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Does the Delivery Method Matter?: Comparing Technologically Delivered Distance Education With On-Campus Instruction

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Abstract

This study examines the effect of delivery method on student academic performance controlling for learner characteristics and student academic preparation. Comparisons were made between television, interactive video, Internet, and in-class lecture courses. Results indicate that technologically delivered courses can be as effective as traditional methods of course delivery. However, the academic performance of students may also be lower or higher in technologically delivered courses when comparing them with students in regular on-campus sections. The need to consider teaching methods, curriculum, course design, and instructor skills and abilities in future research is discussed.

Introduction

Higher education has experienced a dramatic change in how instruction is delivered on college campuses. An increasing number of students take courses through television, live satellite broadcasts, videodisc or CDROM, the Internet, computer-based hypermedia instruction and other forms of technologically delivered education. These courses often attract older adults who work, have family commitments, and other time constraints that make it difficult for them to attend courses on-campus. Students in remote locations or those with disabilities may also benefit from distance education courses. In other cases, alternative delivery methods are used to enhance student instruction.

Researchers have compared technologically delivered or distance education courses with traditional in-class instruction that relies heavily on lectures delivered by faculty. The goal is to determine if new means of instruction compare favorably with the traditional lecture format. The

study results theoretically should ensure a basic level of quality and effectiveness. Most research shows no significant difference in performance between students enrolled in technologically delivered or distance education courses and those in lecture courses. Some researchers have reported that distance education can provide "learning experiences more effective and satisfying than those provided by the on-campus experience" (Thompson, 1996, p.29).

There is controversy over whether the means of delivery or media affect student learning. Clark (1994) maintains that "many very different media attributes accomplish the same learning goal… [and] "we need to ask whether there are other media or another set of media attributes that would yield similar learning gains" (Clark, 1994, p. 22). Clark also states that "learning is caused by the instructional method buried in the media" (Clark, 1994, p. 26). For example, teachers can use drilling methods of instruction to obtain the same results as computers. In contrast, Kozma (1994) believes that learners, who "have difficulty providing representations and operations that are sufficient for learning, either because of limited prior knowledge, limitations in working memory or other reasons.., will likely benefit from the use of the capability of a particular medium to provide or model these representations and operations" (p. 13). The "complex relationships among medium, method, and situation should be addressed (Kozma, 1994. P. 17). Other researchers promote a greater "focus… on the attributes of the human learner involved in learning and ultimately the construction of knowledge" (Jonassen, Campbell, and Davidson, 1994, p. 31).

Simonson, Schlosser, and Hanson (1998) provide a summary of several theories of distance education. One framework that is particularly relevant to this study is Holmberg's (1989) theory. Describing the theory, the authors state that "the core of teaching consists of

interaction between the teaching and learning parties" (Simonson, Schlosser and Hansen, 1998, p. 67-68). With technologically delivered education, students interact with pre-produced courses replacing much of the traditional interaction between students and instructors. Emotional involvement, easy access to information, and a friendly tone contribute to learning pleasure and student motivation—which increases learning. Teaching effectiveness is "demonstrated by students' learning of what has been taught" (Simonson, Schlosser and Hansen, 1998, p. 67).

The need to demonstrate effective instruction has become increasingly important and required by accrediting associations, state boards, and legislatures. State legislatures are heightening the focus on assessment through performance funding or linking state appropriations with educational outcomes (Burke, 1998). According to accrediting guidelines, "the institution must provide for assessment and documentation of student achievement in each course" (Lezberg, 1998, p. 31). Required assessment also includes student and faculty satisfaction surveys and retention studies that compare technologically delivered courses with traditional in-class instruction. Peer review of programs now requires committee members with an understanding of technology-based delivery methods (Crow, 1995).

This study examines the effect of delivery method on student academic performance controlling for learner characteristics and student academic preparation. Comparisons are made between television, interactive video, Internet, and in-class lecture courses. The following sections include a literature review, presentation of the methodology, findings, and a discussion of the study implications.

