning course, with five, cohesive, subject-oriented modules, was able to compensate for the lack of interaction, a result consistent with previous work on distance-learning student satisfaction [Swan, 01].

While our first study confirmed existing results on satisfaction with distance learning, we also hypothesized that the result might not generalize to other courses taught at the same institution. A majority of courses taught there use an alternative model for distance learning, one that is not as organized as the one used for the discrete mathematics course. To begin to address the issue of whether our initial study can be generalized to other courses, we compare the course evaluations for traditional and distance-learning sections of two introductory Java courses taught by the first author. The online versions of these courses mirror the traditional sections, so that they are not any more organized. We investigate what impact this less structured version of distance learning has on student satisfaction.

2 Distance Learning at CTI

In this section we describe the institution where the traditional and distance-learning courses discussed in this paper were taught and describe the model of distance learning used by both courses.

2.1 The Institution

The School of Computer Science, Telecommunications, and Information Systems (CTI) is the largest and most diverse institution for information technology education in the United States. Over 40% of all information technology graduate students in Illinois are enrolled at CTI. CTI offers 10 M.S. degree programs, one M.A. degree program, and several joint M.S. and M.A. degrees with the School of Commerce, the College of Law, and the School for New Learning. CTI also offers 10 Bachelors of Science and 2 Bachelor of Arts degrees in a variety of disciplines.

As the technical school at DePaul University, CTI was one of the first to begin implementing distance learning. Distance education at CTI is designed not only to serve students who live outside the Chicago area, but also to provide more value for students who live in or near Chicago. Distance learning has proven to be a popular option with students. There are now 8 M.S. degrees and 1 M.A. degree available as purely online programs at CTI. Students in online courses account for 21% of CTI enrollments [Miller, 05].

2.2 The Distance Learning Model

When distance learning was introduced to CTI in the Spring quarter 2001, the goal was to provide a large variety of distance learning courses while minimizing the impact on the faculty and the regular sections of courses. To do so, CTI developed a hardware and software system called Course Online (COL). COL simultaneously captures audio, video, the instructor's notes written on the whiteboard, and the images displayed on the instructor's computer screen. The capture of the information is done automatically, and although the equipment is monitored remotely, there are no staff in the classroom when the recording is done. Instead, the lecture is captured using a camera fixed at the back of the room. The video, the audio, the whiteboard, and the computer screen are synchronized, and by the morning after the lecture they are made available to students registered in the class. Multiple playback versions are available for users with high and low-bandwidth connections, and the recordings remain online for the entire quarter. The recordings are a part of an integrated course management system that allows faculty to post course information such as the syllabus, assignments, class notes, and grades and includes a homework submission system. More technology intensive than labor intensive, this form of distance learning is unique [Knight, 02]. Though the system is asynchronous, distance learning students can hear the comments and questions made by in-class students. The distance-learning students and the students in the regular section also can communicate easily with each other via threaded discussion boards and with the instructor via e-mail and posted announcements.

3 The Courses

Each of the Masters degrees at CTI have a prerequisite phase designed to prepare students for graduate study in their chosen area, a common solution for students who wish to switch areas of study after completing their undergraduate degree [Wyatt, 02]. Undergraduate courses are commonly required in this phase of CTI degree programs. Many times the courses required of beginning graduate students are also required of undergraduate students majoring in a similar technical area. CSC 211: Programming in Java I and CSC 212: Programming in Java II are two such courses that serve a mixed undergraduate and graduate audience. CSC 211 and CSC 212 have always used the same textbook, although the textbook used in the courses changed mid-way through the time period discussed in this article. Both textbooks, however, take an object-first approach [Gittleman, 02], [Wu, 06].

The details given below regarding each Java course apply to both the traditional and distance-learning sections. Because each of the distance-learning sections addressed in this paper use the COL system, the courses mirror the traditional sections. The topics taught, textbook used, homework assigned, and exams given were identical for both the traditional and distance-learning sections. Distance-learning students were not physically present in the room when the lecture was given, instead watching the recording of the lecture after it had been presented.

