Teaching Without a Classroom: Delivering Courses Online

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Abstract

Technology has changed the way we deliver courses. The professor who used to carry a few scribbled notes (or a whole armload of handouts) to a classroom equipped only with chalk and a blackboard is a thing of the past. More likely, the instructor will carry a laptop or disk, or perhaps nothing – relying on a PC-equipped teacher's station and the Internet to provide the tools needed for teaching a class.

Recently, however, colleges and universities have begun to go one step further with technology by removing the classroom altogether and instead creating a virtual classroom. Online courses in which students have no classroom contact with the instructor are becoming more and more common, and several entirely online universities have been established. Traditional universities are expanding their offerings to include online courses in addition to traditional lecture/classroom courses. This paper explores some of the issues that arise with online courses.

Introduction

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At Northwest Missouri State University, many courses are being offered online, and several departments are putting programs online. The authors of this paper are working with a group of faculty members to offer the Computer Science major online, enabling students to take all computer science courses in the major without having to be on campus. This paper addresses some of the issues related to online courses and draws on the authors' own experiences to try to answer some of the questions that arise. While each academic discipline is different and faces unique problems in attempting to deliver a valid learning experience via online courses, some problems are unique to all disciplines. This paper focuses on those areas of common interest.

Specifically, we will address the following topics:

- What are the advantages and disadvantages of online courses?
- How are online courses offered successfully? There are several online course delivery systems available. The authors have used both Blackboard and eCollege. This section will discuss some of the features of these systems, but will primarily focus on the online content, which would be the same regardless of the delivery system.
- What about testing? Many studies show that students do cheat, whether we want to admit it or not. Online courses make cheating even easier in many ways. This section will address this problem and offer some possible solutions.
- Do online courses work? This section will present the results of one study the authors conducted, comparing the success of online and traditional lecture/classroom students.

Terminology: Online Vs. Onground

Throughout this paper we use the term online to refer to a course that students can complete entirely by electronic means, with no face-to-face contact with the instructor. We use the term onground to refer to courses that are taught in a traditional classroom setting.

Why Teach Online Courses?

Many universities now offer online courses. Why is this occurring? The answer may be as simple as "Because we can." For many years colleges and universities have allowed students to take courses by correspondence from other universities. This enabled students to get credit for courses that they needed but perhaps could not take on their home campus. The instructor mailed assignments to the student, who completed them and mailed them back to the instructor. The instructor graded the assignments and returned the graded assignments to the student. Exams were usually mailed to a proctor who supervised the exam and then mailed the completed exam to the instructor. Now we have the technology to enhance the correspondence course model to an extent that makes the original model almost unrecognizable. The effect, however, is the same. Online courses, like correspondence courses, enable students to take courses without the requirement of being in the same location as the instructor. However, there are major differences between correspondence courses and online courses. Traditional undergraduate students rarely take correspondence courses, but many students, including residential students in onground courses, also enroll in online courses for a variety of reasons. Technology allows students in online courses to have frequent contact with their instructor (through e-mail and discussion threads) and even allows for real-time conversations using chat rooms. Technology also allows for delivery of electronic materials in a variety of ways. Slide shows, exercise sets, video lectures, and practice exams can all be delivered electronically. The rich variety of materials that can be provided via the web enables students with differing learning styles to successfully complete an online course.

At Northwest, students enroll in online courses for many different reasons. Some students may find it difficult or impossible to come to campus to take courses. They may live too far away, or their personal circumstances may preclude regular attendance in on-campus classes. Even for students who are currently on-campus, online choices provide them with more flexibility in their very busy schedules. We have many students who work twenty hours per week in off-campus jobs, and online courses allow them greater latitude in arranging their work hours. We have several single mothers who elect to take online courses whenever possible, enabling them to spend more time with their children and reducing the financial expense incurred for baby-sitters. We serve a large rural area and have some rural residents who farm and are also pursuing a degree. Online courses allow these individuals to handle the sometimes erratic, and always weather-dependent, demands of farming while taking classes at the same time. A student who is double-majoring frequently finds that two required courses conflict. If one of the courses is offered online also, the student can still take both courses. Students with internships

with companies not in the local area often take one or two online courses while they are working on their internship. Northwest students participating in international exchange programs sometimes take online courses at Northwest, even though they may be half way around the world. International students who want to go home for the summer can see their family and continue their education by taking online courses.

