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ABSTRACT

In recent years, the uses of PowerPoint (a form of multimedia) presentations in classroom instruction have significantly increased globally without examination of their effects on student learning and attitudes. In this study, we test whether using PowerPoint in an accounting course enhances student short-term memory, long-term memory, and attitudes toward class presentation and the instructor. We conducted an experiment, which includes a treatment-control design, in a classroom setting throughout a semester. In one section of an accounting principles II (Managerial Accounting) course, PowerPoint was used as the delivery system, while the second section was taught using a traditional delivery system. The results show that PowerPoint presentation may improve student attitudes toward the instructor and class presentation. The results do not provide conclusive evidence that PowerPoint presentations improve short-term or long-term memory. The latter results are consistent with other media comparison studies that show the medium alone does not influence learning.

Key words: PowerPoint, learning, attitudes, short-term memory, long-term memory, representational style, dual-coding theory

Data availability: Contact the authors

INTRODUCTION

This study investigates whether PowerPoint presentations (a form of multimedia) improve student learning and attitudes compared with traditional classroom presentations. While the use of PowerPoint and multimedia in the classroom has significantly increased globally in recent years (Connor and Wong, 2004; Bartsch and Cobern, 2003), few studies have systematically investigated its impact on student learning and attitudes. Rebele et al. (1998) note that little research exists regarding integration of technology in the accounting curriculum, and suggest that accounting researchers should examine whether technology improves learning. Further, Rebele et al. (1998) recommend "accounting researchers should explore how educational technology can contribute to the continuing evolution and improvement of accounting education" (p. 207).

One study that has examined the relationship between multimedia and student learning and attitudes was conducted by Butler and Mautz (1996). In a laboratory experiment conducted during a 30-minute time period, they found that multimedia did not affect student recall in all situations. Butler and Mautz did find an interaction between the effects of the multimedia presentation and the student's preferred class representation style (i.e., whether the student was considered a "verbal" or "imaginal" learner).

The present study extends Butler and Mautz (1996) in two ways. First, it examines the effect of using PowerPoint presentations throughout a semester on both short-term and long-term memory. While both Butler and Mautz (1996) and this study examine the effect of multimedia and/or PowerPoint presentations on students' learning, the former study only focuses on short-term memory. Second, this study investigates the generalizability of Butler and Mautz's (1996) findings by conducting the research in a classroom setting. While generalizability comes at the cost of experimental control, researchers are invariably interested in whether laboratory results will extend outside the controlled laboratory environment.

The current study finds that students who received instruction via PowerPoint did not (on average) perform better on quizzes or exams. However, the results of our study show that the effect of PowerPoint on short-term memory might depend on other factors such as the topic under discussion and the students' preferred representation style. For example, for more difficult and challenging chapters, students with higher use of imagery performed better on quizzes in the PowerPoint section than did students in the traditional section. This could be of interest to educators since it suggests that for more difficult and challenging chapters, the use of PowerPoint could be beneficial. Inconsistent with Butler and Mautz (1996), no interaction is found between students' preferred representation style and exam performance. The study also finds that, consistent with Butler and Mautz (1996), students have more favorable attitudes toward both the presenter and the presentation when PowerPoint is used to deliver instruction.

Butler and Mautz (1996) concluded, based on a one class period experiment, that students considered multimedia presentations entertaining. However, our study reports that entertainment was not a significant factor in students' attitudes toward class presentation, suggesting that using PowerPoint throughout a semester might not be entertaining.

The paper is organized as follows. The next section presents the literature review. We then describe the hypotheses, followed by the research method. The results are presented next. Finally, we present a discussion of the results, along with the study's conclusions and limitations.

LITERATURE REVIEW

Thompson et al. (1992) categorize five types of media research in educational technology, including evaluation research, media comparison studies, intra-medium studies, aptitude-treatment interaction studies, and alternative research designs (see Thompson et al. (1992) for a detailed discussion). Because the current study compares the effects of two instructional delivery media (PowerPoint and conventional instruction) on learning and attitude, it is classified as a media comparison study. The goal of such studies is to determine if one medium has a greater effect on learning than another (Thompson et al., 1992). The present study is also classified as an aptitude-treatment interaction study because it examines the interaction between preferred representation styles and the medium's characteristics on learning.

Effect of PowerPoint presentations on student learning

The evidence that PowerPoint presentations influence learning is largely anecdotal. Bryant and Hunton (2000) state that the degree of improved learning is a function of a complex set of interactions among learner and medium attributes. Mason and Hlynka (1998) state that PowerPoint helps structure the content and processing of a lesson or lecture. Aiding note-taking (and thus facilitating study) is another purported advantage of using PowerPoint (Cook, 1998). Parks (1999) reports that students liked the lecture outline and graphs on the screen, and that the PowerPoint presentation had a positive influence on students. Harrison (1999) argues that PowerPoint enhances instruction and motivates students to learn. If this is true, the bigger question is, does PowerPoint help students learn?

