Is Technology a One-Size-Fits-All Solution to Improving Student Performance? A Comparison of Online, Hybrid and Face-to-Face Courses

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ABSTRACT
This study examines the effects of a technology-intensive course design on students’ final grades in a criminology program at an upper-division university in the southwest. Ordinary least squares (OLS) regression analyses indicated that the presence of a technology-intensive curriculum alone did not significantly improve student performance. However, interaction effects revealed that the technology-based curriculum enhanced student learning for online students compared to those in hybrid and (FTF) courses although students completed fewer technology projects in online sections. These findings reveal barriers to teaching with technology that are not overcome through the use of systematic training for instructors and students. The study further reveals that adult and traditional learners do not significantly differ in learning when exposed to a technology-intensive curriculum or mode of course delivery.

KEYWORDS
technology, online learning, course delivery mode, adult learner

The infusion of technology and technology-based services in higher education is commonly thought to have revolutionized the learning process and provided institutions with an efficient alternative to traditional instructional methods (Perez-Pena, 2012). When used strategically, technology has the capability of increasing student participation and cognitive ability to comprehend complex topics (Wu & Wang, 2005). Previous research has also shown that technology is highly adaptive to different instructional formats, such as with blended and online courses (Banerjee 2011; Wu, Tennyson, & Hsia 2010), and that students typically are more “satisfied” with courses that have a robust technological component (Dietz, 2002).

Although some have cited many benefits to technology in the classroom, such as using asynchronous discussion threads to enhance collaboration (Valentine, 2001), others have indicated that technology represents a “non-significant gesture that elicits an unconscious and positive response from its recipients” (Kroeber, 2005, p. 295). However, much of this research does not adequately account for differences in student aptitude, instructor performance, and mode of course delivery.

In addition to the rapid growth experienced in online courses nationwide, college enrollment data indicates that enrollment trends for adult learners have outpaced those of “traditional
students” (National Center for Education Statistics [NCES], 2012). At present, slightly more than one third of the student population is over the age of 25; however, in the next six years that figure is expected to increase by more than 20% (Jenkins, 2012). Despite the increase in the “nontraditional” student population nationwide, no known studies have explored how the use of technology affects their academic performance.

Given the popularity of technology-driven pedagogies and application across different course modalities, there is some question whether such methods positively influence student learning outcomes. This study uses a multiple-group quasi-experimental design to measure the effects of a technology-intensive course structure and mode of course delivery on student performance. Most research involving the use of technology has focused on differences between online and face-to-face (FTF) modes of instruction and tools associated with different learning management systems. To this date, few studies examined how the use of technology-based resources external to these systems may affect the learning experience for students in the social sciences.

**LITERATURE REVIEW**

**Who Is an Adult Learner?**

Adult learners are defined as being older, and “returning to college after significant full-time experience in the workforce or in the military” (Quick, 2012, p. 230). In contrast to the younger student population, a significant number of these students remain employed full-time while enrolled in school. The normal life trajectory—education, work, retirement, has become increasingly uncommon for students—a result of rapid social, economic, and cultural changes that present them with unique challenges.

As the number of adult learners proliferates on college campuses, academicians and administrators must remain cognizant of the ways their learning processes differ from traditional students. Given the vast array of technology-based tools available, faculty must integrate technology in a way that optimizes student performance. Indeed, the social and personal transformation of adult learners is largely tied to the different pedagogies that are used to enhance their ways of learning (Merriam & Caffarella, 1999).

**Indicators of Student Learning**

There is some debate as to what measures are the most reliable and valid indicators of student learning (Suskie, 2004). Although multiple measures of successful learning exist, research shows that course grades are the most common metrics due to their ease of accessibility and standardization across similar courses (Driscoll, Jicha, Hunt, Tichavsky, & Thompson, 2012; Urtel, 2008). Importantly, some research has examined indirect measures of student learning such as quality of instructor and student interaction (Schulte, 2004). Bergstrand and Savage’s (2013) study of 118 sociology course sections found that instructors who excelled in teaching face-to-face (FTF) courses were perceived as less effective in online sections, and vice versa. The authors concluded that course modality plays an important role in creating an interactive classroom environment and that certain instructors may be better qualified to teach online or FTF sections. Therefore, measuring the efficacy of specific pedagogies across different course modalities may be best achieved by using designs that control for differences in student-instructor interaction but focus on course grades as ultimate measures of performance.

