

## **Home Work for Learning Statistics: Online Technology Enhanced or Offline with Pen, Pencil, Calculator, and Computer Software - Is one more effective than the other?**

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### **Abstract**

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*In the concentrated time available in a college classroom, there is little time for practice or feedback. Homework provides a forum in which concepts can be reinforced as students assess their knowledge. While it can be difficult to convince students of the merits of homework, delivering homework online appears to be more palatable to the computer savvy generation. In this paper, graded homework followed by a test was given both in the traditional manner and online at a southeastern university. Data analyses compared students' homework scores to test results. The intent of the research was to ascertain whether or not students were more likely to complete online homework assignments and if this impacted test scores. A survey instrument addressing student attitude and opinion was incorporated into the research.*

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### **Introduction**

Research reveals a lack of consensus concerning the impact of homework on student performance. Peters, Kethley, and Bullington (2002) studied the impact of required homework on multiple choice tests in introductory operations management. Their results showed lower average scores for students who completed the mandatory assignments. Other researchers found no evidence that homework impacted student performance on tests (Johnson, 1989; Weems, 1998). Yet other studies have supported the use of homework. Rayburn and Rayburn (1999) reported that accounting students who completed homework assignments outperformed their peers. Lefore and Eiger (2003) had similar findings for students in an introductory biology class. Pascal, Walberg, and Weinstien (1984) found test scores improved with homework and that graded homework showed a greater improvement in scores than non-graded homework. Despite the mixed results, most academicians would agree that homework is necessary (Langley, Ronen and ben Shacher, 2008).

Today technology permits an array of new tools for learning, tools that have been enhanced by the internet (Smolira, 2008). Publisher Wiley and Sons offers a set of online learning tools called Wiley PLUS. Assessment conducted by the University of Tennessee's Institute for Assessment and Evaluation found final averages of students using these tools was 7 percent higher than students who did not (Wieder, 2011). Michelson and Smith (2004) and Peng (2006) reported that students embraced internet-based aids and that web-enhanced technology can improve the overall experience for students. Polling students in microeconomics at the end of the semester, Lee, Courtney and Balassi (2010) found that students felt web-based aids provided a greater understanding of course material.

Some research has found e-homework to have a more positive impact on student performance than traditional homework (Cooper, 1989; Cooper, Lindsay, Nye & Greathouse, 1998; Keith & Cool, 1992; Warton, 2001). Chua-Chow, Chauncey and McKessock (2011) examined the effect of online homework using 2 sections of business statistics. The results indicated that online homework improved class participation, final letter grades and decreased the percent of students who failed the course. The use of e-homework in general chemistry improved retention. Students were more likely to complete assignments, found the assignments worthwhile and recommended the continued use of online homework (Richards-Babb, Drelick, Henry and Robertson-Honecker, 2011). Other studies have failed to find a significant difference in mean grades for students completing web-based assignments (Demirci, 2010).

Whether or not web-based assignments result in higher test scores, there are benefits for students and faculty. Students receive immediate feedback; faculty spend less time collecting, grading, filing and recording (Johnson, 2004). Bridge and Appleyard (2008) reported that 88 percent of the students in their study felt time submitting homework electronically saved time. Another advantage of e-homework is the ability to adapt assignments to the needs of an individual student (Salend, Duhaney, Anderson, and Gottschalk, 2004).

## **Background**

At an AACBS accredited university in the southeast, students must complete an algebra course (or a higher level math class) which is supported by MyMathLab, a web-based delivery system, prior to admission into the College of Business Administration. In the business degree programs there is a sequence of 2 math classes, Business Statistics and Applied Statistics & Optimization. Both of these classes are Excel intensive. The statistics class and the advanced statistics portion of the second class, which focuses on regression, multiple regression and time series analysis, are supported by the web-based delivery system MyStatLab. The portion of Applied Statistics & Optimization that addresses optimization (linear programming, transportation and assignment models) has no online component.

The composition of the Applied Statistics & Optimization class afforded researchers the opportunity to ascertain whether or not students were more likely to complete homework assignments and/or perform better on tests using a web-based delivery system. Optimization was taught using 4 graded homework assignment and a test; all required the creation and submission of Excel files. The advanced statistics portion of the course also had 4 graded homework assignments and a test, all delivered via MyStatLab. At the end of the semester student opinions were gathered concerning the helpfulness of web-based learning aids. A questionnaire (Appendix 1) asked students whether or not they completed homework assignments and if they had not, why not. It also polled students to see if they were more inclined to complete assignments when delivered via MyStatLab, if they felt better prepared for class and tests after using MyStatLab, if they found the Learning Aids available on the web-based system helpful and if they would recommend the continued use of the software package.

