Web-based versus classroom-based instruction: an empirical comparison of student performance

Evelyn H. Thrasher
Western Kentucky University

Phillip D. Coleman
Western Kentucky University

J. Kirk Atkinson
Western Kentucky University

ABSTRACT

Higher education expenditures are being increasingly targeted toward distance learning, with a large portion focused specifically on web-based instruction (WBI). WBI and classroom-based instruction (CBI) tend to offer students diverse options for their education. Thus, it is imperative that colleges and universities have ample, accurate information to help determine the extent and nature of WBI offerings that best fit with the strategy and mission of the institution. In an effort to contribute to the body of knowledge on WBI, this study compares student performance between CBI and WBI, specifically with regard to the learning of procedural knowledge. The study hypothesizes that WBI will be more effective that CBI in this context and tests this hypothesis using t-tests to compare the means on ten spreadsheet projects. The results provide only minimal support for the hypothesis; yet, the results also indicate some interesting anomalies that warrant further discussion and research.

Keywords: Web-based Instruction, Online Learning, Business Education, Pedagogy, Empirical Research

INTRODUCTION

Higher education expenditures are increasingly being targeted toward distance learning, and a large portion of these expenditures are focused specifically on Web-based instruction (WBI) (Koch, 2006; Lam, 2009). WBI is defined as a "hypermedia-based instructional program, which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported" (Khan, 1997, p.6). WBI is dynamic in nature and, therefore, enables the sharing and updating of information almost instantaneously (Rosenberg, 2001). The ability of the Internet to make learning possible regardless of geographic location or time of day has made WBI a very attractive recruiting and retention tool for colleges and universities worldwide (Williams, 2008). Yet, empirical evidence to support the increased emphasis on, and investment in, WBI is sparse and somewhat inconclusive. A number of schools have fallen into the trap of WBI implementation because "everyone else is doing it", and yet these same schools have failed to identify if, or how, WBI supports the school's mission and strategy (Iverson, Colky, & Cyboran, 2005; Sitzmann, Kraiger, Stewart, & Wisher, 2006). WBI and classroom-based instruction (CBI) offer students very diverse options for their education. Therefore, it is critical that colleges and universities have ample, accurate information to help determine the extent and nature of WBI offerings that best fit with the strategy and mission of the institution. To that end, it is important to use metrics such as student learning, reduced cost, user satisfaction, and other similar metrics to assess the value achieved through the use of WBI (Koch, 2006). This study focuses on student performance as a proxy for student learning and compares the results between traditional classroom students and online students. Using a sample of business students in a large southern university, data were gathered on student performance for a series of spreadsheet projects in an introductory information systems course. The data were compared between WBI and CBI students to determine if WBI is at least, equally effective.

LITERATURE REVIEW

Clark (1983, 1994) stated that the delivery medium does not play a significant role for improving learning outcomes. Instead, he suggested that the methods of instruction chosen (e.g., lecture, course materials, assignments) and the individual differences among students would more readily impact learning. Clark (1994) argued that no real value in terms of learning outcomes was to be gained from merely the implementation of WBI. On the other hand, researchers (e.g. Goldstein & Ford, 2002; Sitzmann et al., 2006; Welsh, Wanberg, Brown, & Simmering, 2003) have suggested that the advantages of WBI for schools and faculty will also translate into performance improvements for the students, if the students are adequately ready for WBI (Blankenship & Atkinson, 2010). Flexibility, an increased number of learning modes, and anytime, anywhere access should improve instructional effectiveness resulting in better student performance (Sitzmann et al., 2006). Interestingly, of those studies conducted on the performance benefits of online instruction (Iverson et al., 2005; Saba, 2000), most have tended to support Clark's (1983, 1994) arguments and have not shown WBI to be significantly superior to CBI.

Welsh et al. (2003) noted that the benefits of online instruction may be outweighed by the disadvantages, such as the lack of peer interaction and less dynamic modes of instruction. Others have argued that WBI versus CBI effectiveness is dependent upon the type of knowledge

faculty are disseminating to the students and the level of control students have over their learning (Lam, 2009; Olson & Wisher, 2002). These studies indicated that WBI was significantly better than CBI for teaching procedural and declarative knowledge. Additionally, WBI was significantly more effective than CBI when students had control of the learning experience, received feedback on their work, and applied the learning to assignments or practice (Sitzmann et al., 2006).