Online courses also provide more flexibility for faculty. An online course requires at least as much time on the part of the faculty member as does an onground course. However, without any class to attend, the faculty member has much more choice about when to do the required work. It is also possible to teach an online course while absent from the campus, which some faculty members at Northwest do during the summer months.

Online courses can help with resource scheduling. Students who are off-campus do not use campus provided resources, such as computer labs, classrooms, and student support resources. This frees up those resources for on-campus students and may result in a reduced need to add more facilities or personnel.

When addressing the question of why online courses should be offered it is only fair to also consider the opposite side of the issue – "Why should online courses *not* be offered?" This is a valid question. In our area, regional employers have expressed concern over hiring a student who has obtained an entire degree online and therefore has had few opportunities to learn the teamwork skills that employers consider so important. While online courses can save on some resources, they increase the need for other resources, including faculty time for development of courses and computer resources to handle the electronic content. When interactive content is provided, these needs escalate. Web servers for online courses need to operate 24x7, and help desk facilities must be available. Finally, if you teach at an institution where class sizes are small, it may not be feasible to offer both online and onground sections of a course during the same semester. If a course is offered in online format only, a student may be forced to take the course online and yet may not be the type of student who can be successful in an online course.

How Are Online Courses Taught?

In its most primitive form, an online course could be taught by simply having all normal course materials, such as PowerPoint slides, exercise sets, and exams, in electronic form and making extensive use of e-mail. However, most online students are going to want more services than such a system can offer. Several online delivery systems exist including WebCT, Blackboard, and eCollege. We are currently using eCollege, and that is the system we will discuss in this paper. Other systems offer similar services.

The eCollege Interface

The eCollege interface provides a series of unit buttons on the left hand side of the screen. Your use of these buttons determine the organization of your course. Under a

unit button there can be content items. For example, in Figure 1, the Course Home unit button has several content items including syllabus, calendar, and lab assistant hours.