## **Methodology**

Data was collected in 6 sections of Applied Statistics & Optimization spring and summer semesters 2011. Homework grades and test scores were recorded for both portions of the class. At the end of the semester the questionnaire was administered to gather student opinions of the usefulness of MyStatLab. The survey instrument was approved by the university's Institutional Review Board; students were not required to complete the survey. A total of 170 students agreed to complete the questionnaire. Test scores and homework grades were analyzed for 190 students.

This research project used homework grades and student test scores to test the following hypotheses:

$H_0$ : There is no difference in the percent of students who complete graded homework assignments delivered via the web than assignments that are not web-based.

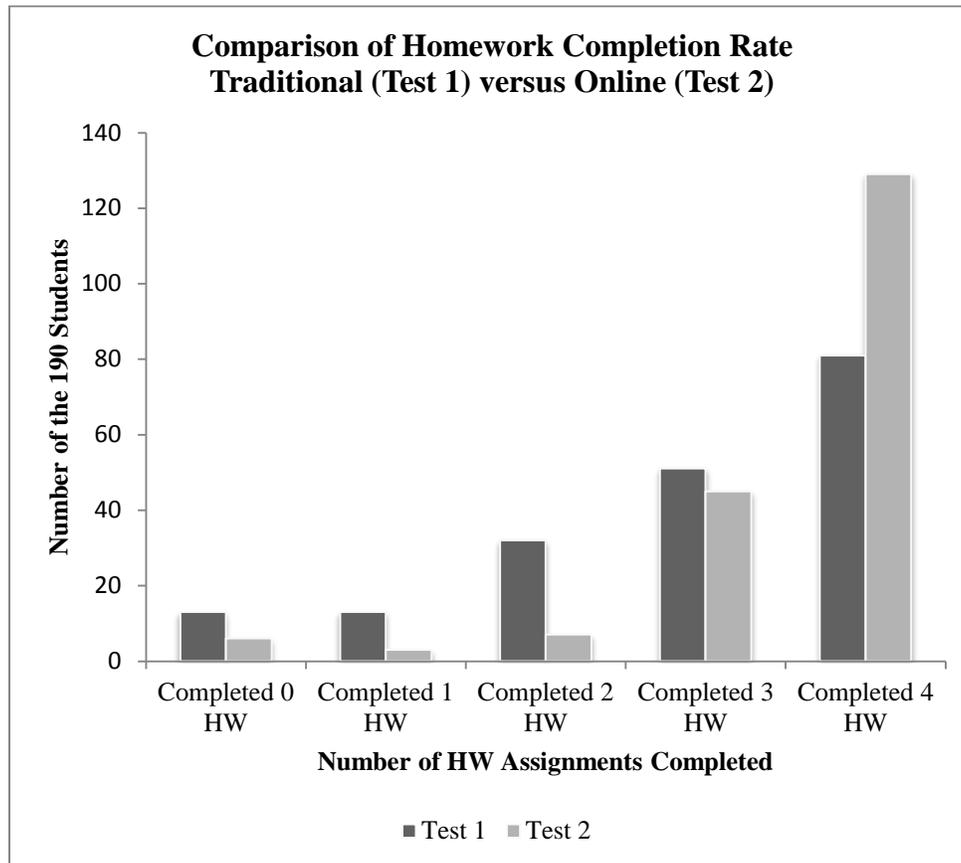
$H_0$ : There is no difference in test scores of students who complete web-based homework assignments versus test scores following homework assignments which are not supported via the web.

## **Results**

Research Hypothesis 1: There is no difference in the percent of students who complete graded homework assignments delivered via the web than assignments that are not web-based.

Four homework assignments were collected and graded before each test. For the first test homework was delivered in traditional, paper fashion while homework for the second test was supported by a web-based delivery system. A comparison of the number of students completing the assignments is displayed in Figure 1. Almost 68 percent of the students completed all 4 online assignments compared to roughly 43 percent when homework was not online. Chi- square analysis (p-value < .0001) determined there was a significant difference in the percent of students turning in web-based homework assignments versus traditional homework. Hypothesis 1 is not supported.

