THE EFFECT OF POWERPOINT ON STUDENT PERFORMANCE IN PRINCIPLES OF ECONOMICS: AN EXPLORATORY STUDY

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Abstract

Due to technological advances and media-savvy college students, the use of multimedia presentations on college campuses has increased rapidly. Both faculty and students think that multimedia presentations enhance learning. Empirical evidence supporting these perceptions is inconsistent, however. The purpose of this study is to empirically test whether multimedia presentation formats improve student learning of economics over traditional lecture methods. The results indicate that multimedia presentations can improve test scores significantly. Additionally, students who are above-average academic performers receive more benefit from multimedia presentations than students of below-average academic performance.

Introduction

Technological advances and media-savvy customers have led to a boom in the use of multimedia presentations in college classrooms. Multimedia formats are popular with faculty and students alike. In fact, faculty and students think (i.e., perceive) that the use of multimedia presentations improves student learning (Hogarty, Lang, and Kromrey 2003). The empirical evidence supporting this perception is inconsistent, however.

The purpose of this study is to empirically test whether multimedia presentation formats improve student learning of economics over traditional lecture methods. The effects of grade point average, SAT and/or ACT scores, and effort on homework were controlled for.

Literature Review

Control Theory predicts that providing freedom in learning increases learning compared to traditional methods (Eveland and Dunwoody 2001). Print media dictate learning in a linear fashion (i.e., top to bottom, left to right). Web pages allow the viewer to process information in a nonlinear fashion (i.e., scan text, jump from link to link, process animation, etc.) Applying control theory to the use of multimedia presentations, one would expect increased learning with multimedia because viewers can control how they process a screen.

Similarly, the theory of *structural isomorphism* suggests that navigating a Web page more closely mimics the associated nature of memory and information processing than does navigating a print article (Eveland and Dunwoody 2001). Therefore, this theory predicts that learning in a nonlinear fashion will be greater than in a linear fashion. Thus, the theory of structural isomorphism would predict increased learning from multimedia presentations.

The *contiguity effect* states that a coordinated presentation of verbal and nonverbal information is more effective than a separate presentation of the verbal and the visual (Michas and Berry

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2000). If an instructor meaningfully integrates text with visual images in a multimedia presentation, proponents of the contiguity effect would predict increased student learning.

Dual-coding theory posits that there are two distinct information processing systems; one for verbal information and one for visual information. This theory predicts that learning improves when both systems are employed (Michas and Berry 2000). Again, proponents of this theory would predict better learning from multimedia presentations than traditional presentations.

Trindade, Fiolhais, and Almeida (2002) propose that students learn better from processes that are sensory, visual, inductive, and active, while lectures tend to be verbal, deductive, and passive. Multimedia presentations allow for graphical simulations, which allow for mental imagery and associated knowledge, which should lead to increased learning.

Proponents of multimedia presentations believe they improve learning through enhanced attention (Luna and McKenzie 1997), improved recall through multimodal benefits, a matching of technologically savvy learning styles with the latest technology, and an increase in organization.

The theory of *cognitive load* states that hypermedia such as the Web may reduce learning by increasing cognitive load and disorientation (Eveland and Dunwoody 2001). Similarly, Michas and Berry (2000) and Goolkasian (2000) both found a *split-attention effect*. This theory posits that learning is reduced when people are required to attend to multiple modes of information that are in need of integration.

Critics complain that multimedia presentations exhibit a lack of creativity (Wineburg 2003), cause a strangling of interaction (Microsoft.com), promote style over substance, inhibit learning through excessive clutter, and often cause material coverage to be sacrificed. A study by Becker and Watts (1996) found that there was a lack of innovation in the teaching of economics across the country. They propose using a variety of teaching methods to actively engage students and increase their involvement in the learning process, which will increase their interest and learning of the subject.

A study by Luna and McKenzie (1997) indicates that both faculty and students think multimedia presentations enhance learning. However, test results showed no difference between multimedia and traditional lecture formats. Similarly, Eveland and Dunwoody found no difference in learning for print versus the Web at the .05 level. At the .10 level, however, learning was better for print than the Web. This series of inconsistent empirical results may be explained by situational factors such as nature of the topic (e.g., medicine, political science, engineering, etc.) or characteristics of the users (e.g., degree of technological savvy or level of education).