PowerPoint presentations incorporate graphics, animation, and color (imagery). Human information processing theories focus on how the human memory system gathers, transforms, compacts, elaborates, encodes, retrieves, and uses information. Sensory registers, short-term memory, and long-term memory are the three major storage structures of the human brain. The sensory system registers stimuli and holds them for a brief period until they are recognized or lost. Short-term memory, with its limited capacity, receives information from sensory registers. It holds information longer than the sensory registers through a rehearsal process, recycling the information again and again. Long-term memory is a permanent store of human knowledge, and receives information from both sensory registers and the short-term memory system (Moore et al., 1996). Research has shown that attention plays an important role in determining when and how information is further processed from sensory registers to short and long-term memory. If information is not attended to, it is quickly lost in the sensory stimulus stage of processing. Reynolds and Baker (1987) find that presenting materials on a computer increased attention and learning, and learning increased as attention increased.

Human information processing theories can shed light on how PowerPoint features (graphics, animations, etc.) may influence learning. One of the theories is Paivio's dual coding theory of memory and cognition (Paivio 1986). This theory suggests that imagery and verbal systems are two subsystems of information processing. According to dual coding theory, the imagery system processes information about nonverbal objects, including images for shapes, pictures, models, animation, color, and sound.

While dual coding theory has implications for both short- and long-term memory encoding, according to Paivio (1990), "…the structural representations of dual coding theory relate to relatively

stable long-term memory information corresponding to perceptually identifiable objects and activities, both verbal and nonverbal" (p. 54). The general model of information processing assumes that encoding results in a memory trace, and that information can be encoded at a representational, referential, or associative level (Paivio 1990). Information encoded at a representational level generates a short term memory trace, while information encoded at the referential level elicits both referentially-related verbal and nonverbal memory traces of a longer term nature. Associatively encoded information results in memory traces that include information about multiple verbal or nonverbal items (Paivio 1990).

It is referential encoding that is most relevant for this study. The graphical nature of the PowerPoint presentation arouses students' imagery systems, which become more activated when information (e.g., instructional materials) is presented in non-verbal forms. PowerPoint presentations should arouse the imagery system and could contribute to comprehension, and improve short and long-term memory. Since, in a PowerPoint presentation, topics are presented in a hierarchical fashion with graphics, color, and animation, students could "use a mental image of that outline to study, to retrieve the information on a test, to organize their answer for an essay question, and to perform other educational tasks (Clark and Paivio, 1991. p. 176)." Rose (2001) also notes that presentation of learning materials in graphical form is beneficial for students.

Many studies have empirically tested dual coding theory (see Paivio, 1986 for review of dual coding theory). For example, relying on dual coding theory, Mayer and Anderson (1991) compare the effect of presentations using words-with-picture with those using words-before-picture, on learning. They predicted that the words-with-picture group would outperform the words-before-picture group because of referential connections between imagery and verbal representations. The results of their study support the prediction. Peek (1987) finds that when pictures and text are presented together, information retention is improved.

Other studies have shown that color is a factor in memory representation. For example, Hanna and Remington (1996) find that color, as a stimulus, is a part of memory representation. Allen (1990) submits that colors are encoded as a verbal representation as well as in the perceptual mode in the form of a visual image. In a review of literature on the use of color in teaching, Dwyer and Lamberski (1983) conclude that when color is central to the ideas and concepts being presented and the students pay attention, the use of color improves learning.

In the present study, students in the traditional group (without PowerPoint) received only a text-based, black-and-white presentation (overhead transparencies), while students in the treatment group (with PowerPoint) received graphics, color, and animation in instructional delivery. Therefore, we expect that students receiving PowerPoint presentation will outperform the traditional group because students in this class will have more opportunities to make referential connections between imagery and verbal representation than in the traditional presentation.

Butler and Mautz (1996)

The current paper extends the work of Butler and Mautz (1996). These researchers examined whether multimedia presentations improve short-term recall of accounting systems materials, as well as the effects of multimedia on student attitudes toward the presentation and presenter. Sixty subjects were randomly assigned to one of two sections receiving different presentation media: traditional and multimedia.