**Technology: Mode of Instruction**

Online courses, defined as “asynchronous computer-mediated courses” (Schultz, 2004, p. 6), involve no live classroom instruction and typically rely on learning management systems (LMSs) for delivering course content. Faculty may incorporate into the online environment a variety of exercises that to some degree are intended to mimic real-time methods of class instruction. In addition, blended or “hybrid” courses offer some combination of online and FTF interaction between the instructor and student. Both online and hybrid courses are becoming increasingly popular due to their...
flexibility and appeal to universities as a means of increasing enrollment (Park, Boman, Care, Edwards, & Perry, 2008). However, a common concern among faculty is that technology may be used inappropriately given differences in student proficiency with technological tools as well as the types of course delivery modes available.

The vast majority of prior studies have focused on the use of technology as a mode of instruction (i.e., online, hybrid, or FTF) rather than a pedagogical tool. Research examining the effects of mode of course delivery on indirect measures of student learning has produced mixed results. Bergstrand and Savage (2013) compared differences in student ratings of instruction for those enrolled in online and FTF courses and found that students perceived online instructors as less effective, viewed them as less respectful than FTF teachers, and reported that they do not learn as much in online classes (pp. 302–303). The authors attributed these findings largely to the lack of interaction between the instructor and student, which “may also make it difficult for instructors to deliver negative criticism or feedback in a supportive manner, as instructors are unable to soften criticism with facial or vocal expressions” (p. 303). The study concluded that the quality of online instruction likely depends on the instructor teaching the course, because some instructors excel in the classroom versus online.

Research has thoroughly documented the benefits of using technology as a mode of instruction. Using a national sample of 113,500 undergraduates who were enrolled during 2007–2008, Pontes and Pontes (2012) found that adult learners enrolled in online courses were significantly less likely to have an enrollment gap than those who enrolled only in FTF classes. More to the point, the study found that 54.2% of nontraditional students did not remain enrolled for the entire year, whereas traditional students were more likely to stay enrolled.

Previous studies have shown a strong correlation between GPA and retention of adult learners (Farabaugh-Dorkins, 1991). Adult learners who earn good grades during their first semester returning to school are thus more likely to complete their degree than those who do not do as well. This finding underscores the importance of creating positive experiences for those returning to school and acclimating themselves to the university culture. Further, selecting the technology that best complements the content is also a critical issue facing faculty and may have profound implications for student learning and retention.

Technology as an Instructional Tool

The use of media, software, and Web-based resources are valuable resources to instructors looking for ways to integrate course content with technology. Such tools are now more available through publishers, universities, and private as well as government websites than ever before, resulting in more integration within the classroom and less reliance on traditional methods of content delivery. Although technological tools have proliferated in recent years, many instructors in colleges and universities believe that traditional methods such as lecturing are more effective in delivering content to students. Research on the effectiveness of technology to teach content areas is not well documented in the literature and has produced mixed findings.

Prior studies suggest that the proper balance of technology can enhance students’ ability to analyze and interpret data, model construction and testing, and foster collaboration (Dani & Koenig, 2008). As distinguished from mode of delivery, the use of technological tools to teach across disciplines is becoming more popular in colleges and universities. For example, simulations, a specific form of computer modeling, may facilitate learning by providing visualization opportunities that may not be possible in actual fieldwork (van Joolingen, de Jong, & Dimitrakopoulou, 2007). Research suggests that when appropriately integrated with content, these technologies are at least as effective as traditional methods in promoting student learning, achievement gains in science, and supporting students’ understanding of abstract and complex concepts (Scalise et al., 2011; Trundle & Bell, 2010).
Benson et al. (2002) contend that technology has become a central component to the educational process; therefore, future pedagogical research should focus on the efficacy of technological tools to teach content areas. Observing this call, Pearson (2010) explored the efficacy of online blogs as a means of increasing student collaboration, participation, and writing proficiency. Her results indicated that 91% of students supported the continued use of blogs. One key theme emerging from her study was that the online component provided a “safe space” for public discourse not present in FTF courses (Pearson, 2010, p. 212). For students returning to college, the anonymity associated with the online environment may provide an important means of facilitating creativity and interaction among peers. The result of the free exchange of ideas has indeed been shown to increase perceptions of learning in the virtual environment (Rovai & Barnum, 2003).

