

# Comparison of Student Performance in Paper-Based Versus Computer-Based Testing

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**ABSTRACT.** The author investigated the impact of assessment methods on student performance on accounting tests. Specifically, the author used analysis of variance to determine whether the use of computer-based tests instead of paper-based tests affects students' traditional test scores in accounting examinations. The author included 2 independent variables, student gender and student class, as covariates. The findings indicate that there was no significant difference in the values of the students' performance according to the 2 methods of assessment. The findings also revealed that neither student gender nor class was correlated to the test scores in either form of testing.

Keywords: assessments, in-class, online, tests

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**W**eb-based instruction in higher education has grown tremendously. A major use of Web-based instruction is to enhance traditional in-class courses (*Web-enhanced*). An online course is taught entirely over the Internet, and there is usually little or no face-to-face contact with the instructor or classmates. However, Web-enhanced courses are traditional classroom courses whose content is augmented by a Web site where the instructor places additional information, assignments, grades, and special links for the students to access at specific times. Many universities are significantly investing in course management software and in training and support capabilities to introduce Web-enhancement to traditional courses. Faculty are embracing these tools as well and are investing significant time and energy into adding Web-based supplements to their traditional courses (Pack, Jackson, Laughner, Thomas, & Wheeler, 2003; Wheeler & Jarboe, 2001).

Four fundamental components are necessary for educators to successfully Web-enhance a course: administration, assessment, content, and community (Schmidt, 2002). The present article focuses on only the assessment component. The assessment component addresses how a student's performance and learning can be assessed via the Internet. One advantage of assessing student learning online is the ability to

provide instant feedback to the student. Students like the speed of grading and feedback that online learning provides (Ricketts & Sibley, 2002). Because questions are submitted and graded online, the instructor does not have to collect, correct, or even record grades. This situation reduces the need for remediation during valuable class time and helps teachers and students to spend more time on new or more advanced subject matter (Wingard, 2004). Online testing also makes it easy to provide repeated testing opportunities for practice purposes. Multiple-choice, true or false, and matching items can be easily administered through the Internet.

In the present research, I investigated the impact of assessment methods on student performance on examinations. Specifically, analysis of variance was used to determine whether the use of computer-based tests versus paper-based tests affects students' performance on examinations in traditional accounting courses. I included two independent variables, gender and accounting course, as covariates.

## Prior Research

Prior researchers have primarily compared the performance of students in online courses with the performance of students in traditional courses (*traditional students*) and have found mixed results. Most of these researchers have

found no differences in learning outcomes. Schulman and Sims (1999) concluded that the learning of online students is equal to the learning of in-class students. In Schulman and Sims' study, they compared the performance of students who were enrolled in five different undergraduate online courses with that of students who were enrolled in traditional in-class courses that were taught by the same instructors. Dellana, Collins, and West (2000) also determined that the performance of online students is not significantly different from the performance of traditional students for final student scores in an undergraduate management science course. Gagne and Shepherd (2001) analyzed the performance of two class sections in an introductory graduate-level accounting course. One section was a traditional, campus-based class taught in the conventional face-to-face lecture mode. The other was taught in a distance education format, and the students had no face-to-face contact with the instructor or each other. The examinations for both sections were administered in paper-based formats: The online students were required to have the examinations proctored. Gagne and Shepherd concluded that the performance of students in the distance course was similar to the performance of students in the on-campus course. The results of Rivera and Rice (2002), Noyes and Garland (2003), and Warren and Holloman (2005) have also revealed that there are no significant differences in the students' outcomes between a face-to-face class and an online class. Bonham (2001) compared the performances of classes that used computer-generated homework with those that used the traditional written format. Bonham found no major differences between the classes that used online homework delivery and the classes that completed the same assignments and were graded by traditional paper methods.