Literature Review

There is currently extensive literature on technologically delivered or distance education. This review describes several studies that compare the effectiveness of technologically delivered courses with in-class lecture methods of instruction. Studies predicting student achievement in technologically delivered courses are also presented followed by research on student and faculty satisfaction. The review concludes with a description of literature that provides guidelines for setting up technologically delivered or distance education courses.

Many studies have been conducted to examine learning outcomes and whether the method of delivery or media impacts student academic performance. Researchers have used both student grades and test scores as measures of student achievement confirming that technologically delivered courses can be as effective as lecture or face-to-face methods of instruction. For example, Smeaton and Keogh (1999) did not find any significant difference in the exam scores for college students enrolled in an undergraduate database course taught through a lecture versus a web-based method of instruction. Prior multimedia experience and usage did not significantly increase student performance on the exams. D'Alessandro and associates (1993) found "no significant statistical difference in instructional effectiveness" between the use of a multi-media text book versus an in-class lecture for a radiology course. Barker (1988) demonstrated that videodisc instruction was just as effective as a lecture demonstration in teaching physical therapy students how to perform a sliding board transfer. Liao (1998) conducted a meta-analysis of thirty-five studies comparing the academic performance of students in computer-based hypermedia courses with the performance of students in lecture courses. Although some studies favored lecture methods of instruction, the authors reported that overall "hypermedia instruction

has moderately positive effects on students' achievement over traditional instruction" (Liao, 1998, p. 352). These positive effects were greater for studies controlling for instructor bias or using the same instructor across courses. Other researchers studying the effectiveness of television courses found no significant difference in the grades or exam scores of students receiving education via television versus on-campus instruction (Los Angeles Community College District, 1974; Luskin and Zigerell, 1978). Satellite-broadcast or televised instruction with live two-way communication has also been shown to be just as effective as traditional classroom instruction (Eiserman and Williams, 1987; McCleary and Egan, 1989; Hudspeth, 1993).

A second area of research focuses on identifying successful students in technologically delivered courses using grades or student persistence. Bink and his associates (1995) provided an excellent review of several studies showing that student characteristics such as age, gender, marital status, occupation, prior credit hours completed, and student perceptions of course difficulty were significantly related to student persistence in televised courses. In their own study, the authors found that students with higher prior grade point averages, more positive "perceptions of the promptness of material delivery", and more college experience had higher grades in telecourses (Bink et al., 1995, p. 17). Fjortoft (1996) reported that "respondents with higher levels of perceived intrinsic benefits of obtaining the degree were more likely to persist in the distance learning post-baccalaureate pharmacy program (p. 57)." There was also a strong correlation between extrinsic and intrinsic benefits. Older students were less likely to persist which contradicted other research studies, and "surprisingly individuals with higher levels of comfort with learning individually were less likely to persist" (Fjortoft, 1996, p. 57). In a study of 2,288 students at the Open University in the United Kingdom, the authors reported "a strong

negative association between reproducing orientation and academic outcome" (Richardson, Morgan and Woodley, 1999, p. 23). Students with poor study habits and low scores on achievement motivation earned low grades. Older students and males earned lower grades than younger students and females. Students with more prior education and those taking mathematics courses had better academic performance.

Another area of research related to Holmberg's concept of learning pleasure is student satisfaction. The underlying assumption is that high student satisfaction contributes to learning or is an indicator that instruction within the classroom is effective. On satisfaction surveys, students may report their frustrations or positive experiences—which can be used to improve course delivery. In a survey conducted by Larson and Bruning (1996), many students in a satellite-broadcast college mathematics course stated that the schedule moved too rapidly or could not be altered to adjust for classes having difficulty with some topics. Students also expressed some difficulty in asking questions. However, students reported that the visual nature of the instruction increased their ability to learn the material. Another survey completed by Tiene (1997), indicated that students at remote sites were less inclined to ask questions, believed that it was more difficult to obtain help from the teacher, and did not have the same level of involvement as students in the class with the instructor. About 60 percent of the students liked the satellite broadcast course as much as regular classes. At another university, staff developing a web-based course in meteorology surveyed students and subject matter experts to improve the course (Phelps and Reynolds, 1999). Feedback included recommendations to improve the readability of text, clarify navigation routes, add more multi-media components, and include summaries at the end of each module. Ngai and Chan (1998) developed a multi-media courseware CD-ROM to teach

