Teaching Basic Accounting to Engineering Economy Students: Are Computer Tutorials More Effective than Traditional Classroom Lectures?

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Abstract

Many colleges and universities are making an effort to incorporate computers and technology into their teaching environments and grappling with the effectiveness of using such technologies. This article addresses the effectiveness of using a computer –based tutorial as a method of learning versus traditional lecturing. This paper is based on a study that compared student's test scores using computer mediated accounting tutorials alone with those of students who received traditional lectures and computer mediated tutorials in the same topic. The students sampled were junior and senior undergraduate engineering students taking a required Engineering Economics core course that contained computer tutorials for basic accounting. Based on previous research (Merino, 1989 and McNaught 1995) it was anticipated that both methods would be satisfactory instructional tools and yield similar educational results.

The results of the research indicate that there is no statistically significant difference between the two methods. This study concludes that computer based tutorials could be substituted for traditional lectures without impacting what a student learns- at least for teaching accounting fundamentals. For both groups, a major improvement in learning occurred as evidenced by the final mean scores.

Background

There are various methods students use to solve problems in the classroom. Pitman, Gosper and Rich (1999) report that different students use different course related materials (paper vs. computer) in differing ways and to different degrees. Use of varied teaching resources is very important to match individual student learning styles and thus could have important implications for future educational programs and curriculum contents Holman (2000).

There are different methods used in teaching accounting. This study was set up to determine if a computer mediated tutorial was as effective a method of teaching as a classically taught college course. To accomplish this, two groups of students were examined: those who already took a traditional accounting course vs. those who had never taken an accounting course. Both groups of students went through computer-mediated tutorials on aspects of accounting used in Engineering Economy. (It should be noted that the accounting subject matter, was covered only in the computer tutorials and was not taught in lecture format in the Engineering Economy class.

Knowledge of accounting taught in the tutorials would be necessary for the students to complete future problems later in the course.) Pre-test and post-test scores of the two groups were collected, analyzed and compared to determine if there were differing or similar results for the two different teaching methods.

The goal of this study was to evaluate whether students who previously studied the accounting in a classical college course setting would score higher on the post-test after taking the computer mediated tutorial than those students who took the computer mediated tutorial alone. The assumption is that those students who already received traditional course instruction will not score significantly higher on the post-test.

The authors believe that the computer mediated tutorial will be just as successful in teaching accounting to college engineering students as the classical college Engineering Economy course. This is comparable to the results found by Merino (1989) and McNaught, et al. (1995).

Population

One hundred and forty seven, fourth and fifth year engineering students from Stevens Institute of Technology participated in this study in the spring of 2001. All students were part of an Engineering Economics class that is a required core course for all Stevens' engineering students, regardless of discipline. All tests were distributed in lab in paper format. Pre-tests were distributed and collected at the start of lab and post-tests were distributed and collected approximately 3 hours later at the end of lab. Tests were filled out by all attending students and then returned to the professor immediately upon completion.

All students at Stevens are required to own computers upon entrance to college in their freshmen year. Thus, all Stevens' students could be considered to be computer fluent by the start of this course in their junior or senior years. As such, differences in pre-existing computer knowledge or fluency were not considered a factor influencing the results of this study.

The Study

On the first day of the lab portion of the Engineering Economy course a general survey was administered to all students in the class. This survey asked the students their engineering discipline, GPA, etc. These demographic characteristics were collected to assist in determining whether there were other possible explanations, higher GPA for example, that might skew the results of this study.

Most importantly, however, this first survey was used to differentiate two distinct groups for the purpose of this research. The two separate groups were distinguished by whether or not the students had previously taken the Engineering Cost Accounting Course - a traditionally taught class at Stevens. The sample rendered an N of 33 to 35 for those students who previously took the traditional course, and an N of 94 to 107 for those students who only took the tutorial. Numbers differ per computer tutorial as non-valid pre-and/or posttests were collected but not

used. (Non-valid tests would be those for which there was only a pre-test or only a post-test for a student for a specified tutorial, but not both.)

It was hypothesized that those students who took the traditionally taught class and computer tutorial would not have a significant difference in post-test scores from those students who used the computer tutorial alone. Having previously taken an Engineering Accounting course, the computer tutorial covering similar accounting material should have no additional effect on the traditionally taught students.