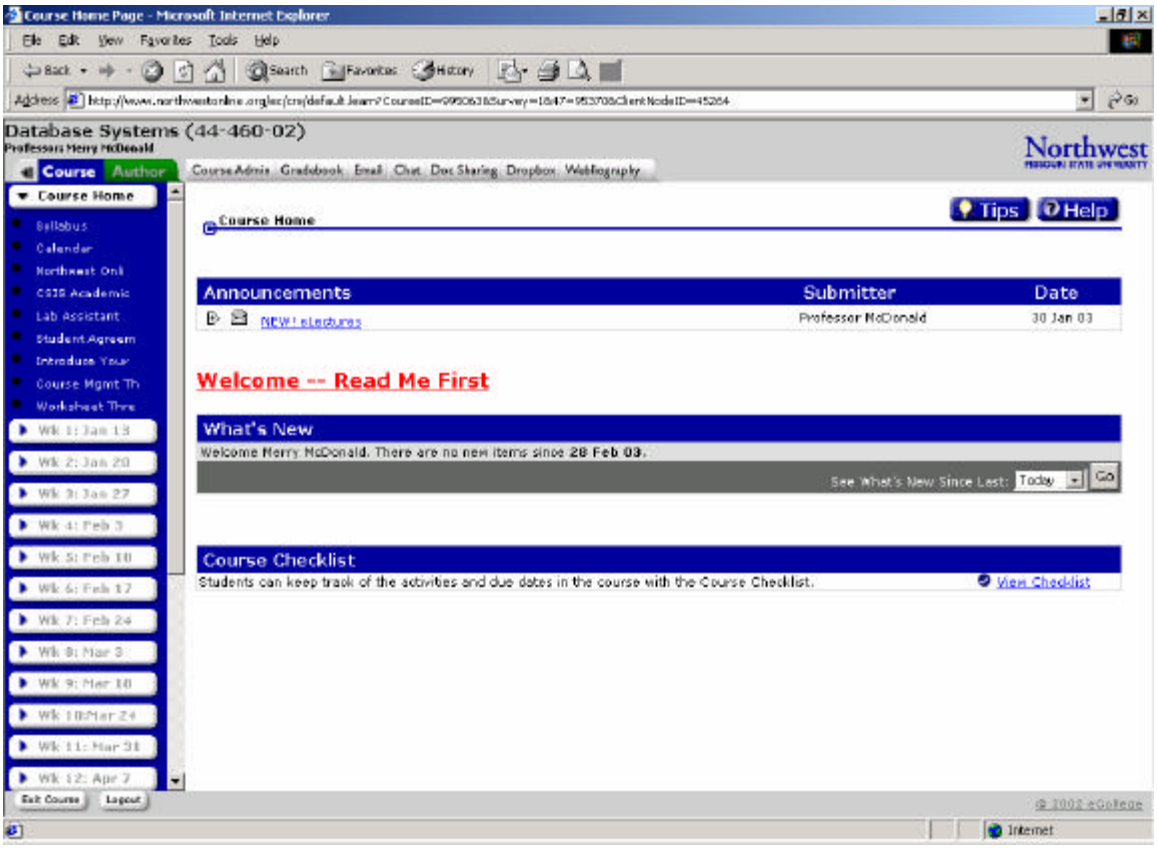

Figure 1: eCollege Home Page

A Course Home button is always present in eCollege and always contains syllabus and calendar content items. The remaining buttons are created by the instructor. There are generally two approaches for organizing the remaining buttons. Some instructors organize by course content. One button might be labeled Lectures and might contain copies of all the PowerPoint slides in the course. Another button might be used to access worksheets or exercise sets.

A second method, illustrated in Figure 1, is to organize by weeks. When a student clicks on a weekly button, a screen appears like the one shown in Figure 2. This page tells the students exactly what they need to do during the specified week and provides links to the slides, worksheets, assignments, and exams for the given week.