dissection techniques and surveyed students regarding their learning experience. The authors reported that "multimedia presentation heightened students' motivation" and reduced the costs of obtaining specimens for dissection (Ngai and Chan 1998, p. 239). Students were pleased with the animation, and the clarity of the demonstration. A web-based task analysis course in the Communication, Education and Training Department at the University of Wisconsin—Stout was also evaluated by their students (Schlough and Bhuripanyo, 1998). About "77 percent indicated they would prefer the classroom" versus the Internet course (Schlough and Bhuripanyo, 1998, p. 1). However, students believed that the delivery method provided convenience, allowed them to work at their own pace, and they appreciated the ability to speak with the instructor on the phone and communicate with each other on the web using postings. Students stated that the course required self-discipline, and some felt isolated. They offered several recommendations for improving the course such as creating a chat room, encouraging small group work, and having mid-term or end-of-term face to face meetings.

Although satisfaction surveys may be used to improve course delivery, several articles published in the literature also provide general guidelines on how to design technologically delivered courses (Ehrmann, 1999; Wolcott, 1996; Christensen and Cowley-Durst, 1998; Calderon-Young, 1999; Daughtry, 1978; Baltzer, 1982; Murphy, Cathcart, and Kodali, 1997; Zvacek, 1991; Olcott, 1997; Zeller, 1995; Moller, 1991). Each delivery method or media has it own advantages and disadvantages. The type of delivery or media may be selected based upon several criteria such as the method that is "(a) most easily implemented, (b) most efficient, and (c) most cost-effective" (Morrison, 1994, p. 43). An institution's ability to expand its market may also be an important consideration.

The teaching methodologies, design of the curriculum, and technical set up of specific media are also discussed in the literature. Several delivery methods or media are described including how to develop and use courseware (Kelly and Anandam, 1978; Brinkley, Pavlechko, and Thompson, 1991; Oblinger, 1997), broadcast television courses (Wiesner, 1987; Hendrick, 1978), establish satellite systems or videoconferencing (Piskurich, 1997; Erhard and Schroeder, 1997;Wynn, 1997; Shaw et al., 1997; Berge, 1999; Watson and Rossett, 1999; Price, 1996; Pool, Blanchard, and Hale, 19995), air audio programs (Takemoto, 1987), construct Internet or web-based courses (Driscoll, 1997; Shaw et al., 1997; Berge, 1999; Watson and Rossett, 1999; Price, 1996; Pool, Blanchard, and Hale, 19995; Whalen and Wright, 1999; Sherry, 1996), implement interactive video programs (Johnson, 1987; teach via email (Koneman, Osman-Jouchoux, and Wilson, 1994), set up multimedia classrooms (Lamb, 1992; Solomon, 1994; Lawless and Brown, 1997), or develop computer conferencing (Collis and Smith, 1997; McIsaac and Ralston, 1997; Bellman, 1992).

Researchers have conducted only a limited number of studies focusing on the effect of course design or teaching methods on student performance in technologically delivered courses. Brush (1997) studied the impact of group composition on student achievement in computer-assisted instruction. Low and high ability students were grouped either homogeneously or heterogeneously with little impact on academic achievement. Schnackenberg and his associates (1998) found that students preferred less practice in a computer delivered teacher preparation program, but academic achievement was greater in the full version that included more practice. In other words, meeting student learning preferences may not always result in greater academic performance.