3.1 Programming In Java I

The first course in the Java sequence, CSC 211 takes a balanced approach between introducing objects early and teaching more procedural concepts. The first five weeks of CSC 211 cover variables, data types, expressions, control structures, and the use of some pre-defined classes. Around the time of the midterm, students begin to learn how to define their own classes. During the remainder of the course, writing classes, arrays, and event-driven programming and graphical user interfaces are the focus. A week-by-week schedule for the course is provided in Table 1.

Week	Topics
1	The programming environment; a Hello World example; an introduction to classes; the System.out class
2	More about classes; types, variables, expressions; simple I/O using predefined classes (i.e. JOptionPane and Scanner)
3	Boolean expressions; branching statements; looping statements
4	Developing programs; testing programs; writing classes
5	Midterm exam
6	Writing classes including constructors, the toString method, accessors, mutators
7	Writing classes including static members of classes
8	One-dimensional arrays and examples using arrays
9	Arrays as class members; arrays of objects
10	Event-driven programming and graphical user interfaces

Table 1: CSC 211 course topics

The data considered in this article come from the course evaluations in the eight sections of CSC 211 taught by the first author between September 2003 and March 2005. Of those eight sections, five were traditional evening sections (Fall 2003 [two different sections], Fall 2004, and Winter 2005 [two different sections]), and three were distance-learning sections (Fall 2003, Fall 2004, and Winter 2004). All sections were structured in roughly the same manner, with weekly programming assignments, a midterm exam during the 5^{th} week of the quarter, and a final exam during the 11^{th} week of the quarter. In addition, all but one of the sections used CodeLab, an online tutoring system available through Turings Craft [05], although the details of how CodeLab was used varied from quarter to quarter. The exact percentages for each evaluation item are detailed below.

In all the sections taught in the Fall 2003, homework was worth 30% of the grade, and the midterm and final exams 35% of the grade each. CodeLab was used as extra credit on the homework during the Fall 2003 quarter. In all of the Fall 2004 sections

and in two of the Winter 2005 sections, homework was 35%, the midterm 30% and the final 35% of the grade. There were required CodeLab exercises on each homework assignment, consisting of roughly 10% of each assignment. In one of the Winter 2005 sections, homework was 25%, weekly quizzes were 10%, the midterm was 30%, and the final exam 35% of the grade. CodeLabe was not used in that section of the class. Finally, in the Spring 2005 section, homework was 25%, weekly quizzes were 10%, the midterm 30%, and the final exam 35% of the grade. CodeLab exercises were optional, and every 10 CodeLab exercises completed earned 1 extra credit point on the associated exam (the midterm in the first 5 weeks of the quarter and the final in the latter 5 weeks of the quarter).

3.2 Programming In Java II

Building on the knowledge gained in CSC 211, students in the second quarter Java course, CSC 212, learn more advanced array topics such as searching, sorting, and multidimensional arrays. Other course topics include event-driven programming and graphical user interfaces in more depth than seen in CSC 211, inheritance and polymorphism, exception handling and generation, I/O streams, recursion, and the use of fundamental data structures such as lists and stacks. A week-by-week schedule for the course is provided in Table 2.

Week	Topic
1	Review of Java basics, classes, and methods
2	Review of arrays; multidimensional arrays; searching; sorting; an introduction to interfaces
3	Event-driven programming and graphical user interfaces with a focus on Swing components
4	An introduction to inheritance
5	Midterm exam
6	Inheritance and polymorphism.
7	Abstract classes; exception handling
8	Exception generation; file I/O
9	An introduction to recursion
10	Data structures; the Collection interface; stacks; queues

Table 2: CSC 212 course topics

The data considered in this article come from the course evaluations in the nine sections of CSC 212 taught by the first author between March 2003 and March 2005. Of those nine sections, five were traditional evening sections (Spring 2003, Winter 2004 [two different sections], Fall 2004, and Spring 2005), and four were distance-

learning sections (Spring 2003, Winter 2003, Fall 2004, and Spring 2005). All sections were structured in roughly the same manner, with weekly programming assignments, a midterm exam during the 5th week of the quarter, and a final exam during the 11th week of the quarter. The exact percentages for each evaluation item varied from quarter to quarter and are detailed in the paragraph below.

In both Spring 2003 sections, homework was 40% and the midterm and final exams 30% of the grade. In the three Winter 2004 sections, homework was 25%, the midterm 35%, and the final exam 40% of the grade. In the two Fall 2004 sections, homework was 35%, the midterm 30%, and the final exam 35% of the grade.