There is also some debate as to whether technology-driven pedagogies are more effective in enhancing critical thinking and problem-solving skills (Cheong & Cheung, 2008). Ammarell (2000) found that over two thirds of students who used an online news network viewed it as either “very or extremely effective” in getting them to think more critically about course topics. Saleh, Asi, and Hamed (2013) reached a similar conclusion in their study. They reported that 78% of the students favored the use of case studies in an online course, compared to 50% taking the course FTF with the instructor. FTF students who found the case studies less effective reported not having enough time to complete the assignment or that group members often did not contribute equally to the assignment. These studies suggest that student learning is tied to the design of the intervention and the effectiveness of the instructor in blending technology with course content.

It is possible that technology may be more useful for certain types of students. Adult learners are more likely to have dependent children than traditional students, so they quite possibly have some additional time constraints that would prevent them from becoming proficient with technology-based instructional tools. This problem may be compounded when using more sophisticated forms of technology. For example, some students may benefit from FTF interaction with faculty when learning how to use statistical or other advanced data analysis tools.

Prior research shows that the key strategy to teaching effectively with technology is matching the technology with the course content and the mode of course delivery, and not the content with the technology (Bennett & Green, 2001). Including abundant sources of media may stifle the learning process and have distinct consequences for students less familiar with the virtual world. Conversely, projects that require some basic knowledge of the steps involved and that can easily be performed with different operating systems and software with fewer technical barriers are more likely to enhance learning for a broader population of students. Previous research suggests that perceived usefulness and perceived ease of use are factors likely to affect technology adoption (Davis, 1993). Courses that consist of front-loading strategies that include announcements and explanations about unique aspects of the course can ameliorate student anxieties associated with learning new instructional tools. For instance, training videos that show students how to navigate various technology-related tools may help increase perceived usefulness, resulting in a more universally designed course.

Hypotheses

This study assesses the effect of a technology-intensive course design on student performance and whether outcomes differ based on the type of course modality used (FTF, hybrid, or fully online). Given the lack of existing research on this topic to date, the study hypothesizes the following:

H1: There will be no significant difference in students’ final grades in technology-intensive courses compared to non-technology intensive courses, net of control variables.
H2: There will be no significant difference in students’ final grades across different course structures that are designated technology-intensive, net of control variables.

H3: There will be no significant difference in students’ final grades for adult and traditional learners, net of control variables.

**METHODS**

**Course Design**

This study took place at an upper-division undergraduate (junior and senior) and graduate institution in south-central Texas. During the spring 2013 semester, three faculty members received training on how to use the technological resources for the experimental groups in this study. To test the effect of technology use on student performance, a sequence of three technology-based assignments were staggered throughout the course. The assignments consisted of a video presentation, a concept mapping assignment, and a crime analysis project. The faculty members were selected based on the type of courses taught and the feasibility of implementing a technology-based component in online, hybrid, or FTF courses. Each faculty member taught two sections of the same course, one designated as the experimental (technology-intensive course) and the other as the control group. Course requirements, exams, and grades were weighted identically for all components in the pair of courses. One faculty member taught two sections of a hybrid course on Victimology; another instructor taught two sections of Corrections online, and a third was the instructor in two FTF sections of Gangs and Gang Behavior, for a total of six sections. This design allowed instructor characteristics such as teaching style to remain relatively constant in both sections of the same course except for the intervention component. Therefore, the additive effects of the variation in teaching style across all modalities would be relatively similar when comparing the technology-intensive sections to control sections. The sample consisted of all students who completed each course (N = 244). Figure 1 illustrates the quasi-experimental design incorporating different instructors for each set of courses.

**FIGURE 1**

Quasi-Experimental Study Design

```plaintext
Hybrid Faculty

Online Faculty

FTF Faculty

Tech-intensive
n = 59

Control
n = 60

Tech-intensive
n = 34

Control
n = 26

Tech-intensive
n = 35

Control
n = 26
```
The sequence of technology-intensive projects was as follows: (a) video presentation, (b) concept mapping project, and (c) crime analysis project. In collaboration with the university’s distance education coordinator, the author developed a series of videos that were used by each instructor (either in-class or through the LMS) to serve as resources for the faculty and demonstrate to students how each tool should be used.