The literature confirms that technologically delivered courses can be as effective as lecture methods of instruction. Prior research highlights the importance of controlling for student characteristics and academic ability when evaluating academic performance. The majority of studies that have compared technologically delivered courses with lecture methods of instruction have failed to control for student variables. This study contributes to the current literature by controlling for these factors along with using the same instructor for comparisons of in-class and technologically delivered courses. The study provides support that technologically delivered courses are often as effective as traditional methods when controlling for student differences. However, alternative delivery methods can also result in decreased grades as well as increased academic performance for students. The need to use final exam scores, consider course design, teaching methods, and instructor characteristics in future research is also discussed.

Methodology

The present study was conducted to determine whether students in technologically delivered or distance education courses were as successful academically as students in the same courses taught in more traditional classroom settings. The study included 1,567 students enrolled in technologically delivered and lecture courses during the 1999 academic year at Utah Valley State College (UVSC). In fall 1998, there were 18,174 students attending the college. Their average age was 22 years old. About 93 percent were Caucasian, and 46 percent were females. About half of the entering freshmen needed remedial education. The institution is a public college serving a dual role as a community college and offering a limited number of bachelor degrees.

Logistic regression was used in the analysis because the dependent variable, student grade point average, was bimodal and did not satisfy the statistical assumptions for analysis of covariance and multiple regression. The dependent variable was altered to create a dummy variable for use in the logistic regression. Students earning a B or higher in courses were coded with a "1" and students earning less than a B in the course were coded with "0". A grade of a B or higher was used as a measure of student competence because it is believed that this grade indicates that students have learned the material well enough to be competent in the subject and would perform well in more advanced courses in the subject area.

Several control variables were entered in the regression equations. These included academic variables such as student need for remedial English, math, or reading (also dummy varibles, 1 = Yes, 0 = No). A student's cumulative grade point average at the time of the course was not used because the distance learning course was the first course for many of the students in the study. The number of college credit hours completed prior to the course was also included to account for any differences in the level of college experience for students in each class. Other differences among comparison groups were controlled by considering student demographic characteristics. Several dummy variables were used to identify students of color, females, and married students, students full-time at the time of the class, students transferring from other institutions, and those seeking a degree (1 = Yes, 0 = No). A student's age at the time of the course was also entered into the equation.

The same instructor was used for comparisons between students in the traditional courses and technologically delivered courses to reduce the impact of instructor characteristics on the results. Competence was predicted for each course to control for possible effects of the subject

matter. The subject areas evaluated in the study were introductory chemistry, philosophy, health, biology, and mathematics courses. Concurrent enrollment courses were not evaluated. To follow guidelines for correlational research, only courses with at least thirty students were included in the study (Borg and Gall, 1989).

The delivery methods (interactive video, Internet, and television) were entered as dummy variables. The analysis was completed to determine if the delivery method affected student competence in the subject when controlling for several variables to keep the groups equivalent.

The regression coefficients and results of the Wald statistic were presented in the tables. A negative coefficient indicates that a variable may reduce student competence in the subject; whereas, a positive coefficient shows that the variable may increase or is positively associated with student competence. If the Wald statistic resulted in a statistically significant relationship at the .01 or .05 level, it was noted at the right of the coefficient.

In general, the models were good predictors of student competence in classes. About 70 to 74 percent of students in the math and chemistry television courses, computer-assisted English course, and interactive video health course were classified correctly. Nearly 70 percent of students in the other courses were correctly classified. The results for two interactive video philosophy courses and an Internet business management course were not presented because the variables included in the analysis were poor predictors of competence in these subjects.

The Effect of Delivery Method on Academic Performance

The results on student academic performance in television, interactive video, and Internet courses are presented in the following sections and indicate that student academic performance

varies depending on the course, instructor and delivery methods. In several courses, the delivery method didn't matter. In other cases, students in technologically delivered courses earned significantly lower grades, but they also earned significantly higher grades than students in the on-campus section for one course.

Television courses on-campus were pre-taped and broadcast on a public television station channel and several cable channels (Palmer, 1999). The tapes were generally developed for use over at least five years. The large majority of students took a series of exams and quizzes in the testing center on-campus. Some students also took exams supervised by a proctor in libraries at other locations. Quizzes were also completed on the Internet for some courses. Philosophy 2050, Ethics and Values, required submission of three papers and journals. In Math 0990, Introductory Algebra, students with test scores below 80 percent were required to submit homework assignments for specific chapters. Students in all courses were able to contact the teacher for additional help and questions. Courses generally included a grader or an assistant who could provide additional help and answer questions.