4 Student Satisfaction

In order to evaluate the impact of the sibling distance learning model on student satisfaction, we will analyze the student evaluations for the CSC 211 and CSC 212 courses the first author has taught. First, we describe the student evaluation process at CTI in order to provide background for that analysis.

4.1 CTI Course Evaluations

CTI conducts student evaluations of every course during every quarter. The evaluations are conducted online via the CTI Web site. The students must log into a secure system and may submit only one evaluation per CTI course in which they are enrolled. No identifying information about the student is associated with the evaluation, making them anonymous. Completing an evaluation is mandatory for all students enrolled in CTI courses. Course evaluations are completed during the 8th and 9th weeks of the 10 week quarter, although results are not made available to instructors until after grades are submitted. The evaluations consist of 22 multiple choice questions and several sections for comments. The multiple choice questions ask the student to rate various aspects of the course and the instructor for the course. The ratings are on a scale from 0 to 10, and the meaning of a rating depends on the question. In general, a higher number indicates a greater degree of student satisfaction with the area addressed by the question. A zero indicates that the student feels the question is not applicable.

On the course evaluation, there are ten questions labeled as course-related questions. However, one of them, "How fair is the grading of the homework and exams of this course" focuses more on an instructor-related issue and will be considered in the next section. One of the questions listed in the instructor-related section, "Would you recommend this course to another student", deals more with course-related factors and will be considered here. The course-related questions (Q_CR) are listed below:

1. Was this course well organized?
2. Do you feel the course objectives were accomplished?
3. The amount of work you performed outside of this course was:
4. How difficult was this course material?
5. The textbook for this course was:
6. Supplementary reading for this course was:

7. The assignments for this course were:
8. What is your overall estimate of this course?
9. How valuable was this course in terms of your technical development?
10. Would you recommend this course to another student?

Note that there was no supplemental reading for either course, beyond the online Java API. We include the data for this course question in our analysis for completeness, but no conclusions should be drawn from that question for obvious reasons.

The remaining twelve questions are for instructor-related (Q_IR) factors.

1. How would you characterize the instructor's knowledge of this subject?
2. How would you characterize the instructor's ability to present and explain the material?
3. Does the instructor motivate student interest in the subject?
4. How well does the instructor relate the course material to other fields?
5. Did the instructor encourage participation from the students?
6. Was the instructor accessible outside of class?
7. What was the instructor's attitude? How did he/she deal with you?
8. How well did the instructor conduct, plan, and organize classes?
9. Were the instructor's teaching methods effective?
10. How fair was the grading of the homework and exams of this course?
11. Would you take this instructor for another course?
12. Rate the teaching effectiveness of this instructor as compared to other faculty in the department.

4.2 Analysis of Java Evaluations

In this section we analyze the course evaluation data for the Java courses taught by the first author from September 2003 to March 2005. We first consider the data set that includes all students in both Java I and Java II during the time period and run a regression to determine what differences are attributable to the distance-learning format. We then restrict consideration to the data for the live sections, both traditional and live students in a section with an associated distance-learning section. In this second analysis we determine if any of the results we see in the first regression are due to any differences between traditional and sibling sections or to differences between Java I and Java II courses.

4.2.1 Full Sample Regression

Since all sections of CSC 211 and CSC 212, both traditional and distance-learning, were taught by the same instructor, there is not a need to add a dummy variable in our regression equation for the purpose of netting out instructor-specific fixed effects. In order to net out changes over time we include a variable for time and in order to determine the effect of distance learning, we include a dummy variable for the distance learning sections. Our Ordinary Least Squares (OLS) regression equation is given by equation (1):

$$Q_i = \alpha_0 + \alpha_1 t + \alpha_2 DL + u_i \qquad (1)$$

where Q is an individual question on the course evaluation, t = time, DL = 0 if the course is a traditional course or the student was a member of a sibling course and DL = 1 if the student is a distance learning student, meaning that he/she watched the course remotely and did not attend a traditional lecture. Time is included as a proxy in order to account for systematic and immeasurable changes in teaching and/or student attitudes across time. The variable for time will include changes in the course structure, changes in the professor's teaching methods, and changes in general student attitudes toward their educational experience across time. One reason to include time as a variable is to eliminate spurious correlation. Time is measured by quarters taught at DePaul (for the Fall Quarter of 2002-2003, t = 1, for the Winter Quarter of 2002-2003, t = 2, etc.). The dummy variable for distance-learning is included in order to account for differences between distance-learning students and traditional students who are in the classroom where the lecture is being presented. If α_2 is statistically different from 0, it will indicate a difference in how students view distance-learning as compared to sitting in on a lecture.