Providing training videos to students illustrating the functionality of the technological tools and example exercises established some consistency in the explanation of the material to the instructors and across course sections. Students in the experimental sections were given guidelines that included uploading their video as a “private” link on YouTube or posting on Blackboard, which is the university’s designated learning management system. By uploading their video in one of these two mediums, students were able to access the link and view an audible response as opposed to a text-based response, which was the alternative designated in the control section of each course.

For the concept mapping project, students learned how to use and apply concept mapping to a topic related to their choice of one of two assigned readings. Concept maps provide a tool for demonstrating how particular components of a process, or findings from a study, can be visually displayed and organized. In this case, the university library purchased Edraw, a type of Microsoft software for graphic design. Students selected a topic and mapped the concepts visually by using the software and provided substantive explanations explaining how the concepts were related. For example, in one course students were given an article on intimate partner violence to critique with concept mapping, which included an illustration of the cycle of violence and quantitative results from a study illustrating the prevalence of repeated victimization in a sample of victims of abuse. In the alternative non-technology section, students were required to write a short paper (3–4 pages) critiquing the findings of an empirical study and relating them to information that was covered in the lecture and discussion preceding the project.

The final and most intensive technology project consisted of an exercise in crime rate analysis. For this project, students were required to select some crime type and construct a series of charts reflecting crime data on their topic. Students were allowed to draw on data from the state’s Department of Public Safety website or the Bureau of Justice Statistics (BJS) website as sources for this project.1 Using the available drop-down menus available on the BJS site, students constructed Microsoft Excel tables and graphs illustrating comparisons of crime rates between jurisdictions or trends in crime. For each graph, students were required to select an analytical question that could be answered using the data for each graph and then provide a response that was consistent with the data depicted in the chart. For the alternate control project, students were required to write an analytical paper (8–10 pages) on crime rate trends and comparisons of crime rates in at least three jurisdictions.

By using the methods described earlier, we were able to make the technology-intensive sections and the control sections sufficiently distinct but not overwhelming to students. In this way, the technology-intensive course sections contained content that was sufficiently distinct from the control sections. This design provided three pairs of courses, so that each instructor taught one pair of courses in either FTF, hybrid, or online. This design allowed for differences in instructor interaction and style to be comparable across course sections.

Measures
This research was approved by the university’s Institutional Review Board (IRB No. 2012-49). The data for this project came from the faculty member’s records for each student (final course grades and assignments completed) as well as the university’s records (student GPA, gender, and age).

Student performance was measured by using final course averages, as determined by a combination of weighted scores on unit exams, the final exam, and course assignments. Exams consisted primarily of multiple choice questions, and approximately 10–20% of the grade for
each exam consisted of essay and short answer questions. Course assignments in the non-intensive technology section consisted of a mixture of article critiques, case studies, and analytical exercises requiring students to apply theoretical concepts to current events. Technology-intensive exercises comprised 25% of the overall course grade for each of the experimental courses.

The NCES defines an adult learner as an individual over the age of 24 (NCES, 2013). Thus, this variable was measured both as a continuous variable and dichotomously. To account for differences among student aptitude, we controlled for the student’s grade point average as reflected on a scale of 0 (lowest) to 4 (highest) as well as the number of credit hours completed by the student as of the end of the spring semester. To control for differences in academic workload, we included the number of credit hours attempted for the semester by each student. As a final measure of student motivation, we controlled for the number of technology-intensive assignments that each student completed, because those who completed more assignments likely would earn higher grades in the course. Finally, we controlled for the gender of each student.

### Analysis

Ordinary least squares (OLS) regression was used to measure whether technology-intensive courses, mode of course delivery (online, hybrid, or FTF), and adult learner status affected final course grades, net of control variables. The basic strategy entailed introducing the variables sequentially (see Driscoll et al., 2012) to determine how the modeling process affected our independent measures.