With the exception of age, the effect of academic variables, educational commitment and student demographics on student performance were inconsistent (Table 1). Older students were more likely to earn a B or higher in television courses than younger students. The effect of taking the course via television versus on-campus was inconsistent. Students who took Chemistry 1110, Elementary Chemistry, via television performed better than students in the course on-campus. (Note the positive number 1.7674 for Television under Delivery Method). In contrast students completing Philosophy 2050, Ethics and Values or Math 0990, Introductory Algebra, through the televised course performed less well than students in the campus course. There was no significant

difference in performance for students in Math 1050, College Algebra, taking it through television or on-campus.

Table 1
Television Instruction and Student Performance (* p < .05, ** p <. 01)

Variables	Courses							
	Chem 1110 N = 130		Math 1050 N = 87		Phil 2050 N = 430		Math 0990 N = 244	
Delivery Method								
Television	1.7674	**	-.5204		-.38619	**	-1.1833	**
Control Variables								
Academic Variables								
Remedial English	.0016		.3229		-.0627		-1.0992	**
Remedial Math	-.2016		-.2394		-.2284		-.6984	
Remedial Reading	.5290		-.2677		-.4886		-1.0945	
Total Hours Completed	-.0015		.0240		.0136	**	-.0027	
Educational Commitment								
Degree Seeking	-8.7274		5.8283		5.6622		-.3697	
Student Demographics								
Age	.1234	*	.2527	*	.0706	**	.0792	**
Students of Color	.1911		.7670		.2888		.7938	
Female	-.3542		-.5140		.2142		.3528	
Full-Time	-.7782		.3699		-.0684		-.0142	
Married	-.9328		-2.1516	*	.3114		1.0665	*
Transfer Student	-.8153		-1.5937	**	-.7072	**	.1793	
Constant	5.9358		-11.8671		-4.3662		-.4282	

The other courses evaluated in the study were delivered through interactive video and the Internet. The majority of interactive video courses are delivered to on-campus students and high school students for concurrent enrollment credit. In the evening sections, adults also take the courses at the remote sites (Palmer, 1999). The performance of concurrent enrollment students was not evaluated in this study. Several courses on-campus are offered through the web; however, enrollments in the courses were usually small (below 30). Therefore, only one interactive video course and one Internet course were included in the study (Table 2).

In the interactive course Health 1100, Personal Health and Wellness, the instructor teaches the course in a classroom on-campus. The course is delivered to remote sites through telephone lines, microwave, or fiber optic cables (Palmer, 1999). A few students in the course receive instruction at home on their television. The large majority of students can communicate live with the teachers through off-site cameras, monitors, and audio capabilities. Facilitators at the remote sites give exams; while, other students take the exams on-campus.

Biology 1010, General Biology, is an Internet course that is presented primarily with power point presentations. Students complete quizzes through the web-based course and take a final exam in the testing center on-campus. Students have the capability to email responses to questions back to the instructor.

In the regression analysis, the academic preparation of students and student demographics appeared to affect student competency; but, it is uncertain whether these effects would be consistent for several courses. Students in the interactive health courses did not perform as well as students in the same course in the home room. (Note the negative number -.6899 for

Interactive Video under Delivery Method). In contrast, students in the web-based course were significantly more likely to earn a B or higher in the course than students on-campus.