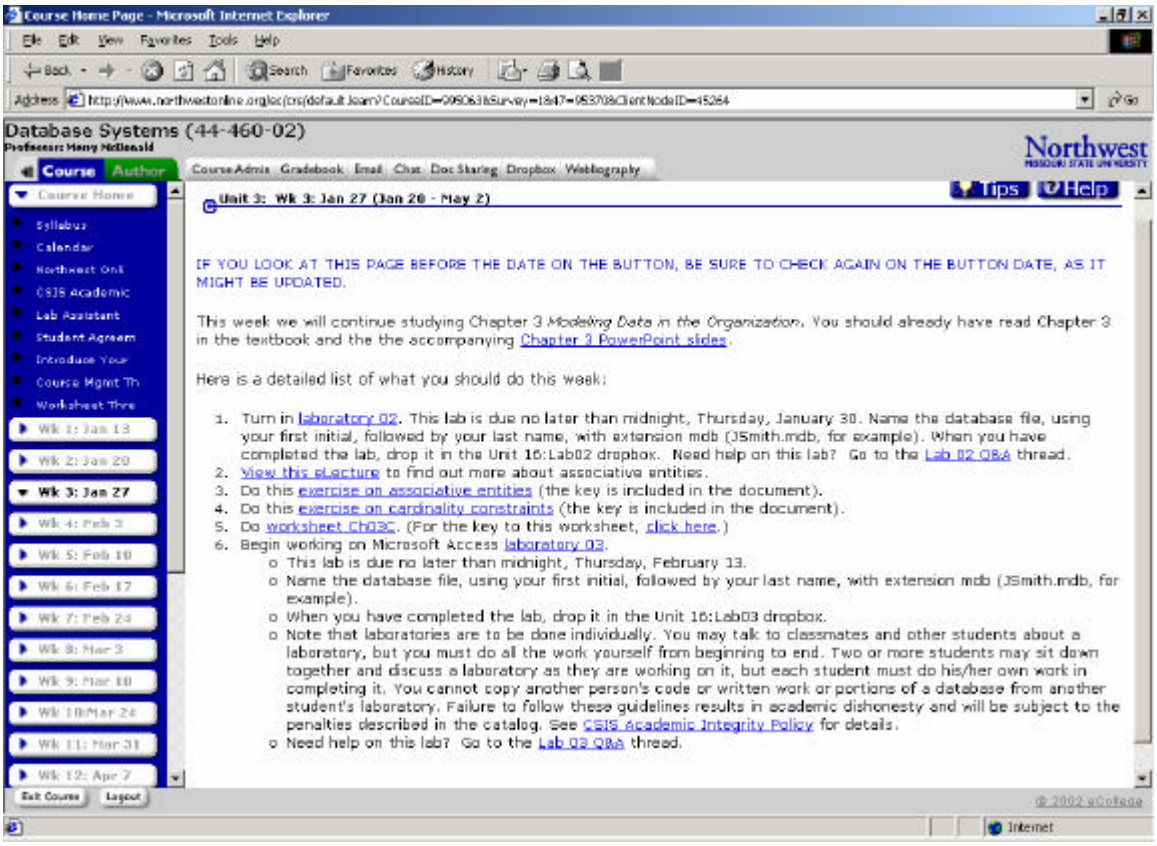

Figure 2: Weekly Activities Page

Following the weekly unit buttons, the instructor may include additional buttons to provide alternative methods of access for certain content items. For example, a student may open the Week 3 page and discover a link to a lab required for that week. The lab can also be accessed by going directly to a Labs unit button, which the instructor creates and adds below the weekly buttons.

Key ingredients to look for in the choice of a course delivery system are flexibility in organizing your course and the ability to link to other parts of the course. eCollege provides both of these capabilities.

Course delivery systems also offer many other features to enhance your online courses. These features are essential to make your course easy to manage and to provide the additional services students expect. Some of the additional features are discussed below. The features described here are available in eCollege. Similar features are available in most other course delivery systems.

Online Gradebooks and Exam Builders

eCollege's gradebook system allows instructors to easily specify items that will be graded and possible points for those items. Grades can always be entered manually, but some grades can be entered automatically using the exam or dropbox features discussed below.

Students can check their current grades and calculate their grade to date at any point in the course. The eCollege gradebook does not allow you to calculate weighted averages.

Using eCollege's exam builder, instructors can build test banks of questions and can then create quizzes and exams based on one or more of the test banks. All students may take the same exam, or each student may take a "personalized" exam of randomly selected questions. Questions may be true/false, multiple choice, multiple answer, short answer, or essay. If the exam is completely comprised of questions that can be graded automatically, such as true/false or multiple choice, then the exam can be set up so that the exam grade is automatically entered in the gradebook. The student can view his/her own grades in the gradebook and, if allowed by the instructor, the student can also view the graded exam with correct answers indicated.

Document Sharing and the Dropbox

Students and faculty can upload and download files into the document sharing section. Files can be marked "for instructor only" or "for entire class".

When a content item is created, a dropbox can be created at the same time. This is very convenient for collecting homework assignments. Students can then "drop" their assignments, projects, or papers in the dropbox, and they arrive in the instructor's dropbox under an Inbox heading. Each content item has a separate dropbox, so it is easy to keep submissions organized. Submissions to the dropbox can include file attachments. The instructor can open a submission, grade it, make comments, and then return it to the student. Once returned, it also stays in the instructor's dropbox but under the Outbox section of the dropbox. The grade assigned is automatically entered in the gradebook.