### TABLE 1.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Online (n = 119)</th>
<th>Hybrid (n = 60)</th>
<th>Face-to-Face (n = 65)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Student GPA*</td>
<td>1.82/4</td>
<td>2.95</td>
<td>.48</td>
</tr>
<tr>
<td>Hours Enrolled**</td>
<td>3/21</td>
<td>9.85</td>
<td>3.41</td>
</tr>
<tr>
<td>Hours Completed</td>
<td>12/165</td>
<td>101.67</td>
<td>22.41</td>
</tr>
<tr>
<td>Assignments Completed**</td>
<td>0/3</td>
<td>2.08</td>
<td>.99</td>
</tr>
<tr>
<td>Required Course</td>
<td>0/1</td>
<td>.47</td>
<td>.50</td>
</tr>
<tr>
<td>Age</td>
<td>18/59</td>
<td>32.50</td>
<td>9.19</td>
</tr>
<tr>
<td>Gender</td>
<td>0/1</td>
<td>.28</td>
<td>.45</td>
</tr>
<tr>
<td>Course Grade</td>
<td>0/4</td>
<td>2.92</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Note. An ANOVA was used to test for differences in the equality of means across course type.

*p < .05. **p < .001, using a two-tailed t-test.
RESULTS
Table 1 reflects the descriptive statistics for the variables in the analysis. Contrary to what was expected, students enrolled in FTF courses had significantly lower GPAs compared to those in online and hybrid courses. Students in online courses were also enrolled in significantly fewer semester hours compared to the other groups, although no significant univariate differences were found between groups on the number of total hours completed. Surprisingly, students enrolled in online courses completed significantly fewer technology assignments compared to those enrolled in hybrid or FTF courses, suggesting that instruction was less effective when no FTF contact took place between the instructor and student. Student age and gender also did not significantly vary across groups. For the dependent variable course grade, the univariate results revealed that the average grade for students enrolled in FTF courses was significantly lower compared to those in the other two groups. These preliminary findings are at odds with previous research that shows students in FTF courses do significantly better than those in online courses (Urtel, 2008).

Table 2 reports the findings from the first series of multivariate models measuring student performance according to differences in curriculum design (technology-intensive or not). In this analysis, all sections of FTF, hybrid, and online sections are combined to test the additive effects on students’ final grades. Models 1 through 4 show the incremental effects of the independent measures relative to the curriculum design. Model 1 indicates that students enrolled in the technology sections did not perform significantly better than the students in the control sections. Moreover, this result remained constant across models 2 through 4, which included the incremental introduction of academic and demographic factors. These results confirm the null hypothesis that students do not perform significantly better in technology-intensive courses relative to non-intensive courses.

<table>
<thead>
<tr>
<th>Independent and Control Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course type (0 = control)</td>
<td>.06 (3.04)</td>
<td>.05 (2.51)</td>
<td>.04 (2.49)</td>
<td>.04 (2.51)</td>
</tr>
<tr>
<td>Student GPA</td>
<td></td>
<td>.57 (2.70)</td>
<td>.55 (2.72)</td>
<td>.55 (2.73)</td>
</tr>
<tr>
<td>Hours enrolled</td>
<td></td>
<td>–.01 (.37)</td>
<td>–.02 (.38)</td>
<td></td>
</tr>
<tr>
<td>Hours completed</td>
<td></td>
<td></td>
<td>.15* (.05)*</td>
<td>.16** (.05)</td>
</tr>
<tr>
<td>Required course</td>
<td></td>
<td>.05 (2.98)</td>
<td></td>
<td>.04 (3.00)</td>
</tr>
<tr>
<td>Age (over 24 = 1)</td>
<td></td>
<td></td>
<td></td>
<td>–.03 (3.05)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>–.02 (2.75)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>.00</td>
<td>.32</td>
<td>.33</td>
<td>.33</td>
</tr>
</tbody>
</table>

Notes. Standardized beta coefficients reported with standard errors in parentheses.

* $p < .05$; ** $p < .01$.
Consistent with the univariate results and supporting the claim that past success predicts future success, those who had higher GPAs and completed more semester hours tended to have higher overall semester grades. The standardized beta coefficient (.55) shows that the student’s GPA is the most powerful predictor of student success, followed by the number of hours completed (.15). In comparing the results for models 2 through 4, it is clear that although both variables represent student success, the goodness-of-fit measures change very little when differences for hours enrolled, student age, and gender are accounted for.