The traditional group received a thirty-minute presentation with conventional text-based, black-and-white visual aids (which resembled overhead transparencies), while the multimedia group received the same thirty-minute presentation but with a multimedia display that incorporated graphics, animation, sound and color.[1] Past media studies have been criticized largely for the lack of experimental rigor and control. Butler and Mautz's (1996) study is noteworthy for its attempt to provide as strong internal validity as possible by tightly controlling extraneous influences. Among other controls, the experiment took place within the laboratory; the same instructor taught both groups; the material was delivered to both groups via computer; students did not have any prior knowledge of the subject matter; and delivery of the material was scripted and timed to be identical.

Using the Individual Differences Questionnaire (IDQ) (Paivio and Harshman, 1983; Harshman and Paivio, 1987), Butler and Mautz (1996) tested the hypothesis of whether students' preferred means of representing information interacted with the effects of multimedia presentation. The IDQ consists of 86 true-false questions and measures imagery and verbal habits, preferences, and abilities.[2,3] Application of the IDQ results in a continuous variable representing the student's preference between verbal or imaginal representation of information. This score then forms the basis for the independent variable representing a student's preferred representation style.

Butler and Mautz (1996) found short-term memory improved because of an interaction between students' preferred representation styles and the effect of multimedia presentations. The study also found that students in the multimedia group had more positive attitudes toward the presentation and presenter.

Interaction between Learners' Preferred Representation Styles and PowerPoint Presentation

Cognitive theory suggests that learning is optimized when learners' preferred representation styles are congruent with the attributes of educational technology. While offering guidelines for educators in using technology for instruction, Bryant and Hunton (2000) suggest that individual characteristics (cognitive differences) be taken into account in instructional design. Dual coding theory suggests that learners have preferred representation styles. Some individuals learn and recall well from visually presented information while others learn and recall well from verbally presented information. Kozma (1994) submits that to understand the relationship between media and learning, we need to consider the interaction between the attributes of the medium and the cognitive processes of students.

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[1] Butler and Mautz (1996) used Compel software, another well-regarded multimedia presentation software. The software allows integration of sound, animation, video, and hypertext into presentations (Butler and Mautz 1996). Their presentation appears comparable to a common PowerPoint presentation as used in this study.

[2] Paivio and Harshman (1983) argue that at least four and as many as six dimensions underlie the IDQ. The six factors they identified are (1) good verbal expression and fluency, (2) habitual use of imagery, (3) concern with correct use of word, (4) reading difficulties, (5) use of images to solve problems, and (6) imagination. The factors relevant to this study include factor 2 and factor 5. See Paivio and Harshman (1983) for a complete description of these factors.

[3] IDQ has been used extensively in prior empirical studies, including Olson et al. (1988), Cohen and Saslona (1990), Overby (1990), Butler and Mautz (1996).

HYPOTHESES

Based on the above discussion and dual coding theory, the first two hypotheses, stated in alternative form, examine the effect of PowerPoint presentations on both short and long-term memory.

H1: PowerPoint presentations will stimulate students' *short-term* memory such that students perform better on quizzes.

H2: PowerPoint presentations will stimulate students' *long-term* memory such that students perform better on exams.

Butler and Mautz (1996) found that multimedia presentations improved short-term memory of those students who prefer an imagery representation. Since PowerPoint presents visual information, we expect improved learning for those students who prefer an imagery representation. That is, students with a higher imagery representation should outperform students with a lower imagery representation in a PowerPoint presentation. To examine whether learner representation styles interact with the attributes of media, the following two hypotheses, presented in alternative form, are examined:

H1a: PowerPoint presentations will interact with students' preferred representation style, affecting stimulation of *short-term* memory.

H2a: PowerPoint presentations will interact with students' preferred representation style, affecting stimulation of *long-term* memory.

PowerPoint Presentation and Student Attitudes

To evaluate the effectiveness of educational media, it is important to examine learner attitudes towards PowerPoint presentation. Anecdotal evidence suggests that many students consider accounting principles courses (first college-level courses in financial and managerial accounting) boring. PowerPoint presentations may be entertaining and may change negative impressions into positive ones. Clark (1983) argues that students may have a positive attitude toward a medium because of novelty in the classroom. Nowaczyk et al. (1998), assessing semester-long student perceptions of multimedia in an introductory behavioral statistics course, report that media technology made the class presentation and discussion more interesting. On the other hand, McInnes et al. (1995), studying students taking a three-term course in management accounting, report that computer-aided learning had an adverse effect on student interest in accounting.

In the laboratory setting, Butler and Mautz (1996) found that students in the multimedia group viewed the multimedia presentation more favorably compared to students in the traditional presentation group. The current study examines whether the use of PowerPoint during a semester-long presentation affects student attitudes toward presentations. The next hypothesis, in alternative form, is presented below:

H3: Students viewing a PowerPoint presentation will have a more favorable attitude toward the presentation session than students viewing a traditional presentation.