Class Live! and Discussion Threads

Class Live! is a chat feature that allows for synchronous communication between instructor and class members. Students can "raise their hand" for permission to speak, so conversation can be regulated somewhat, as it would in an ordinary classroom. Class Live! includes a whiteboard feature where instructors and students can write or draw. For example, mathematical equations can be displayed easily and a drawing tool provides graphics capabilities.

Discussion threads allow for asynchronous communication between instructors and students. Students or instructor can post and respond to questions. Individual discussion threads can be set up for many different topics.

E-Mail

eCollege provides full e-mail sending facilities, including the ability to attach files. You cannot receive e-mail through the eCollege website.

Management Tools

eCollege provides a number of management tools. A File Manager system allows you to upload and organize files which you can then link to from other web pages on the course site. You can check enrollment through the course website and you can also check individual user activity for each course unit.

A particularly nice feature of eCollege is the Group Management utility. This feature allows the instructor to assign individuals to groups and then customize the course content items for each group. For example, suppose you are teaching three different sections of a database course during the same semester. One section is an undergraduate online section; a second section is an undergraduate onground section; the third section is actually a different course – a graduate level beginning database course for students in non-technical majors. The two undergraduate sections have identical content, but because one is online and one is onground, assignments may vary slightly and total points available may differ for the two groups. The graduate section is quite different in content and assigned work, but some of the exercise sets and PowerPoint slides are appropriate for them to use. The instructor can enroll all these students in the same eCollege course, but assign them to different groups. Course content items can be made available to different groups, and the gradebook can keep track of graded items for each group. Groups can have their own Document Sharing section and their own chat rooms. Instructors can send e-mail to all individuals in a group. This feature is also useful for managing team projects, where each team can be assigned to a different group.

eCollege and other course delivery systems provide all the tools necessary for successfully offering courses online. However, just because we *can* do something does not mean that we *should* do it. In the remaining sections of this paper, we look at two issues that must be addressed before making a final judgment regarding online courses: (1) how do you ensure academic honesty in online courses, and (2) do students perform as well in online courses as in onground courses?

Academic Integrity in Online Courses

Online courses present special challenges when it comes to testing. At Northwest, instructors teaching online courses require students who live close to campus to return to campus for exams. These exams are usually given in the evening. If a student lives close to campus, but cannot take the exam at the scheduled time, an alternative time is set up for the student to take the exam individually. However, we sometimes have students who cannot come to campus for exams.

Different instructors deal with off-campus students in different ways regarding exams. One instructor uses the following method. For the hour exams given in the course, the exams are e-mailed to the off-campus students after all other students have taken the exam. The e-mailed exams have a read receipt requested, so the instructor can tell when the student opens the e-mail. The student knows what the subject header will be for the e-mail containing the exam and is cautioned not to open the e-mail until ready to begin

the exam. Once the e-mail containing the exam is opened, the exam must be completed and returned to the instructor within the time frame specified by the instructor.

The final exam must be proctored by someone arranged for by the student and approved by the instructor. A proctor who is not personally acquainted with the student is asked to request a picture id from the student before allowing the student to take the exam. The exam is mailed to the proctor. The proctor administers the exam and then mails it back to the instructor.

Grades are calculated differently for students who take the exams off-campus. First all grades are averaged in the ordinary way, and a course grade is determined on that basis. Then the instructor adds ten percent to the percent score on the final exam. The student's grade in the course cannot exceed the latter percentage. Thus far, using this scheme has not resulted in a student's grade being lowered from their calculated average, based on all of the student's work for the semester. It is designed to catch those students who have a wide discrepancy between their unsupervised work and their grade on the proctored final exam. So far, such a discrepancy has not occurred.

This method has worked well for the instructor who is currently using it. However, the number of students taking exams off-campus has been small. Even though only the final exam is proctored, coordinating with the proctor does take time, and this burden will increase if the number of off-campus students grows larger.