Schulte (1998) discovered that online students scored significantly better than traditional classroom students on exams in a social statistics course. Four question types—matching, objective, definitions, and problems—were used in the study. The results were consistent on both the

midterm examination and the final examination for all four question types. Clariana and Wallace (2002) conducted a study on paper-based and computer-based assessments in which they compared the test performances of freshman business undergraduate students who took each type. The students were given 100 identical multiple-choice questions that tested facts and concepts related to general knowledge of computers that was covered in class lectures and course readings. Clariana and Wallace found that students who took the computer-based assessment achieved better results than those who took the paper-based assessment. The results suggest that higher-attaining students benefited most from the computer-based assessment. Clariana and Wallace used only one posttest.

However, Brown and Liedholm (2002) found that traditional students perform significantly better on exams than do online students in a microeconomics course. Grandzol, Eckerson, and Grandzol (2004) used a master of business administration statistics course in their study of the comparability of outcomes in online and traditional environments. The students in the study each took three graded assessments. Grandzol et al. found that the online student performance was lower in some dimensions of learning. The *t* tests suggest that there were no significant difference in the mean test scores for the students in the midterm examination, but there were significant differences for the final examination and the research paper.

Some other researchers have examined students' attitudes toward online testing and concluded that students have a positive attitude toward it. Peat (2000) concluded that students liked online assessment because they could take advantage of the accessibility of the online assessment tasks from a variety of locations. The students also liked the valuable, prompt feedback that they received because this helped them make judgments about their own learning. In a study by Nichols, Shaffer, and Shockey (2003), students reported that they were satisfied with online instruction and that there was no difference in learning. Wilson-Jones and Caston

(2006) examined the attitude of undergraduate education majors toward Web-enhanced and traditional instructions. They looked at two education classes: One used Web-enhanced instruction, whereas the other used face-to-face instruction. Their findings showed that 55% of the students preferred taking tests in class, whereas 45% preferred online tests. However, the study did not compare test performance between the two classes.

The present study differs from prior work in that it addresses the use of online testing methods for traditional in-class courses. I sought to find out whether traditional students taking undergraduate accounting courses perform better when they are given online assessment than when they take the tests using traditional in-class testing methods. The students were tested multiple times by using computer- and paper-based assessments methods during the course of this study.

## METHOD

### Participants

Participants were 75 students enrolled in any of three specific undergraduate accounting courses at a small Northeastern university in the spring of 2005. The students were mainly sophomores and juniors. The first course, an introductory accounting class (Accounting I), was required of all the students in the School of Management. The course section that I used in this study had 33 registered students. The second course, Accounting for Decision Making, was required for nonaccounting majors in the School of Management and had 27 students registered in this section. The third course, intermediate Accounting II, was a follow-up to Intermediate Accounting I and was required of all accounting majors. This course had only one section with 15 registered students. The same professor taught all the classes in the present study. All of the students had previously taken at least one online test in other courses at the university.

### Research Design

I gave students in all three classes four tests—two of which were computer-

based, whereas the other two were paper-based—and one final comprehensive in-class examination. Each of the four tests comprised 25 multiple-choice questions selected from various publishers' textbooks. All the students received the same test questions. The questions related to course content that was already covered by the instructor in the classroom, and the students were informed that the tests counted for course grades. The grading policy was also clearly stated in the course syllabi and Web sites. The students were allowed 50 min to take each of the tests. The final examination comprised problem-type and essay questions and were administered in-class in the pencil-and-paper format.

The first and third tests were online. In the computer-based assessments, the tests were administered online in a computerized classroom and proctored by the instructor. All the students took the online tests at the same time. The platform used for the computer-based assessment was Blackboard because the university subscribes to this software and provides the necessary infrastructure and support. The multiple-choice questions were randomly presented one at a time, and the students were allowed to backtrack and review or change their answers to previous questions. Students were also allowed to skip questions and return to them later. On completion, all online examinations were graded instantly, and the students were provided immediate feedback.

The second and fourth tests were in-class assessments and were administered in pencil-and-paper format. There were 4–6 questions on each page. Students were able to answer the questions in any order and to review and change their answers prior to submitting their paper. The instructor graded the in-class tests and returned them to the students in the following class session.