Please see Table 1 for a tabular outline of expected results.

Table 1 – Hypothesized Results

	Group X – Students who..	**Group Y – Students who..**
	previously <u>Took</u> the traditional course	**<u>did NOT Take</u> the traditional course**
Pre-test	X1 – High	Y1 - Low
Post-test	X2 – High	Y2 - High

Note: No significant difference expected between X2 and Y2

The 147 Stevens' students participating in the study were separated into five sections by the registrar. Each section took the same three computer tutorials (A, B, and C) over the semester time period. Prior to each tutorial, before any teaching on that tutorial began, every student took a pre-test. The purpose of each pre-test was to judge the students pre-existing accounting knowledge in the particular area covered by each proceeding tutorial (A, B and C). The post-tests, administered after the completion of a tutorial, were used to determine how much the students had learned from each tutorial (A, B, and C) beyond the knowledge with which they came to class (i.e. their pre-test score). Both pre and post test were similar.

Data Analysis

<u>Hypothesis 1</u> – Will those students who previously took the traditionally taught course and the computer tutorial score similarly on the Post-test or differently to those students who just took the computer tutorial alone.

NULL HYPOTHESIS/STATISTICAL TESTS

Null hypothesis H (0) - No difference in mean test scores between conditions (X2=Y2)
Two -tailed T-test (95% confidence limit)

The null hypothesis is that there is no difference between the two post-test means (X2 and Y2); i.e. both methods are equally effective in teaching the subject. To test this, a t-test was used on the post measures. Please refer to the tables in the Appendix to view the detailed data and how it strongly matched the hypothesized trends outlined in Table 1 earlier. Table 2 below summarizes the numerical results of the data analysis:

Table 2 – Statistical Results

	t	Degrees of freedom	Significance	Effect Size+
Post-test 1	1.372	134	.172*	0.27
Post-test 2	-1.194	140	.234*	-0.23
Post-test 3	-1.750	137	.082*	-0.34

* not significant, $p > .05$

+ Effect sizes are calculated by taking the difference between means for the two groups and dividing by the standard deviation for the total sample.

As denoted in the table above, none of the tests showed a significant difference in post-test scores for the two methods - lecturing versus computer tutorials. Thus showing that a statistical difference between the methods could not be found. In addition, the calculated effect sizes were very small. Two were negative and one was positive which is relatively strong evidence that there is no meaningful difference between the two groups. Lastly, it should be noted that the sample size was relatively large (N approaches infinity after 120 subjects, i.e. the t value does not vary) and there was good statistical power. Although one can never "prove" the null hypothesis, the results were obtained with a relatively large sample size and, on balance; they show no evidence of a difference between the two instructional methods. Thus, the type of instructional method did not make a difference.

Consequently, as assumed no significant difference was evidenced between the post-test scores. The computer-mediated tutorial alone was just as successful at teaching the accounting used in Engineering Economics to college engineering students as the classical college course and the tutorial combined.

Impact of GPA

A final analysis was performed to ensure that the G.P.A of the students who already took the traditional course was not significantly different than those who took the tutorial alone. The authors wanted to assure that this was true so as not to invalidate the findings in this paper. An independent samples t-test was performed on GPA using whether or not a student took the traditional course as the grouping variable. As expected there was no significant difference between the G.P.A.'s of those students who had previously taken the traditional Engineering Economics course and those who had not ($t = -1.30$, $p < .05$).

Results

1) Based on the hypothesis, the post-test scores for the two methods were not significantly different from one another. Thus, computer mediated tutorials seem to be as competent an instructional method as traditional lecturing.

2) The test results clearly indicated a major improvement in student scores for those who took the traditional course previously (differences in X scores range from .32 to .53) and an even greater improvement for those who did not take the traditional course (differences in Y scores range from .51 to .76).

Implications and Future Research

Today, many campuses are incorporating technology into some aspect of their teaching environments (Keown, 1999; McLester, 2001). Interesting points on the impacts of such technology in the classroom were raised in the process of performing this research. The consensus thus far is that computer mediated learning can exist as a single teaching unit or it can be used in combination with the traditional classroom experience (Sweeney and Ingram 2001).