Studies suggest that students in online courses feel the coursework is more challenging but that those challenges are overcome through increased student control of the learning environment (Iverson et al., 2005). Deemed a learner control environment (Iverson et al., 2005; Lam, 2009), the WBI environment should lend itself nicely to a student-driven experience, allowing the student to access course information and navigate the course in a way that best suits his or her learning style and preferences (Lam, 2009). Additionally, Iverson et al. (2005) suggest that successful students in online courses demonstrate certain characteristics, such as a heightened enjoyment of learning, the intent to use what they've learned, and a goal achievement orientation. Given these student characteristics and the WBI advantages, one might expect these students to outperform their peers in the traditional classroom. This was evident in Bryan, Campbell, and Kerr's (2003) study using an introductory information systems course. The results indicated that WBI students outperformed CBI students on concept tests and were equally as successful as CBI students for activities.

Improved student performance in a WBI environment is not likely the result of the technology itself, but rather a combination of technology, student control of learning, student learning objectives, and the type of knowledge being disseminated (Schaber, Wilcox, Whiteside, Marsh, & Brooks, 2010; Young, Klemz, & Murphy, 2003). These authors found that WBI was superior to CBI when the course design included course management software consistently used at the institution and project-oriented instructional materials. Additionally, WBI has been touted as most effective when the course includes a large amount of procedural knowledge and problem solving (Lam, 2009). The ability to create a modularized, well-organized WBI course lends itself very nicely to these types of courses.

The arguments presented suggest that WBI should be more effective than CBI when students have greater control of the learning environment and when procedural knowledge is being taught. Therefore, the following hypothesis is offered.

H: Students enrolled in a WBI course will outperform their peers in a CBI course on procedural task-based projects.

METHOD

Participants and Course Description

Participants were undergraduate students at a public, southern university enrolled in an introductory information systems course, Principles of Information Systems, from spring 2007 – spring 2010. The total sample included 878 students, of which 415 completed the course in a traditional classroom setting (CBI) and 463 completed the course online (WBI). The demographic information collected indicated that the average age of the participants was 24; 526 participants were males, and 352 were females. This course is required for all business majors; thus, the majority of the students (678) were majoring in a business discipline.

The content for this course was a mix of conceptual material on introductory topics in information technology and in-depth training on spreadsheet skills. The course objectives were developed by a committee of IT professors based on the expressed needs of business faculty and external employers. A learning management system was used extensively in both the CBI sections and the WBI sections for the administration and completion of the course. Course materials used in all sections included a textbook, video lectures and tutorials, links to external resources, and an auto grading spreadsheet training product. Thus, with the exception of regular access to the professor through face to face class meetings, the delivery of the course was the same for both WBI and CBI sections.

Overview of Research Design

For this study, a comparison group design was implemented. Course objectives, assignments, materials, and content were the same; but, the delivery method was either WBI or CBI. Selection into these course sections was not random, but was driven by several factors, including availability, scheduling, and student preferences. Students self-registered into this course, and student enrollment was limited to 30-40 students per section, regardless of the delivery method.

Procedures

From spring, 2007, to spring, 2010, sections of Principles of Information Systems were delivered each semester, both fully online and in the classroom. A series of ten spreadsheet projects were completed in both CBI and WBI sections, and these projects were graded automatically through Casegrader for Microsoft Excel 2007. Each project was procedural in nature and consisted of a set of predefined steps to be completed in a certain order and using a certain set of skills. Thus, each project was completed, submitted, and graded identically across all sections of the course. To test the hypothesis, comparisons of the resulting project grades from both delivery methods – WBI and CBI – were completed in SPSS using an ANOVA with single-tailed t-tests.

Results

Interestingly, of the ten spreadsheet projects assigned, the data analysis indicates that students in the WBI sections of the course only outperformed the classroom students on the first project ($t=-1.971$, $p<.05$). Projects 3 through 7 indicated no significant performance differences across the delivery methods. And, projects 2, 8, 9, and 10 indicated significantly better performance for those students in the classroom ($t=2.233$, $p<.05$; $t=1.982$, $p<.05$; $t=3.128$, $p<.01$; $t=5.652$, $p<.01$). These results are summarized in table 1 (see Appendix).

While the hypothesis was not supported for projects 2 through 10, Figure 1 (see Appendix) indicates two interesting phenomena. First, the trend for project scores is tracking definitively downward regardless of the delivery method. Second, the gap in scores between WBI and CBI widens for projects 9 and 10. In fact, there is a 10-point difference between WBI and CBI students for the final project.