## RESULTS

Of the 75 students initially registered for the classes, 21 were not included in the final sample, either because they had withdrawn from the classes or missed one or more of the four tests that I had administered dur-

ing the semester. Thus, the test results of 54 students were used in the analysis. Students' performances were analyzed separately for each of the three classes.

Table 1 shows the average test grades for the three classes for both the in-class tests and the online tests. Accounting I students performed better on the in-class tests than did the students in the other classes, whereas the Accounting for Decision Making students were the best performers on the online tests. The Intermediate Accounting I students had the lowest test score averages under each testing format. Overall, the Accounting I students performed slightly better than did the students in the Accounting for Decision Making class. The Intermediate Accounting II students had the lowest overall test average. An examination of prior semesters' tests results showed that students in Intermediate Accounting II consistently had lower average test scores than did students in Accounting I and Accounting for Decision Making, which are both introductory accounting courses. This finding is consistent with Reed and Holley's (1989) finding that students' test grades tend to drop as the students progress through the sequence of accounting courses. Thus, the overall average of the students who completed Introductory Accounting was higher than that for Intermediate Accounting II students.

Table 1 also shows the final examination test averages for all three courses. Accounting for Decision Making had the highest average, whereas Intermediate Accounting II had the lowest test score average. However, I did not compare the final in-class examination score averages with either the online or in-class test score averages because they had different question formats. The online and in-class tests comprised multiple choice questions, whereas the final examination comprised essay and problem-type questions.

Further analysis did not reveal the existence of a test learning curve. Table 2 shows that Accounting I students' average test score was higher on the first online test than on the second, but the test averages for the two in-class tests were the same. Accounting for Decision Making students' performance did not vary between the first and second online tests. However, their test score average was higher on the second in-class test than on the first. Intermediate Accounting II students had a lower test average on the first online test than on the second. The test score average for these students was also higher on the second in-class test than on the first. These observations are consistent with previous semesters' tests results of courses taught by the instructor. Some students performed better on the tests given earlier in the semester than on the later

**TABLE 1. Descriptive Statistics (in Percentages) for Accounting I, Accounting for Decision Making, and Intermediate Accounting II**

Variable	Accounting I <sup>a</sup>	Accounting for Decision Making <sup>b</sup>	Intermediate Accounting <sup>c</sup>
Gender			
Male	55	41	50
Female	45	59	50
Classification			
Sophomore	25	46	8
Junior	40	36	50
Senior	35	18	42
School of Management major			
Yes	50	82	100
No	50	18	0
Online tests average	70	71	61
In-class tests average	74	69	63
Overall tests average	72	70	62
Final exam average	72	75	67

<sup>a</sup>*n* = 20. <sup>b</sup>*n* = 22. <sup>c</sup>*n* = 12.

**TABLE 2. Test Score Averages (in Percentages), by Majors, for Accounting I, Accounting for Decision Making, and Intermediate Accounting II**

Measure	School of Management	Non-School of Management	All students
Accounting I	<i>n</i> = 10	<i>n</i> = 10	<i>n</i> = 22
Online test 1	70	74	72
Online test 2	66	70	68
Online tests average	68	72	70
In-class test 1	74	74	74
In-class test 2	74	74	74
In-class tests average	74	74	74
Total average	71	73	72
Accounting for Decision Making	<i>n</i> = 18	<i>n</i> = 4	<i>n</i> = 22
Online test 1	69	78	71
Online test 2	69	78	71
Online tests average	69	78	71
In-class test 1	62	78	66
In-class test 2	70	83	72
In-class tests average	66	81	69
Total average	68	80	70
Intermediate Accounting II	<i>n</i> = 12	—	<i>n</i> = 10
Online test 1	58	—	58
Online test 2	64	—	64
Online tests average	61	—	61
In-class test 1	60	—	60
In-class test 2	66	—	66
In-class tests average	63	—	63
Total average	62	—	62

tests, whereas other students did better on later tests than on the earlier tests.