Methodology

In an attempt to assess the effect of applying new technology to the classroom, two sections of Principles of Macroeconomics were chosen. These two sections met back to back in the same classroom. The professor was the same for each. In the class meeting at 10 a.m. on Monday, Wednesday, and Friday, a lecture was prepared using the PowerPoint presentations provided by McGraw Hill for the 15th edition of McConnell and Brue's *Economics,* but rather than employing the PowerPoint slides in the lecture, the instructor relied on the chalk-and-talk presentation style except for a few lectures on the multiple expansion of credit by the banking system. In the 11 a.m. Monday, Wednesday, and Friday section, the PowerPoint slides were used as often as possible but stayed very close to the lecture outline used in the 10 a.m. section. Both sections had the PowerPoint slides available as reference material on the course Web site. In an attempt to control for the effects of control theory and structural isomorphism, subjects in both experimental conditions were allowed to process information in a manner of their choosing (i.e., linear vs. nonlinear). Processing information in a linear fashion requires the individual to process information from top to bottom and left to right. Processing information in a nonlinear fashion allows the individual to scan text, process pictures or words in the order of their choosing, or jump around the page.

Each section was examined with identical tests on the same dates. Student performance is measured as the total number of correct answers on four exams with 185 questions. Explanatory variables included the student's score on the SAT or ACT measured as standard deviations from the mean of the two sections combined (Z-Score). In the case where the student took both exams, we calculated Z-Score based only on SAT. Weighted High School Grade Point Average (WHGPA) is chosen because the students were predominantly first-semester freshmen. The weighting is done by the university admissions office to adjust the high school grade point average for performance in honors classes in high school. Student involvement with the course is measured by the number of homework assignments turned in on the date due and is measured by (EFFORT). A dummy variable for the use of the PowerPoint in the second section of the course is used to capture the effect of the digital presentation style in the second section of the course.

All of the variables are normally distributed except for EFFORT and PPT. EFFORT has a -1.46 skewness coefficient, which indicates the distribution is skewed to the left with relatively few small values. This finding is further corroborated in the mean of EFFORT, showing 93.9 percent of the students turned in all of their assignments on time. PPT has a kurtosis coefficient of -2.005, indicating a relatively flat distribution, which would be expected for a dummy variable.

Descriptive statistics are presented in Table 1. While enrollment in the classes 57 students, lack of data caused two incomplete observations. These were not included in the statistical analysis. There were 24 students in the class where chalk was generally used and 33 students in the class receiving the multimedia presentation. Performance is the total number of questions answered correctly on four examinations issued during the semester. The number of questions possible was 185. The two class mean performance on the exams was 77 percent correct. The maximum was 171 questions, or 92 percent, correct. The variable Z-Score was constructed to standardize the performance on the SAT exam and the ACT exam by presenting this performance as standard deviations above the class mean. The Z-Scores' near-zero but nonzero mean is interpreted as coming from the fact that some students took both exams in high school. The students in these classes who took the SAT in high school scored an average of 1,095. The students in these classes who took the ACT scored an average of 22.5. Ninety-four percent of the students in class were able to turn in all of their homework on time.

Table 1: Descriptive Statistics.

	Performance	Z-Score	WHGPA	EFF0RT	PPT	SAT	ACT
Mean	143.509	0.038	3.431	0.939	0.564	1095.11	22.458
Standard Error	2.238	0.138	0.080	0.014	0.067	19.12	0.730
Median	147.000	-0.128	3.540	1.000	1.000	1060.00	22.500
Mode	159.000	-0.742	3.610	1.000	1.000	1000.00	23.000
Standard Deviation	16.601	1.023	0.596	0.102	0.501	128.25	3.575
Sample Variance	275.588	1.047	0.356	0.010	0.251	1644.83	12.781
Kurtosis	-0.437	-0.488	0.130	0.995	-2.005	-2.54	-0.753
Skewness	-0.563	0.488	-0.748	-1.494	-0.264	5.15	0.343
Range	67.000	4.444	2.700	0.333	1.000	570.00	12.000
Minimum	104.000	-1.755	1.710	0.667	0.000	870.00	17.000
Maximum	171.000	2.689	4.410	1.000	1.000	1440.00	29.000

The correlation matrix (Table 2) shows strong correlation among many of the variables. Given the small sample size, a correlation coefficient with an absolute value exceeding 0.26 is significant at the 0.05 level (0.306 for 0.01 level of significance). In that we relied only on the SAT in the case where the student had taken both the ACT and the SAT, the SAT and Z-score are perfectly correlated. Performance is significantly correlated with Z-score, WHGPA, EFFORT, SAT and ACT. A key finding of this correlation analysis is that PPT, the dummy variable for the digital presentation method, is not significantly correlated to performance or any of the other variables under investigation. In economics and business, there are many cases where it is unreasonable to assume that a variable *Y* is a function of just a single variable *X*. A more appropriate way to determine the true relationship may be to construct a multiple regression model that includes all the important variables influencing *Y* (Kenkel 1989).