Researchers (Butler and Mautz, 1996; Bushong, 1998) have also examined whether educational technology in classroom presentations promotes a favorable attitude toward the instructor. Butler and Mautz (1996) report a significant difference in student attitudes towards the instructor between the control and experimental groups for the factors "style of the speaker" and "informativeness." These results suggest that the multimedia group showed a more positive attitude towards the speaker than the group receiving the traditional presentation. On the other hand, using an experiment during a regular class period, Bushong (1998) reports students in non-PowerPoint group felt that the presenter was more enthusiastic than instructor using PowerPoint. The present study examines the student attitudes toward the instructor after a semester-long series of PowerPoint presentations. The final hypothesis of the study, presented in alternative form, is

H4: Students viewing a PowerPoint presentation will have a more favorable attitude toward the class instructor than students viewing a traditional presentation.

RESEARCH DESIGN

In order to examine the effects of PowerPoint presentations on student learning and attitudes, two sections of accounting principles II (Managerial Accounting) were run back-to-back, twice a week. Each session lasted eighty minutes. Sections one and two had 38 and 36 students, and were used as the control and treatment groups, respectively. The presentation for section one (control group) was supported by traditional, text-based, black-and-white, visual aids. The presentation for section two (treatment group) was supported by PowerPoint, which provided color visual aids with graphics and animation. The traditional section met in a classroom that included an overhead transparency projector and chalkboard, while the PowerPoint section met in a multimedia room. The same instructor taught both sections of the course.

A different textbook (Volume II of Ainsworth et al., 1999) was adopted to mitigate effects due to instructor familiarity with the text material. This textbook departs from the traditional approach of accounting principles textbooks by integrating financial and managerial concepts throughout the two volumes. Table 1 presents eleven chapters covered in the course.

Each chapter was taught with a lecture in one session followed by problem-solving in the following session(s). At the end of each lecture session, a quiz with ten conceptual questions (all multiple choice) was administered. Quizzes for chapters 14, 18, 23, and 24 were dropped from the analysis because these quizzes were not administered in the same session as the lecture presentation; rather, they were given at the beginning of the next session or after problem-solving. The quiz for Chapter 25 was eliminated from further analysis since no PowerPoint was used in the treatment group as a result of a technical problem. Therefore, only quizzes from six chapters were used in the analyses.[4]

[4] Analysis of the mean quiz scores for quizzes dropped from the study showed no statistically significant differences between the two groups at the 0.05 significance level.

TABLE 1
Summary of Chapters Used in the Study[a]

Quiz	Chapter	Topic
1	14	Time value of money[b]
2	15	Debt and equity financing
3	17	Human resources
4	18	Long-term debt[b]
5	19	Equity financing
6	20	Operational investment
7	21	Non-operational investment
8	22	Firm performance probability
9	23	Financial position[b]
10	24	Financial position[b]
11	25	Comprehensive analysis[b]

[a] All chapters are from Ainsworth et al. (1999)
[b] The quiz was dropped from analysis because it was taken in the next class or additional problem-solving was undertaken before administering the quiz.

Twenty percent of the course grade was assigned to quizzes. Students needed to take eight quizzes to receive the complete grade for the quizzes. No make-up quizzes were given. To minimize cheating, each quiz had three versions that mixed the order of the questions.

Three objective (multiple choice) exams were administered during the semester. The first exam, worth fifteen percent of the course grade, covered chapters 14, 15, 17, and 18. The exam had two parts: 30 conceptual questions and 20 exercises/problems. Students were asked to provide their answers on two different answer sheets. Different versions of the exam were used, mixing the order of the questions. The second exam, worth twenty percent of the course grade, covered chapters 19, 20, and 21. It also had two parts: 20 conceptual questions and 20 exercises/problems. The administration of the exam was similar to the first exam. The final exam, worth thirty percent of the course grade, covered the remaining chapters. The final exam differed from the previous two exams in that it only had one part with 50 questions and problems. Thus, students completed only one answer sheet. The remaining fifteen percent of the course grade was used for case study and class participation.

Dependent Variables

Hypotheses 1, 1a, 2, and 2a posit relationships between the independent variables and the ability of subjects to recall the presented materials. Quiz scores were used to measure the ability of subjects to recall from *short-term* memory, while exam scores were used to measure the ability of subjects to recall from *long-term* memory.