**Figure 1: Completed Homework Assignments**

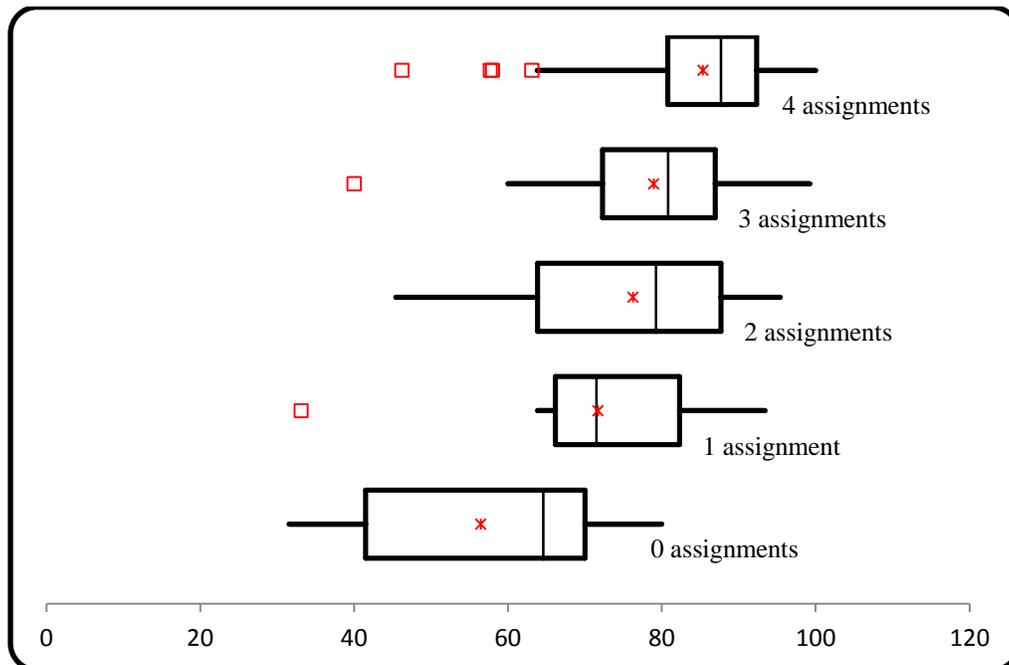


H<sub>0</sub>: There is no difference in test scores of students who complete web-based homework assignments versus test scores following homework assignments which are not supported via the web.

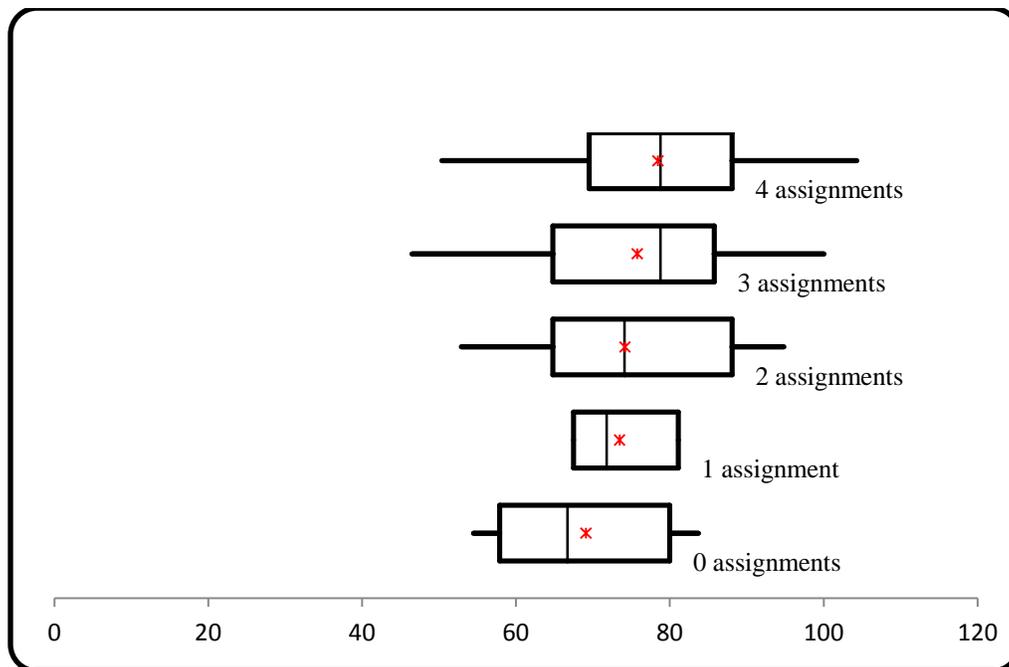
The scores of the 2 groups (traditional Test 1 versus online Test 2) were compared using a Paired-Sample t-test. The resulting p-value of .146 failed to prove that there was a significant difference in the grades students achieved on tests using different delivery systems. Hypothesis 2 is supported.

Test scores for material delivered in traditional fashion (see Figure 2) versus test scores for material with online support (see Figure 3) were compared based on the number of homework assignments completed using Box-and-Whisker Plots.