Table 2 also shows the test averages by major for the School of Management and non-School of Management students. The non-School of Management students performed better on both the online and in-class tests than did the students who had a School of Management major. This is especially evident in the Accounting for Decision Making course, where the nonmajors performed significantly better than did the majors. All the students who had registered in Intermediate Accounting II were School of Management majors. I could not compare accounting students versus nonaccounting students because none of the courses had both types of students registered. Although Accounting I was required of both accounting and nonaccounting majors, only nonaccounting students were registered in the Accounting I section that I tested in this study. Accounting for Decision

Making is for nonaccounting majors, so there were no accounting majors in this course. Only accounting majors were registered in the Intermediate Accounting II course.

The *t* tests comparing the average test scores of the online and the in-class revealed that there was no significant difference in test scores between the two assessment formats for all three courses. Accounting had a *p* value of .2158 and  $t(38) = 1.247$ . For Accounting

for Decision Making,  $p = .5715$ ,  $t(40) = 0.573$ . For Intermediate Accounting II,  $p = .6463$ ,  $t(20) = 0.461$ . Therefore, I concluded that there was no difference in the students' mean test score between the online testing format and the in-class testing format. This finding is consistent with Schulman and Sims (1999), Rivera and Rice (2002), Noyes and Garland (2003), and Warren and Holloman (2005), who have reported no significant differences in the students' outcomes between face-to-face classes and online classes. My finding is also in line with Zhao, Lei, Lai, and Tan (2005), who showed that as a whole, distance education has been as effective as its face-to-face counterpart. Bonham (2001) also found no major differences between the classes that used online homework delivery and the classes that completed the same assignments and were graded by traditional paper methods.

I performed an analysis of variance by using student gender and classification as covariates. Table 3 shows the results of these analyses. It reveals that student gender and class were not correlated with the test scores. This finding suggests that for the three courses, neither student gender nor student class determined the test score under either testing format.

## DISCUSSION

The study reveals that in three different accounting courses, there were no differences in student test scores between the online tests and the in-class tests. The study also revealed no correlation between a student's gender or class and the student's test performance. Thus, instructors may include online tests in their traditional in-class courses

**TABLE 3. Analysis of Covariance Using Student Gender and Classification for Accounting I, Accounting for Decision Making, and Intermediate Accounting II**

Variable	Accounting I			Accounting for Decision Making			Intermediate Accounting II		
	<i>F</i>	<i>df</i>	<i>p</i>	<i>F</i>	<i>df</i>	<i>p</i>	<i>F</i>	<i>df</i>	<i>p</i>
Gender	0.158	3, 38	.69	4.292	3, 40	.14	1.059	3, 20	.31
Class	1.025	6, 38	.39	0.515	6, 40	.14	2.635	6, 20	.09

without affecting the students' test performance, while reaping the benefits of online testing, which include instant grading and feedback to the students. When instructors test students online, they free up class time that would have been spent in administering tests. The students and instructors may spend this additional time on new or more advanced subject matter.

The limitations of this study include the online test conditions that I manipulated to make similar to the in-class test conditions. The online tests were taken in a computerized classroom and proctored by the instructor. I used this condition to ensure that there were no incidents of cheating in the online tests. All students were required to log on and take the online tests at the same time. This condition is different from normal online testing conditions in which a testing window is specified, and the students are allowed to log in and take the test at any time within that window. Future researchers may try to determine whether there is a difference in student performance in proctored versus unproctored online tests.

The differences in the present test scores may have resulted from the complexity and difficulty of the individual tests. This study did not have a control group, and thus no conclusion can be made about the causes of those differences. A future extension of this work may include assigning all the tests—both online and in-class—to two random groups of students and comparing the online performance with the in-class performance of the students for the same test.

The results of this study showed that Intermediate Accounting II had the lowest test score averages on the online tests, the in-class tests, and the final examination. Future researchers may

explain why the Intermediate Accounting II students consistently had test scores that were significantly lower than the other two courses.

In addition, the results showed that non-School of Management students performed better on both the online tests and the in-class tests than did students registered in the School of Management. Further studies are necessary to determine whether these results are applicable to other accounting and nonaccounting courses in schools of management.

#### NOTES

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