Table 3 presents the results of the OLS regression models exploring the relationship between modes of course delivery and the effect of the technology-intensive course design. An additional variable was added to explore the relationship between completion of the technology assignments and student learning. However, no similar variable was included in the model for the nontechnology sections. Moreover, only the significant variables are shown in this analysis.

Contrary to the null hypothesis, the results revealed that when controlling for the number of technology assignments completed, students enrolled in online, technology-intensive courses performed significantly better than did their counterparts in hybrid or FTF courses. However, no significant differences in student grades were found for students enrolled in online, hybrid, and FTF courses that were designated as non-technology intensive. Although these models are not directly comparable, the results reveal that course mode plays a significant role in how successfully students master course content.

The last hypothesis predicted that final grades would not significantly differ from adult and traditional learners, as defined by those over the age of 24. Descriptive results indicated that roughly 77% of the sample were adult learners (n = 189). Further, the multivariate results indicate that these groups do not significantly differ in their academic performance. And as indicated by the descriptive results, adult learners do not significantly differ from traditional learners in terms of the type of course they enroll in (online, hybrid, or FTF). These findings held true regardless of the approach taken to measure age (dichotomous or continuous variable).
DISCUSSION
This research examined the effects of a technology-intensive course design and mode of course delivery (online, hybrid, or FTF) on overall student performance. It also evaluated differences in achievement for adult and traditional learners and investigated whether any variation in outcomes may be related to the presence of a technology-intensive curriculum. Using a matching strategy pairing, like courses and instructors, the independent effect of the technology-intensive curriculum was tested across different modes of delivery while controlling for important contextual variables that presumably affect student performance.

Consistent with previous research (Clark-Ibáñez & Scott, 2008), the results of this study showed that a technology-intensive curriculum alone had no appreciable effect on students’ final grades. When outcomes for technology-intensive and control sections were compared, there were no significant differences across FTF, online, and hybrid courses. The finding that students performed similarly in these contexts suggests that an intensive technology component does not significantly affect student learning. Thus additional efforts to incorporate more “bells and whistles” without considering differences in mode of delivery may be a drain on existing resources.

However, the results show that when technology is integrated with an online course structure, student performance significantly improves. This improvement may occur because students who are more technologically inclined tend to enroll in online courses rather than hybrid or FTF courses. To further explore this question, program “dosage” was included as a separate variable in the online sections to assess differences in the number of technology assignments completed by each student. Although univariate results showed that students enrolled in online classes completed significantly fewer technology assignments compared to hybrid and FTF courses, multivariate results indicated that overall student performance was superior.

Indeed, program dosage had the largest effect in the technology-intensive model, but the effect of having taught the course online had an independent and positive effect on the outcome of interest.

These findings suggest that the sequential introduction of technology-based projects has a positive effect on student learning in online courses. Further, it is intuitive that students who complete more course requirements will perform better, but these findings suggest that an additional positive effect is related to a technology-intensive curriculum. It is important also to note that the technology projects accounted for 25% of the overall course grade for each course; thus, it does not appear that the low completion rate of technology projects in online courses was a significant impediment to overall performance relative to hybrid and FTF courses.

Consistent with prior research (Driscoll et al., 2012), measures of past academic success (student GPA and total hours completed) were significant predictors of students’ final grades. This result held true in both sets of analysis. When comparing the effects of the technology-intensive course design across all modes of delivery (FTF, hybrid, online), student GPA had the largest effect on the outcome variable. This finding was consistent and stable, even when controlling for the number of semester hours enrolled and completed over the course of the student’s academic career.

Despite the positive effects associated with using technology, these results also suggest that students encountered barriers to completing the intensive projects. This finding may be a result of several factors. Some studies have shown that students in FTF courses tend to ask more technical questions than do students in online courses, possibly as a result of their opportunity to discuss the information in “real time” (Summers et al., 2005). Although the study included training videos for students on how to use the data analysis tools, this resource
alone did not appear to have a consistent effect across all course formats. The lack of interaction between students and instructors, particularly with respect to the technology-based projects, was likely a salient factor affecting completion rates. Future research should explore how student perceptions of interaction differ across course modalities and how the use of different pedagogies affects these perceptions.