**Figure 2: Test Scores Versus Number of Traditional Homework Assignments Completed**



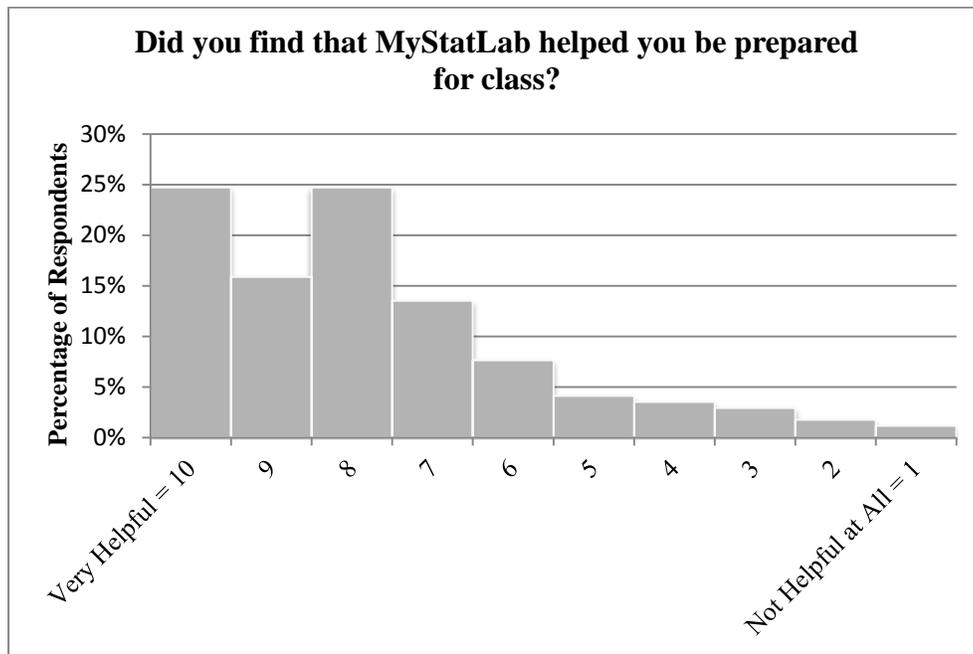
**Figure 3: Test Scores Versus Number Of Online Homework Assignments Completed**



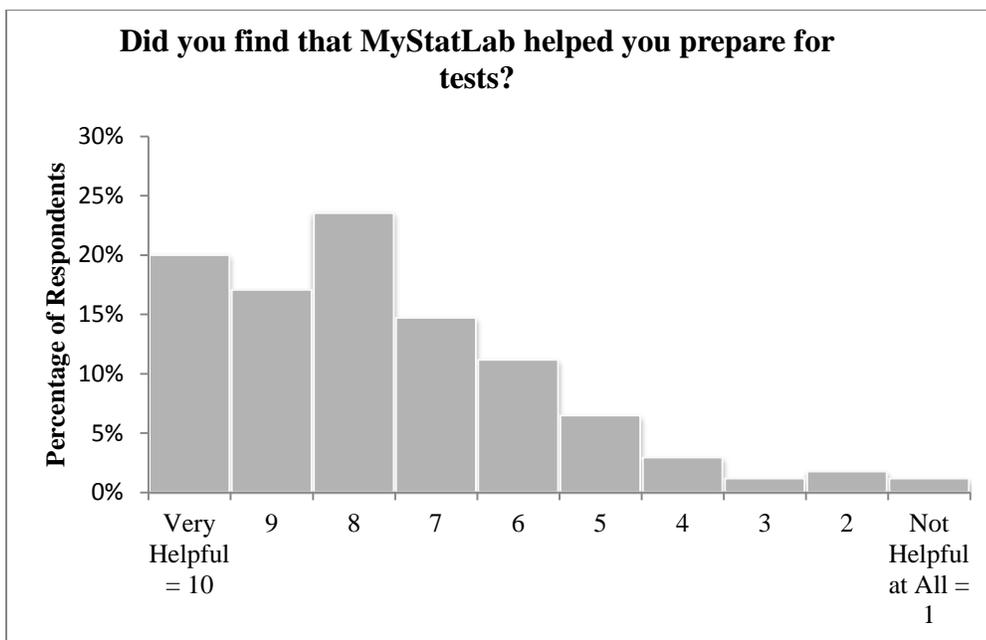
As can be noted in the plots, it appears that the number of assignments completed was a larger factor in test score when homework was completed in a traditional fashion than when it was completed using MyStatLab. This observation was supported by relevant ANOVA results indicating a significant difference in average grades in Test 1 for students who completed different numbers of assignments; however, no significant difference was found in a similar Test 2 analysis.