Tables 3 and 4 summarize our results. The pooled sample including evaluations from all 17 sections of the course (9 sections of 212, 8 sections of 211) yield a total of 286 observations for each question (of the 286 students, 156 enrolled in CSC 212, 130 enrolled in CSC 211, 82 were distance learning students, 204 were students sitting in on a live lecture). After dropping responses of zero for each question (since a response of zero indicates that the student felt the question was not applicable to the course or instructor), regression equation (1) is run 22 times, once for each question on the evaluation in order to determine which questions have a statistically significant difference across time and for distance-learning students.

The coefficients for course-related questions 3, 4, 5, and 6 were all significantly different from zero across time. For both questions 3 and 4, the value was negative, indicating that the students felt the course material was easier over time and they spent less work outside of class. It makes sense that the instructor would improve her technique as the course is taught over time, leading the students to feel that the course is less difficult and requiring the students to do less work to feel prepared for exams. The coefficient on question 5 was also negative; indicating that the students felt the textbook was less appropriate and helpful over time. The instructor for the Java courses tends to rely on her notes the more she teaches the class, leading the students to feel the text is less helpful. Finally, the coefficient for question 6 is also negative, indicating that the students felt the supplementary reading was less helpful. As there was no supplementary material for any of the courses, this result is not interesting. Note that none of the coefficients on these questions were significantly different from zero for the distance-learning students. Any changes in student perception on these questions are not related to distance-learning issues.

Question	Time	Distance Learning
Q-CR1	-0.018	-0.651***
	(0.033)	(0.201)
Q-CR2	-0.035	-0.295
	(0.030)	(0.187)
Q-CR3	-0.058*	-0.088
	(0.030)	(0.186)
Q-CR4	-0.065*	-0.283
	(0.038)	(0.234)
Q-CR5	-0.086*	0.256
	(0.049)	(0.298)
Q-CR6	-0.117**	-0.543
	(0.053)	(0.333)
Q-CR7	-0.038	0.092
	(0.037)	(0.227)
Q-CR8	-0.066	0.112
	(0.041)	(0.256)
Q-CR9	-0.004	-0.346
	(0.043)	(0.264)
Q-CR10	-0.044	-0.089
	(0.035)	(0.217)

Table 3: Regression Results for Course-Related Questions
Coefficient estimates are presented with standard errors in parentheses.

**Statistically significant at the 10% level of a two-tailed test.*
***Statistically significant at the 5% level on a two-tailed test.*
****Statistically significant at the 1% level of a two-tailed test.*

The coefficients for course-related question 1 was significantly different from zero for the distance-learning students. Question 1 addresses the course organization. The coefficient for question 1 is negative, indicating that distance-learning students feel that the course is less organized. This result is not seen in the student population as a whole.

Question	Time	Distance Learning
Q-IR1	-0.010	-0.356**
	(0.025)	(0.152)
Q-IR2	0.005	-0.515**
	(0.035)	(0.219)
Q-IR3	-0.043	-0.528**
	(0.040)	(0.248)
Q-IR4	-0.060	-0.082
	(0.047)	(0.289)
Q-IR5	0.004	-0.627***
	(0.040)	(0.248)
Q-IR6	-0.082**	-0.165
	(0.034)	(0.208)
Q-IR7	-0.014	-0.174
	(0.036)	(0.227)
Q-IR8	-0.014	-0.174
	(0.036)	(0.227)
Q-IR9	0.025	-0.554**
	(0.041)	(0.255)
Q-IR10	-0.022	0.060
	(0.036)	(0.225)
Q-IR11	0.021	-0.501*
	(0.047)	(0.289)
Q-IR12	-0.006	-0.482**
	(0.037)	(0.234)

Table 4: Regression Results for Instructor-Related Questions
Coefficient estimates are presented with standard errors in parentheses.