Student Performance in Online Courses

Background

In the fall of 2001, we had a unique opportunity to explore the question: "Do online courses really work?" Many have posed this question and are awaiting a conclusive response before venturing into this new world of online education. A 1997 study at California State University, Northridge, attempted to address this question with a methodologically sound statistical investigation [2]. This study concluded that students learning statistics from the web consistently outperformed those in a traditional classroom setting. While well received, these results cannot be used to make an assumption about other disciplines, due to the fact that teaching methods even in traditional settings vary widely across academic fields.

During the 2001-2002 academic year, we conducted a comparably rigorous study, specifically targeted at upper-division Computer Science courses. The research question was simple: Is there a significant difference in student performance levels due to course delivery method? Clearly, answering this question would have a substantial impact not only on the viability of online instruction for undergraduate CS students, but also on the justifiability of online degree programs in the field.

Approach

During the fall term, performance data was gathered from online and onground sections of the undergraduate Database Systems and Computer Networks classes at Northwest Missouri State University. As a control factor, students enrolled in these courses met on Thursday evenings to take course examinations regardless of instruction method. Online content was delivered through a Blackboard Course Information site and was available to both online and onground students alike. However, those students in the traditional classroom were not required to participate in online discussions as part of their grade. Following the end of the fall term, two different statistical methods were applied to the data, using exam scores and assignments as measures of individual performance.

Methods of Analysis

As mentioned above, the data was analyzed using two different techniques. These tests, taken together, provide a solid response to the research question posed. The first of these methods is a simple comparison of means, or more specifically, a Student's t-test. This test is used to determine if there is a significant difference between the means of two samples [1]. Simply put, it answers the question "Was there a difference?" The t-test analysis used in this study is somewhat more involved than a simple comparison. To ensure that students in the two groups (online/onground) were of equal caliber prior to taking the course, comparisons were also made on ACT composite means, cumulative GPA means, and the mean number of credit hours completed. Given no differences in these three characteristics, valid comparisons between the performance measures could be made.

Regression analysis was also used to examine the data. This method attempts to model the input data linearly and determine which variables contribute significantly to the effectiveness of the overall model [1]. In general, it tells us which variables are important. Demographic variables, described in Table 1, were used in addition to performance measures in constructing these models.

Table 1: Demographic Variables

Variable	Description
ACTCOMP	Composite ACT score
TOTHRS	Number of credit hours completed through Fall 2001
GPA	Cumulative GPA through Fall 2001
MJCAT1/2	Dummy variables used to describe a student's major: CS, MIS, or Other

Note that ACT composite scores were not used in regression analysis due to missing values for some students in the input data.

Computer Networks

The Computer Networks course used in this study is a junior/senior level introduction to networking. It covers theoretical networking concepts relating to the basic services that networks provide and how protocol stacks are used in network implementation. Specific topics explored are: direct link networks, packet-switched networks, and internets. Sixteen students participated in the online section and 23 took the traditional course. Performance data for students in this course consisted of scores from individual programming projects and exam scores. The variables are described further below in Table 2.

Table 2: Computer Networks Performance Variables

Variable	Description
ASSIGN	Total points from programming assignments
EXAMS	Total points earned on exams
TOTAL	Sum of ASSIGN and EXAMS

Table 3 shows results of the various t-tests used during analysis. Notice that there were no significant differences (at the α=0.01 level) between means for any of the three background demographics. Further comparison shows significant differences between mean exam scores and mean total scores, with no difference in performance on programming projects. Mean total scores were 555.85 and 511.98 for onground and online sections, respectively.

Table 3: Mean Comparisons for Computer Networks

Background Data			
Variable	**t-Value**	**P-value**	**Significant?**
ACTCOMP	0.5300	0.5981	N
TOTHRS	0.9800	0.3350	N
GPA	1.5600	0.1282	N

Course Data			
Variable	**t-Value**	**P-value**	**Significant?**
ASSIGN	1.5500	0.1297	N
EXAMS	2.8200	0.0076	Y
TOTAL	2.9100	0.0060	Y

Regression results for the best one through five variable models are presented in Table 4. Of these, the three variable model with GPA, ONLINE, and TOTHRS as the independent variables was selected as the best model due to high significance of all variables when added last (p values are shown below each variable), a relatively large R-square value (when compared to the max), and an attractive C(p) value (one of the first where C(p) p).