Table 2: Correlation Matrix.

	Performance	Z-Score	WHGPA	EFF0RT	PPT	SAT	ACT
Performance	1						
Z-Score	0.51456504	1					
WHGPA	0.55755977	0.531830	1				
EFFORT	0.34780480	0.064382	0.218579	1			
PPT	0.17221600	0.105152	-0.105770	0.122245	1		
SAT	0.45099732	1	0.516077	0.052872	0.093596	1	
ACT	0.56500352	0.885209	0.674948	0.234456	0.130962	0.740095	1

Results

Table 3 reports the results of the regression models. In Model 1, the only explanatory variable was the dummy variable, which was unity for the observations from the class receiving the multimedia presentation but zero for the class receiving the traditional “chalk and talk” presentation. The adjusted R square = .044 indicates that the PowerPoint presentation explains 4 percent of the variance in student performance. While the coefficient for PPT is not significant at the .05 level, a p-value at 0.068 suggests that further investigation is warranted. The interpretation here is that students in the first class got 139/185 or 75 percent of the answers correct while students in the second class got eight more answers correct over the course of the semester for 143/185 or 77 percent.

In order to gain more understanding of the effects of the variables other than presentation style, Model 2 was estimated with PERFORMANCE as the dependent variable and Z-SCORE, WHGPA, and EFFORT as independent variables (Table 3, Model 2). The variable EFFORT is not significant in explaining performance in these two Principles of Economics sections. It measured the number of homework assignments turned in on the date due. In these two classes 94 percent of the students completed their homework 100 percent of the time. Its variability as measured by its standard error is so small compared to its explanatory power that it adds little to our understanding of the phenomena under investigation. Z-SCORE, the coefficient of scores on standardized tests measured in standard deviations from the mean of this sample, has a strong p-value of (0.006). The coefficient of 5.94, taken with the reported maximum of 2.689 standard deviations above the mean of 0.038 would account for an increased performance of some 16 more questions correctly answered than the class average. Weighted High School GPA (WHGPA) has a p-value of (0.019) and a coefficient of 8.08. The maximum GPA in the sample was 4.4 compared to an average GPA of 3.4 so that having the top GPA in the sample would add eight correct questions to the student's total performance.

Model 3 presented in Table 3 is estimated omitting EFFORT but includes PPT, Z-SCORE, and WHGPA. As would be expected, the R-Square increases, the F-Statistic for the entire equation increases and the level of significance for the F-Statistic improves. These results suggest that using a multimedia presentation style can increase student performance on objective (multiple-choice) exams by a statistically significant amount.

In an attempt to determine interaction effects between method of presentation and grade point average, the data were sorted by weighted high school grade point average and partitioned at the median. For convenience the median was left in the lower half of the sample. The results are dramatic. The p-value for the coefficient of PPT for the top half of the class is 0.024. (See Table 3, Model 4). The p-value for the coefficient of PPT for the bottom half of the class is 0.665. (See Table 3, Model 5).

Table 3.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	138.875	93.229	101.689	73.698	168.018
	(0.000)	(0.000)	(0.000)	(0.005)	(0.000)
PPT	8.222		8.145	16.028	1.620
	(0.068)		(0.027)	(0.024)	(0.665)
Z-Score		5.974	4.995	5.692	6.106
		(0.006)	(0.019)	(0.233)	(0.003)
WHGPA		8.808	10.795	19.153	5.468
		(0.019)	(0.003)	(0.016)	(0.498)
EFFORT		21.111			
		(0.245)			
R-Square	0.061	0.392	0.433	0.264	0.255
F-Statistic	3.470	10.970	13.008	3.985	4.197
	(0.068)	(0.000)	(0.000)	(0.021)	(0.016)
n	55	55	55	26	29

p-values are in parentheses

Conclusions and Recommendations

The results of this study indicate that multimedia presentations can improve student test scores in economics significantly. Additionally, the results indicate that students who have already proven themselves to be above-average academic performers receive far more benefit from multimedia presentations than students of below-average academic performance. A possible explanation for these positive findings is that these college students are technologically savvy and better able to process high-tech deliveries. This series of results provides support for dual-coding theory, which predicts that student learning improves when material is presented both visually and verbally as opposed to having either visual or verbal presentation alone.