**Statistically significant at the 10% level on a two-tailed test.*
***Statistically significant at the 5% level on a two-tailed test.*
****Statistically significant at the 1% level of a two-tailed test.*

The coefficient for instructor-related question 6 was significantly different from zero across time. Question 6 concerns the instructor's accessibility outside of class. The coefficient is negative; indicating that the students feel the instructor was less

available over time. This result is more difficult to explain, but is overshadowed by the results for distance-learning students.

The coefficients for instructor-related questions 1, 2, 3, 5, 9, 11, and 12 were all significantly different from zero for distance-learning students. The instructor is viewed very differently by distance-learning students than by traditional students present in the classroom during lecture. The only instructor-related questions that did not differ for distance-learning students were how well the instructor related the course material to other fields, what the instructor's attitude was, accessability outside of class, instructor's planning and organization of the course, and the fairness of the instructor's grading. Certain areas such as encouraging student participation and effectiveness of teaching methods may well differ for distance-learning students, given that they are not able to directly participate in the class discussion or ask questions and may not be able to physically attend office hours. However, other instructor-related questions that a priori might be expected to yield similar evaluation scores for both populations also were different. This included the instructor's knowledge of the subject. Distance-learning students are less likely to want to take another class with the instructor. Most seriously of all, distance-learning students unfavorably compare the instructor to other faculty; this question has typically been used as a standard measure for merit review and promotion and tenure. The fact that these distance-learning students were significantly more critical of their instructor may have consequences for other faculty who teach distance-learning classes.

These results suggest that overall student satisfaction with the course is slightly different for distance-learning students, while student satisfaction with the instructor is vastly different for distance-learning students. We hypothesize that distance-learning students channel their displeasure with not being able to interact with the instructor or other students in their ratings of the instructor. In some ways, this makes sense. The results show that the class is more interactive over time. Distance-learning students can see the interaction but cannot participate in it, which may only increase their sensitivity to the issue. Distance-learning students may recognize that the problem is not with the course, but since they have no way of rating the way in which the course is delivered, their perception of the instructor is altered. Under this hypothesis, the instructor becomes the focus of their unhappiness with the isolation.

This hypothesis is also supported by an analysis of the not applicable rate for instructor-related questions. Only two of the instructor-related questions have not applicable rates that differ significantly between distance-learning students and live students. Q-IR5 has a not applicable rate of 7% among distance-learning students but less than 1% among live students. Similarly, Q-IR7 has a not applicable rate of 6% among distance-learning students but less than 1% among live students. This contrasts with the high discrepancy between not applicable rates found for our initial work. There our hypothesis was that the distance-learning students were not watching the recordings [Settle, 05]. In this case we hypothesize that the problem is not that the distance-learning students are not watching, but that they are watching and feel as if they are missing out.

4.2.2 Restricted Sample Regression

In order to account for differences between CSC 211 and CSC 212 and to account for potential differences between how the instructor taught sibling sections that had parallel distance-learning sections versus traditional in-class lecture sections, we ran a regression on a restricted sample of the data. We dropped all distance learning students from the sample to compare traditional students to sibling section students. The restricted sample yields a total of 204 observations. In our regression equation, we still include a variable for time to account for immeasurable changes over time. A dummy variable for sibling sections is created as well as a dummy variable for the Java II course. The OLS regression equation for the restricted sample is given by equation (2):

$$Q_i = \beta_0 + \beta_1 t + \beta_2 \text{Sibling} + \beta_3 J2 + u_i \qquad (2)$$

where Q is an individual question on the course evaluation, t = time, Sibling = 0 if the course is a traditional course and Sibling = 1 if the course is a sibling course with an associated distance-learning section, and J2 = 0 if the course is Java I (CSC 211) and J2 = 1 if the course is Java II (CSC 212). The dummy variable for sibling courses is included to account for differences between students in a traditional course and students in a course with a sibling section that has distance-learning students. If β_2 is statistically different from zero, it will indicate a difference between how students in a sibling class to a distance-learning section view their class as compared to students sitting in on a traditional lecture without the distance learning students. The dummy variable for Java II sections is included to account for differences between how students view their classroom experience in Java I versus in Java II. If β_3 is statistically different from zero, students view the Java I and Java II courses differently.