Table 4: Regression Data for Computer Networks

Dependent Variable: TOTAL							
Parameters	**Variables/P-Values**					**R-Square**	**C(p)**
2	GPA					0.2161	7.6888
	0.0029						
3	GPA	ONLINE				0.3231	3.8613
	0.0107	0.0224					
4	GPA	ONLINE	TOTHRS			0.3877	2.3447
	0.0157	0.0086	0.0629				
5	GPA	ONLINE	TOTHRS	MJCAT1		0.3939	4.0046
	0.0146	0.0112	0.0880	0.5578			
6	GPA	ONLINE	TOTHRS	MJCAT1	MJCAT2	0.3940	6.0000
	0.0185	0.0124	0.0938	0.5663	0.9461		

To summarize, onground networking students significantly outperformed online students, and the variable for type of course added to the overall predictive capacity of the regression model. These two results, taken together, lead us to conclude that online and onground students did indeed perform differently, with onground students earning higher marks.

Database Systems

The database course used in this study serves upperclassmen with an introduction to relational databases. It covers data modeling, logical database design, normalization, and physical design. Students also learn how to use SQL and a Database Management System. The online section consisted of 13 students, while the two onground sections had 51 total enrolled. Performance in this course was measured solely on the total exam scores for each student and is represented in the analysis by the variable EXAMS.

Table 5 illustrates t-test results for the database course. Again, no differences existed between the sections in terms of background characteristics. Additionally there was not a significant difference (at the α=0.01 level) between sections for the EXAMS variable. Means for online and onground groups were 412.46 and 435.41, respectively.

Table 5: Mean Comparisons for Database Systems

Background Data			
Variable	**t-Value**	**P-value**	**Significant?**
ACTCOMP	1.4900	0.1417	N
TOTHRS	-1.2400	0.2204	N
GPA	0.6300	0.5291	N

Course Data			
Variable	**t-Value**	**P-value**	**Significant?**
EXAMS	1.2800	0.2067	N

As with the networking course, the best models for regression are shown below in Table 6. The three variable model containing GPA, TOTHRS, and MJCAT1 was selected as the best model for this data.

Table 6: Regression Data for Database Systems

Dependent Variable: EXAMS							
Parameters	**Variables/P-Values**					**R-Square**	**C(p)**
2	GPA					0.1561	8.0947
	0.0012						
3	GPA	TOTHRS				0.2402	3.3105
	0.0040	0.0117					
4	GPA	TOTHRS	MJCAT1			0.2638	3.4077
	0.0024	0.0560	0.1708				
5	GPA	TOTHRS	MJCAT1	ONLINE		0.2760	4.4241
	0.0028	0.0883	0.1362	0.3230			
6	GPA	TOTHRS	MJCAT1	ONLINE	MJCAT2	0.2812	6.0000
	0.0029	0.0750	0.1475	0.2892	0.5175		

The two lines of analysis again lead to parallel results. Total exam scores were not significantly different and the best regression model does not include the course-type variable. Thus, delivery method did not have a noticeable effect on student performance.

Interpretation of Results

The mixed results between the two different courses lead to an inconclusive answer for our original question. However, there are many possible explanations for this observation. One such cause may be that limited population size, particularly in the Database course, has resulted in hidden variability. Further research is necessary to determine the reproducibility of these results and the general effectiveness of online teaching practices.

Conclusion

Technology today offers the possibility for new course delivery methods, including offering courses that are completely online and require no face-to-face contact between instructor and student. Online courses can make it possible for students to complete a college education who might not be able to otherwise and also offer maximum flexibility and convenience for both faculty members and students with busy schedules. Testing issues present some special problems for online courses. More studies need to be done to measure the effectiveness of online courses and the performance of online students as compared to onground students.

References

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