It is recommended that teachers match their use of technology with the degree of technological savvy of their audience.

- Use a variety of modes (e.g., verbal, visual, dynamic, etc.) to drive home a consistent message.
- Use multimedia to complement rather than replace your presentation.
- Avoid clutter and unrelated visuals because they inhibit learning.
- Don't rush a multimedia presentation. Student satisfaction is related to the perception of having the appropriate time to view a screen (Sozmem 2002).

Future Research

Should one wish to further this study, the effect of timing on student performance should be studied. The students did get identical exams, but students in the first class may have shared information about the exam with a close friend in the second section. However, they only had 10 minutes between classes to do so. Future researchers could replicate the experiment with the earlier class receiving the digitally enhanced presentation and the later class the "chalk and talk" presentation.

A limitation of this research is small sample size. Future research into the effects of multimedia presentations on learning should include multiple trials with hundreds of subjects. Teacher efficacy has been shown to be related to teaching effectiveness. A measure of self-efficacy of the instructors with regard to the use of technology may explain some of the inconsistent results in the literature.

Another avenue for investigation might include the publisher's digital presentation included with the text compared to a "pared-down" or "spiced-up" digital presentation more suited to the individual instructor's and/or the students' tastes. Specifically, the effect of different vs. consistent backgrounds, text vs. text and visuals vs. animation, degree of computer savvy of the students, and different layouts could be tested for effectiveness. Demographic variables that deserve future investigation include gender, major, and year in school.

Finally, Luna and McKenzie (1997) and Trindade et al. (2002) suggest that students with different learning styles benefit from different teaching methods. Future research should measure learning style and correlate that style with learning performance.

References

Becker, William E., and Michael Watts. 1996. "Chalk and Talk: A National Survey on Teaching Undergraduate Economics." *American Economics Review* 86:448-453.

Boczkowski, Pablo J. 2004. "The Processes of Adopting Multimedia and Interactivity in Three Online Newsrooms." *Journal of Communication* (June):197-213.

Callow, Jon. 2003. "Talking about Visual Texts with Students." *Reading Online* (April).

Dexter, Sara, and Eric Riedel. 2003. "Why Improving Preservice Teacher Educational Technology Preparation Must Go Beyond the College's Walls." *Journal of Teacher Education* 54 (4, September/October):334-346.

Eveland, William P., and Sharon Dunwoody. 2001. "User Control and Structural Isomorphism or Disorientation and Cognitive Load?" *Communication Research* 28: 48-78.

Goolkasian, Paula. 2000. "Pictures, Words, and Sounds: From Which Format Are We Best Able to Reason?" *Journal of General Psychology* 127:439-459.

Henson, Robin K., Lori R. Kogan, and Tammi Vacha-Haase. 2001. "A Reliability Generalization Study of the Teacher Efficacy Scale and Related Instruments." *Educational and Psychological Measurement* 61:404-420.

Hogarty, Kristine Y., Thomas R. Lang, and Jeffrey D. Kromrey. 2004. "Another Look at Technology Use in Classrooms: The Development and Validation of an Instrument to Measure Teachers' Perceptions." *Educational and Psychological Measurement* 63: 139-162.

Kenkel, James L. 1989. *Introductory Statistics for Management and Economics*. 3rd Ed. PSW-Kent Publishing Company.

Luna, Carl J., and Joseph McKenzie. 1997. "Testing Multimedia in the Community College Classroom." *THE Journal* 24(7).

Smith, Paul C., 1997. "Psychology in the Design of Multimedia Presentations in the Classroom: An Interview with Richard S. Velayo." Teaching of Psychology24(2).

Sozmem, Yildirim. 2002. "Interactive Lecture Supported by Multimedia Presentation: A New Teaching Tool for Faculties with Crowded Classes and Limited Budgets." *Education for Health* 15: 391-393.

Trindade, Jorge, Carlos Fiolhais, and Leandro Almeida. 2002. "Science Learning in Virtual Environments: A Descriptive Study." *British Journal of Educational Technology* 33(4).

Tuttle, Harry Grover. 1995. "Dos and Don'ts of Multimedia Presentations." Multimedia Schools 2(5, Nov/Dec2).

Wineburg, Sam. 2003. "PowerPointless." *American School Board Journal* (November).

Wuorio, Jeff. 2004. "Presenting with PowerPoint: 10 Dos and Don'ts." Microsoft.com.