Tables 5 and 6 summarize our results. Once again, after dropping responses of zero for each question 22 regression runs were done on equation (2) to test for statistically significant differences across time, for sibling sections, and for Java II sections.

None of the coefficients for course-related questions were significantly different from zero across time. The coefficient for course-related question 5 is significantly different from zero for students in sibling courses. Students in sibling courses have a different view of the textbook than students in traditional sections of the course, but do not view any other course-related aspect of their sibling section differently. The coefficients for course-related questions 4, 5, and 10 are significantly different from zero for students in a Java II section. Students in sections of Java II found some aspects of the course significantly different than students in a Java I section. The Java II students were less satisfied with their textbook, they felt the class was more challenging, yet they were more likely to recommend the course to another student.

These results are key to understanding the results from the full regression. First, students do view Java I and Java II differently, however, since the number of Java I distance-learning sections, and the number of Java II distance-learning sections were comparable in the sample and the number of students in the sections were comparable as well, the difference between Java I and Java II sections does not account for the difference between distance-learning students and traditional students. Second, students in a live section that have a sibling distance-learning section do not view the

course significantly differently than do students who sit in on a traditional section. The presence of sibling distance-learning sections does not affect the live students and therefore does not help explain the difference between distance-learning students and traditional students.

Question	Time	Sibling	Java II
Q-CR1	-0.020	-0.030	0.132
	(0.037)	(0.250)	(0.223)
Q-CR2	-0.055	0.148	-0.034
	(0.035)	(0.235)	(0.210)
Q-CR3	-0.041	-0.287	0.003
	(0.036)	(0.244)	(0.218)
Q-CR4	0.006	-0.234	0.649**
	(0.046)	(0.310)	(0.277)
Q-CR5	-0.040	0.961**	-0.707*
	(0.058)	(0.403)	(0.360)
Q-CR6	-0.083	0.585	0.045
	(0.062)	(0.406)	(0.364)
Q-CR7	-0.062	0.121	-0.078
	(0.044)	(0.302)	(0.270)
Q-CR8	-0.065	-0.166	-0.011
	(0.052)	(0.353)	(0.316)
Q-CR9	-0.018	-0.084	-0.194
	(0.054)	(0.364)	(0.325)
Q-CR10	-0.025	0.095	0.425*
	(0.042)	(0.285)	(0.255)

Table 5: Restricted Sample Regression Results for Course-Related Questions
Coefficient estimates are presented with standard errors in parentheses.

**Statistically significant at the 10% level of a two-tailed test.*
***Statistically significant at the 5% level on a two-tailed test.*
****Statistically significant at the 1% level of a two-tailed test.*

Question	Time	Sibling	Java II
Q-IR1	-0.018	0.091	-0.176
	(0.028)	(0.193)	(0.173)
Q-IR2	-0.010	-0.080	-0.083
	(0.043)	(0.290)	(0.260)
Q-IR3	-0.043	0.033	-0.017
	(0.048)	(0.321)	(0.288)
Q-IR4	-0.078	-0.047	-0.493
	(0.056)	(0.378)	(0.337)
Q-IR5	-0.019	-0.250	-0.311
	(0.045)	(0.302)	(0.271)
Q-IR6	-0.123***	-0.023	-0.133
	(0.039)	(0.263)	(0.238)
Q-IR7	-0.027	-0.159	0.224
	(0.044)	(0.301)	(0.269)
Q-IR8	-0.042	-0.103	-0.109
	(0.037)	(0.251)	(0.225)
Q-IR9	-0.003	-0.059	-0.163
	(0.049)	(0.333)	(0.299)
Q-IR10	0.009	0.028	0.026
	(0.045)	(0.309)	(0.277)
Q-IR11	-0.023	0.020	-0.276
	(0.057)	(0.387)	(0.345)
Q-IR12	-0.034	-0.078	-0.184
	(0.045)	(0.314)	(0.280)

Table 6: Restricted Sample Regression Results for Instructor-Related Questions
Coefficient estimates are presented with standard errors in parentheses.