The results of this research agree that both the singular and supplemental forms of computer tutorials were just as successful at teaching the accounting skill used in Engineering Economics.

- In the combined form the computer mediation seems to act as a supplement to the traditional classroom.
- In the singular form, computer mediation seems to act as a competent tutor.

This outcome is in keeping with those results found by McNaught, et al. (1995). These authors found that students with poor background knowledge (in this case with Chemistry Lab) who participated in a computer mediated tutorial, performed as well in class as those students who did not take the computer mediated tutorial but who came to class with a better background in the subject. Similarly, Holman (2000) found that those students who were taught in a classroom setting showed no significant difference in post-test scores from those who were taught by computer tutorial. Considering Holman's results, some might have argued that in this study the students who took both the traditional course and the computer mediated tutorial should have scored higher on the post-test, as opposed to equal to as shown here, than those students who only took the computer tutorial. Perhaps, as the data shows, even in combination, tutorials and classroom instruction are just as successful at teaching accounting as tutorials alone. However, the research thus far only deals with teaching basic skills in specific topics.

Future research on the subject of teaching effectiveness could go beyond basic skills in the comparison of computer tutorials versus traditional learning environments. When a student advances past the basic skills, what then? Could computer tutorials be as competent a teacher in problems that are not just "skill and drill"? How would a computer tutorial rank with a learned professor in the teaching of interpretations of Elizabethan Opera? Although the research performed here did deal with three different and increasingly difficult levels of accounting knowledge used in Engineering Economy, how would a computer tutorial compare with a non-mathematical or science based lesson? More research is necessary before these questions can be answered.

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Acknowledgements:

Special thanks go to Dr. Richard Reilly of Stevens Institute of Technology for his assistance.

Appendix

Table – Results of Tutorial A

		Group X	**Group Y**	**X - Y**
Test		**Took traditional course**	**Did NOT take traditional course**	**Difference in Means**
Pre – A	Mean	.5450	.3138	.2312
	Std. Dev.	,2526	.2637	
	Std. Error	.0433	.0260	
Post – A	Mean	.8655	.8245	.0410
	Std. Dev.	.1347	.1536	
	Std. Error	.0235	.0151	
	Diff. in Means: Pre - Post	.3205	.5107	.1902

Table – Results of Tutorial B

		Group X	Group Y	X – Y
Test		**Took traditional course**	**Did NOT take traditional course**	**Difference in Means**
Pre - B	Mean	.4188	.1808	.2380
	Std. Dev.	.2648	.1893	
	Std. Error	.0454	.0188	
Post – B	Mean	.8054	.8448	-.0394
	Std. Dev.	.1479	.1755	
	Std. Error	.0250	.0169	
	Diff. in Means: Pre - Post	.3866	.6640	.4774

Table – Results of Tutorial C

		Group X	Group Y	X – Y
Test		**Took traditional course**	**Did NOT take traditional course**	**Difference in Means**
Pre - C	Mean	.3885	.1902	.1983
	Std. Dev.	.2646	.1909	
	Std. Error	.0460	.0196	
Post - C	Mean	.9224	.9505	-.0281
	Std. Dev.	.0939	.0770	
	Std. Error	.0161	.0075	
	Diff. in Means: Pre - Post	.5339	.7603	.2264

Biographical Information

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Donald Merino is a tenured full professor of Engineering and Technology Management and Management at Stevens Institute of Technology and the Alexander Crombie Humphreys Chair of Economics of Engineering. He teaches Engineering Economics, Decision Analysis, Total Quality Management, and Strategic Planning. He is the founder and Program Director of the Executive Master in Technology Management (EMTM) Program. He was founder of the undergraduate Bachelor of Engineering in Engineering Management (BEEM) at Stevens. He won the Morton Distinguished Teaching Award for full professors at Stevens. John Wiley published his book, "The Selection Process for Capital Projects". Dr. Merino received two Centennial certificates from the ASEE in Engineering Economics and Engineering Management. He is past Chair of the Engineering Management Division and Engineering Economy Division of ASEE.

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