Online homework and test delivery did not result in significantly different test scores for students. However 73.5 percent of the students surveyed reported that they were more likely to complete homework assignments when the problems were delivered online and 91.8 percent recommended that faculty continue to use the web-based delivery system MyStatLab. Students felt better prepared for class (see Figure 4) and better prepared for tests (see Figure 5) after working online. Students had positive attitudes about the online delivery of homework and tests but this did not translate into better performances on tests.

**Figure 4: Mystatlab Helped Prepare For Class**



**Figure 5: Mystatlab Helped Prepare For Tests**



The web-based system used in this class offers numerous aids that students can employ to assist in the solution of problems. These aids were not demonstrated in class; each is simply accessed by clicking on a toolbar. The survey revealed that students relied heavily on help from an aid which shows a different example as well as its solution, an aid which provides definitions to terms, and the textbook. The majority of students did not use 4 of the 7 aids available.

**Figure 6: Mystatlab Aids Used By Students**

<b>Learning Aids Available in MyStatLab</b>	<b>Percentage of Students Who Used Aid</b>	<b>Percentage of Students Who Did Not Use Aid</b>
View an Example	94.1%	5.9%
Help Me Solve This	90.6%	9.4%
Textbook	68.2%	31.8%
StatCrunch	48.2%	51.8%
Study Plan	44.1%	55.9%
Instructor Tip	37.1%	62.9%
Video	34.7%	65.3%

### Conclusions

Over the years various researchers have reported mixed results on the impact of homework on student performance. Some researchers found student performance improved with homework (Rayburn and Rayburn, 1999; Lefore and Eiger, 2003; Pascal, et. al., 1984). Peters, et. al., 2002 reported lower test scores after homework assignments were completed. Other researchers found no evidence that homework impacted student performance on tests (Johnson, 1989; Weems, 1998). Based on our results, there was no difference in test grades for traditional style homework versus e-homework. However, the findings indicate that when the homework is completed using traditional homework methods, the more assignments that are completed the higher the test grade. Unfortunately, preliminary results do not indicate the same pattern for e-homework.

Online delivery did encourage students to complete more homework assignments. Significantly more students (68 versus 43 percent) completed all four assignments on the web-based delivery systems. In the concentrated time available in a college classroom, homework can reinforce knowledge. Students self-reported that the online delivery made them more likely to undertake assignments (73.4 percent), that it was easy to use (88.8 percent), made them feel more prepared for class (78.8 percent) and tests (75.3 percent), and 91.9 percent felt they would use MyStatLab if they had the chance to begin the class anew.

So, if the students felt that the use of MyStatLab was a positive, why was there not a difference in test results? Obviously we cannot answer that question with certainty; however, the fact that the students reported making significant use of the “View and Example” and “Help Me Solve This” tools may indicate that they relied on these “crutches” to be successful in completing the homework. Since the tools were not available during testing the students may have been lulled into a sense of security of knowledge that they did not possess.

The material for the traditional test is Linear Programming; the material for the online test is Regression. All data was gathered using students of one faculty member. In future semesters, data will be gathered from students of additional faculty. In addition, students will be told that the “helpful tools” will not be available during testing. This may impact the results. A larger sample will also allow researchers to ascertain whether or not gender and/or discipline affect student performance and/or opinion.

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## Appendix I Homework Delivery Questionnaire

1. Name \_\_\_\_\_
2. Gender:  
 Male       Female
3. Major:  
 Accounting  
 Information Systems  
 Logistics  
 Economics  
 Finance  
 Management  
 Marketing  
 Other (Please specify \_\_\_\_\_)
4. Did you submit at least one home work assignment in this course?  
 Yes (**If yes, skip to Question 6.**)  
 No
5. Why did you not submit the homework assignments? (Check all that apply.)  
 No time  
 Did not think assignments were beneficial  
 The assignments were too complicated  
 The assignments were not necessary  
 Other (Please specify) \_\_\_\_\_  
(Thank you. This ends your questionnaire.)
6. Did you submit at least one homework assignment that was delivered via MyStatLab?  
 Yes (**If yes, skip to question 8.**)  
 No
7. Why did you not submit MyStatLab homework assignments? (Check all that apply.)  
 Did not think it would help  
 No time  
 Did not think the assignments were beneficial  
 The assignments were too complicated  
 The assignments were not necessary  
 MyStatLab was too complicated  
 Other (Please specify) \_\_\_\_\_
8. Did you submit at least one home work assignments that did not use MyStatLab?  
 Yes (**If Yes, skip to question 10.**)  
 No