**Statistically significant at the 10% level of a two-tailed test.*
***Statistically significant at the 5% level on a two-tailed test.*
****Statistically significant at the 1% level of a two-tailed test.*

Even more striking than the restricted regression results for course-related questions are the restricted regression results for instructor-related questions. Only the coefficient for instructor-related question 6 is significantly different across time. None of the coefficients for the instructor-related questions were statistically different from zero for the sibling sections. The evaluations of the instructor do not significantly

differ for sibling sections. By comparison to the instructor-related questions in Table 2, distance-learning students view the instructor vastly differently than students who sit in on the lecture when it is taking place and this is not attributable to the section being either a sibling section or a Java II section. Students sitting in on lectures in a sibling section get a very similar experience to students who sit in on lectures in a traditional section. However, distance-learning students get a different experience and are far less satisfied with their instruction. This dissatisfaction shows up in the instructor-related evaluation questions.

5 Conclusions And Future Work

The results of this study are different from the initial results obtained by the authors. Distance-learning students are less satisfied than either traditional students or their peers in live sibling sections with the course. The distance-learning students feel that the course is less well-organized and that the course objectives are not met as well. This result cannot be attributed to the type of live section or to the type of Java course, as our restricted regression shows. This explanation is consistent with previous work on student satisfaction with online courses that has shown distance-learning students to be sensitive to course organization and to rate the course poorly if excellent course organization does not compensate for a lack of interaction [Swan, 01].

Most striking are the results for instructor-related questions. Distance-learning students rate the instructor lower on seven out of the twelve questions. While some are understandable, such as encouraging student participation, the effect spills over to other questions, such as the instructor's knowledge of the subject, whether the students want to take another course with the instructor, or the instructor's teaching effectiveness as compared to other instructors. Distance-learning students are unhappy with the course and attribute the change to the instructor. One hypothesis for these results is that an increasingly interactive class, which seems to be the situation when you consider the analysis of the data for live students, would highlight the shortcomings of the distance-learning format. Unable to understand that the situation is inherent to distance-learning courses using this format, some distance-learning students may penalize the instructor. Even those students who understand the situation lack the ability to express their frustration with the format. The course evaluations at CTI pre-date the creation of distance-learning, and there are no questions that ask about the technology used to present the class. This hypothesis is supported by the not applicable response rate discussed in the section on instructor-related questions.

There are a number of possible reasons why the results obtained for the Java courses differ significantly from our previous study on graduate discrete mathematics courses. The most obvious difference is the format of the distance-learning sections. The discrete mathematics distance-learning course was constructed solely for the distance-learning students. Rather than using the COL recordings, making it a sibling class of a live section, the course consisted of higher-quality pre-made recordings created in advance. The course also consisted of five highly-organized modules. The literature shows that superior organization in a distance-learning course can make up for a lack of interaction [Swan, 01]. The Java distance-learning courses were no more

organized than the traditional sections, providing no compensation for the lack of interactivity. In a related issue, the sample sizes for the distance-learning sections of the discrete mathematics courses were relatively small. Another contributing factor is the type of students in the course. The discrete mathematics course is a graduate class, while the Java programming course is open to both undergraduates and graduate students. While undergraduates are not encouraged to enroll in distance-learning sections, in practice they do, and undergraduates may lack the maturity to compensate for a lack of live interaction with the instructor.

This work suggests many avenues for future study. First, it would be interesting to repeat this analysis for other courses and see if distance-learning sections for other types of classes show a discrepancy between course- and instructor-related evaluation questions. As CTI begins to develop more distance-learning courses that are designed solely for distance-learning students, rather than being sibling courses for live sections, it would be interesting to determine if the improved satisfaction seen in our earlier work is present in those courses, or if the results seen here are more typical of distance-learning courses at CTI. All of the Java sections considered in this article were evening courses, taught once a week for 3 hours at a time. Day sections tend to be mostly undergraduates and evening sections have a mixed undergraduate and graduate population. It would be interesting to consider if student evaluations for the course and/or instructor differ between day and evening sections. Finally, we are interested in the question of whether distance learning has an impact on student performance. While there are a number of studies that show student performance in traditional and distance-learning courses are similar [Carr, 00], [Rivera, 02], [Schoech, 00], [Sonner, 99], [Spooner, 99], it would be interesting to investigate the issue for CTI students. Few of the previous studies have considered information technology courses.

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