Table 2
Interactive Video/Internet Courses and Student Performance (* p < .05, ** p <. 01)

Variables	Courses	
	Hlth 1100 N = 438	Biol 1010 N = 238
	Delivery Method	
Internet Course	--	.7573 *
Interactive Video	-.6899 **	--
	Control Variables	
Academic Variables		
Remedial English	-1.1237 **	-1.1661 **
Remedial Math	.8332 **	-.5651
Remedial Reading	-1.6263 **	.1917
Total Hours Completed	.0029	.0069
Educational Commitment		
Degree Seeking	-.5125	-7.5611
Student Demographics		
Age	.1073 **	-.0496
Students of Color	-2.0182 **	-.4969
Female	1.4221 **	.7811 *
Full-Time	-.5502 *	.7930 *
Married	.4205	.2391
Transfer Student	-.0696	.1729
Constant	-1.0809	7.5079

Study Implications

The published research generally shows no difference in learning outcomes for students taking courses via technology, distance education or through traditional lecture methods. This research shows that learning outcomes may vary, depending on the course or instructor. Most of the comparative research has not controlled for the academic preparation of students, their college experience, commitment to earning a degree, and other student characteristics that may produce differences in learning outcomes. These variables should also be controlled because the traditional and technologically delivered courses that are compared may have a different composition of students. For example, students in some classes may be less prepared for their college experience than students in the other classes resulting in lower academic performance. However, these variables had inconsistent effects across courses.

The inconsistent effects of delivery method or media may be due to several factors. Teachers may use different teaching methodologies, have a varied curriculum, and alternative course designs that produce different effects. Teachers may have strengths or skills and abilities in certain areas that affect outcomes. Future research needs to account for these variables to understand their impact on student learning in these courses. The results may help colleges identify more effective ways to design and teach technologically delivered or distance education courses.

One way to study these effects would be to introduce specific changes in the course and then re-examine student performance keeping the instructor constant. There would be two primary benefits to this research: (1) Faculty may improve their teaching effectiveness, and (2) It

would provide opportunities for faculty to publish research. There is also an extensive literature published on alternative ways to design technologically delivered courses, which would provide ideas for improving student performance in courses.

In ongoing research, standardized exams should be used because of the subjectivity of grading. Students might show improvement in their performance because instructors altered their grading practices. In other words, the increased performance for students would not be due to the changes in course design. This confounding influence was controlled in the present study because instructors were not informed of the research.

Grades in courses are also a relatively subjective measure of student academic performance. The use of a dummy variable as a measure of competence reduces this problem by creating a dependent variable that does not discriminate between students in such a detailed manner and creates a rough indicator of competence. However, the use of grades is still problematic for several reasons. Teachers may grade on the curve in each course separately, artificially creating no significant difference in student performance because the average grades in the courses are the same. Instructors on campus also reported altering grades for classes based on an absolute scale. For example, an instructor stated that if he had a section with students who did not perform well, he would sometimes adjust the absolute scale to give the highest performers an A and so on.

The assignments, curricula, and grading policies were not always equivalent for technologically delivered courses and the traditional on-campus courses. One instructor only graded students using exams in televised courses; whereas, students in the on-campus sections also received grades for assignments, class participation, and attendance. Students who

experience test anxiety can make up for lower grades on exams by putting in additional effort on assignments, papers, regularly attending and participating in class lectures, or completing extra credit assignments.

Exam scores could not be used in the current study for several reasons. In the large majority of cases, instructors did not use the same exams across courses. Exams were similar in some instances, but not exactly the same. Tests were developed for television courses and kept consistent over the years to make the courses cost effective. As the field of study changed and new knowledge was generated, instructors would incorporate new topics into their lectures and adjust course content in the on-campus courses. They would then modify their exams, creating inconsistencies between the exams for technologically delivered courses and those taught through traditional face-to-face instruction. Teachers also did not save the exams and only had final scores.

One implication of these findings is that the on-campus courses may be more up to date in some cases. The ability to easily update the technologically delivered course may be an important consideration in selecting the medium.

The need to show that technologically delivered or distance education courses are as effective as lecture methods of instruction is not the most important research question. Research shows that technologically delivered courses can be effective in teaching students. The way to maximize the potential of a particular medium or delivery method seems to be the more relevant question. Market and cost considerations may then be used to select the way in which a particular course is delivered. Technologically delivered or distance education will continue to

transform the educational system and enhance the learning process. We need to learn how to use it efficiently and effectively.

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