DISCUSSION

Although the hypothesis that students in an online class will outperform those in a traditional classroom on procedural tasks was only supported for one project, the results indicate that in six out of ten spreadsheet projects, performance was at least equal across both delivery methods. These results support the position of Iverson et al. (2005) that encouraging students to consider WBI over CBI does not do an injustice toward the student and his or her education. However, students should be aware of their own learning style and individual needs when choosing a course section, as those needs may be more a determining factor of performance than the delivery method itself (Clark, 1994; Sitzmann et al., 2006).

It is likely that the failure to support the hypothesis for projects 2, 8, 9, and 10, may be due in part to the lack of instructional materials for these projects in the online course materials. Instructional simulation tools used in the course lacked ample coverage of the specific skills needed for these particular projects, so students were limited to video tutorials for these projects. In addition, the procedural skills needed for projects 8, 9, and 10 were more difficult that those required in earlier projects. Thus, it could be that CBI students sought more assistance from the course instructor in the classroom for these cases and, in turn, outperformed the online students.

The same online resources, simulations and asynchronous tutorials are available to both CBI and WBI students; therefore the dramatic rate of decrease for WBI students in the final two projects when compared to their CBI counterparts may be explained by instructor presence that leads to greater student confidence. It should also be noted, however, that the final two projects tend to have greater discipline-based skill competencies than previous projects and are longer and more involved than the other projects. Project 9 deals with tasks related to accounting and finance like cash-flows, balance and income statements, and discount rates; while project 10 introduces operations management topics including what-if scenario management, the construction of data tables, and an optimization problem. Thus, perhaps the more discipline-specific nature of these projects, along with the time involved in completing them, also attributed to the widening gap in performance between WBI and CBI students.

According to Blankenship and Atkinson (2010), another important criterion for student success is their level of online learning readiness. These authors used the McVay (2000) Online Readiness Questionnaire and identified two factors, namely self-management of learning and comfort with non-face-to-face communication, as predictors of success for students in WBI courses. It is possible that the inability of students to choose a course section based solely on their level of comfort with the delivery method also contributed to the lack of significant results in this study, particularly if some of the students in the WBI sections were not adequately ready for online learning.

The results also lend support to those who have called for a greater focus on blended learning (Iverson et al., 2005; Kerres & deWitt, 2003; Pratt, 2002). Blended learning provides richer media by combining personal interaction with moderate learner control, thereby offering benefits of both WBI and CBI (Iverson et al., 2005). Thus, according to media richness theory, a blended approach should lead to the greatest learning and most positive performance (Daft & Lengel, 1986). In this study, the only tangible difference across the course sections was the presence of an instructor in CBI sections. Otherwise, all students had access to the same course materials and media, regardless of the course section they selected.

FUTURE RESEARCH

The mixed results of this study further suggest that perhaps the real effect on student performance is not solely the delivery method, but rather a combination of instructional technologies, delivery method, richness of instructional media, and individual differences among students (Young et al., 2003). Thus, additional studies are needed to investigate and further isolate the different factors that are present in WBI versus CBI to find those factors that play the most critical role in student performance. Perhaps from those studies, the best balance of WBI and CBI to maximize student success can be identified.

One limitation of this study that should be addressed in future studies is the ability for students to self-select into a WBI or CBI course section. It is probable that some of the participants in this study were not enrolled in the section most suited to their learning style simply because of the availability of space in one section versus another and the need to complete the course in a specific semester. Future studies should consider the ability for students to enroll in the section they feel is most suited to their learning style.

A follow up related study would be helpful to further assess the influence of student characteristics and instructor characteristics on student performance in WBI courses versus CBI courses. The literature on technology-enabled education is unclear on the effects of demographic characteristics on student success (Koch, 2006; Lam, 2009). Thus, studies of this type could build on the findings of this study to develop a more complete picture of student success in online learning.

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APPENDIX

Table 1. ANOVA of WBI versus CBI Student Performance

Project	WBI/CBI	Mean	t-Test
1	CBI WBI	93.542 95.909	-1.971*
2	CBI WBI	92.282 89.958	2.233*
3	CBI WBI	92.805 90.857	1.800
4	CBI WBI	95.083 93.702	1.614
5	CBI WBI	84.010 81.700	1.342
6	CBI WBI	82.652 83.029	-0.202
7	CBI WBI	85.322 83.139	1.139
8	CBI WBI	88.411 85.667	1.982*
9	CBI WBI	86.508 80.503	3.128**
10	CBI WBI	84.545 74.910	3.320**

N (CBI) = 415. N (WBI) = 463.
*p < .05, **p<.01.

Figure 1. Mean Scores by Project