To this date, few studies have examined the ways that adult and traditional learners benefit from technology as an instructional tool. Whereas past research has indicated significant improvements in retention for adult learners enrolled in online courses, no research has examined how they benefit from the use of technology as a form of pedagogy. The results from this study show that a technology-intensive curriculum does not significantly affect learners classified as adult or traditional. This finding suggests that additional measures to alter content delivery for adult and traditional learners or attempts to ascertain how these students may benefit with respect to technology may have no meaningful impact on their learning success.

This study expands on previous research by exploring the efficacy of technology-based exercises when integrated across different course modalities. The finding that the technology-intensive curriculum resulted in better outcomes for students taking courses online underscores the importance of gauging student learning styles as they relate to using technology, particularly when courses are taught online. In reality, students who are more successful in online courses may naturally favor technology over traditional methods of instruction, and as a result, they achieve better outcomes. This finding is at odds with prior research concluding that students who prefer online sections are less successful than those who do not (Olson, 2002).

The current analysis also highlights the potential and versatility of technology-based instructional tools that can be integrated into most learning management systems, allowing faculty the flexibility to tailor technology to specific assignments and course goals. And whereas previous research has focused on differences in outcomes when comparing traditional exercises such as discussion forums and blogs (Pearson, 2010), this study takes our understanding of the efficacy of technology a step further by examining the impact of a series of innovative technology-based exercises on student performance. The possibilities with respect to the use of technology across different course mediums are quite diverse, which highlights the importance of connecting the tools, content, and student populations so that optimal results may be achieved.

Although this inquiry highlights important issues relating to teaching with technology, it has some limitations. The sample size used in this study was sufficient to detect significant effects, but it is possible that studies using larger samples and a larger range of instructors may yield different outcomes. However, it is important to note the substantive importance of the findings given the limited sample size. For instance, although GPA and online mode were both statistically significant in the model exploring interaction effects, previous GPA exerted roughly twice the impact on student grades.

Efforts to effectively model the learning process and control for relevant contextual variables present challenges for scholars attempting to disentangle the effects of different pedagogies on student learning outcomes. Instructor performance is likely a pivotal factor affecting student learning in addition to the pedagogy used; however, this study did not account for variation in aptitude. Using student ratings of instruction, Bergstrand and Savage (2013) recently found that students were less satisfied with online courses than with FTF courses. Future efforts to ascertain the effects of teaching with technology should include measures of instructor performance along with student GPA, to further explore how these factors are
associated with student learning. The findings from this study represent a first step toward understanding the role of technology and its integration with different modes of course delivery on student learning.

There is also some question whether overall course grades are adequate measures of student learning, particularly as it relates to the use of specific pedagogies. More proximate measures of learning that measure independent effects relative to total effects could potentially yield more robust results. Methods such as student ratings of instruction, performance on specific assignments and exams, and peer evaluations have been used to model the construct of learning. However, the use of student grades is consistent with standardized methods of assessment (Suskie, 2004), thus making the results more generalizable than they would be if more indirect measures of student performance had been used. Significant to this study is not so much the method of assessment of student learning but the magnitude of the difference in results across course modalities and pedagogies.

Despite these limitations, this study expands on previous research in important ways. In the study conducted by Driscoll et al. (2012), the university had a policy that prohibited students with a low GPA from enrolling in FTF courses. The results of that research indicated that when differences for prior GPA were accounted for, the effect of course type (online or FTF) disappeared. In this study, no such policy existed. This finding underscores the importance of controlling for contextual variables that likely have some influence on academic performance. In addition, this study improves on prior research by including multiple instructors and comparing identical courses taught in the same semester (other than the presence or absence of the technology component) to measure performance outcomes. By administering the project in this fashion, any differences in instructor performance with respect to teaching with technology could be held relatively constant across course sections. Finally, this study measured the effect of technology as an instructional tool when integrated with different course formats. Understanding the limits and benefits to using technology in different course formats has important implications for faculty, particularly as distance education courses become more popular and integrated into the culture of higher education.

NOTE

1 Reported crime data (UCR and NVCS) may be extracted from the BJS website at http://bjs.gov/index.cfm?ty=daa

REFERENCES


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