Hypotheses 3 and 4 posit relationships between the independent variables and the attitude of subjects toward class presentation and instructor. To evaluate the attitudes of subjects toward class presentation and the instructor, a questionnaire similar to that employed by Butler and Mautz (1996),

Steinbart and Accola (1994), and Pei and Reneau (1990), was administered at the end of the semester. A second experimenter administered the questionnaire, provided the rationale for the questionnaire, and assured students that the instructor would not see the results until after course grades were submitted. In this questionnaire, subjects evaluated the class presentation and instructor, respectively, for ten characteristics (Oppenheim et al. 1981; Butler and Mautz 1996). The ten characteristics related to the class presentation were: well-documented, strong, enjoyable, concise, entertaining, easy to follow, professional, clear, stimulating, and interesting. The ten attributes related to the instructor were: prepared, concise, professional, clear, inspiring, understandable, credible, interesting, strong, and effective in his use of supporting materials. In addition, seven other items dealing with the efficiency and effectiveness of the instructor appeared in the questionnaire. Subjects rated each characteristic and attribute on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Covariates

To control for the effect of prior accounting knowledge, three questions were included in the questionnaire administered at the end of the semester. The first question asked subjects to check one of the three statements that in general best described their preparation for taking quizzes. The three statements were as follows

I reviewed each chapter thoroughly before coming to the class to take the quiz.
I reviewed each chapter partially before coming to the class to take the quiz.
I only relied on the class lecture and presentation in taking the quiz.

The second question asked subjects to indicate the number of hours they spent, on average, studying each chapter before coming to the class to take the quizzes. The third question asked students to rate on a 7-point Likert-type scale ranging from 1 (very little) to 7 (very much) the extent they studied each chapter, on average, before coming to the class to take the quizzes. The three questions were highly correlated with each other (correlation higher than 0.54); therefore, only the third question, a continuous item, was used in statistical analyses as a covariate. Grades of subjects for Accounting Principles I (Financial Accounting) and the overall GPA of subjects before the start of the semester were also used to control for the intellectual abilities of subjects to recall materials. Since the two grades were highly correlated ($r=.77$, $p<0.001$), only overall GPA was used in this study as a covariate.

Subjects' grades for the first two exams were used to control for their satisfaction regarding the class presentation and instructor. This method was followed on the grounds that students who had received higher grades might have been more satisfied with the class and instructor. The grades for the two exams were summed to form the covariate.

Independent Variables

The first independent variable represented the course delivery system: traditional versus PowerPoint. As mentioned earlier, in the traditional section of the course, presentations were made through text-based, black and white visual aids, while the section using PowerPoint utilized graphics, color, and animation in presentations. The second independent variable was the subject's preferred representation style, as measured through the IDQ.

RESULTS

Hypothesis One—Short Term Performance Effects

The first hypothesis examines the effect of PowerPoint presentation on students' *short-term* memory. An analysis of covariance was conducted with quiz scores as the dependent variable, overall GPA and extent of study as covariates, and section as the independent variable.[5] The findings for the six eligible quizzes are presented in Table 2.

The results presented in Table 2 show statistically significant differences in performance in two out of six quizzes.[6] On the quiz for Chapter 17 (a more discussion-oriented chapter), students in the PowerPoint section outperformed the traditional students ($p<0.032$). On the other hand, on the quiz for Chapter 22 (a chapter requiring walk-through solutions), students in the traditional section outperformed the PowerPoint students ($p<0.003$). We note also the low r-squares for each model, indicating that the models do not explain a great deal of the variance in the relationships. Based on this, we cannot conclude evidence for the existence of a PowerPoint presentation effect. However, the results do spark an interesting question for future research: that is, a possible interaction between the topic difficulty and the medium used.

Hypothesis One(a)

This hypothesis posits an interaction between students' preferred representation style and the media presentaion. We tested the interaction effect using a regression analysis in which quiz score served as the dependent variable and overall GPA, extent of studying before taking the quiz, section, preferred representation style, and interaction between section and preferred representation style served as independent variables.[7] Two sets of regressions were run (one for each of the two preferred representation styles). Each regression was run on each of the six quizzes, yielding a total of 12 regressions.

The first preferred representation style factor examined was habitual use of imagery. This factor had a mean of 11.69 (theoretical range 0-13; actual range 3-13) and a standard deviation of 2.24. The coefficient alpha for this factor was 0.83. According to Paivio and Harshman (1983), "someone high on this factor often uses mental imagery to think, remember, solve problems, and imagine described events" (p. 471). Therefore, hypothesis 1a posits that students scoring high on this factor who attend the PowerPoint section may be able to recall information better. The results of the regression analysis, presented in Panel A of Table 3, show a significant interaction for the Chapter 21 quiz. No significant interactions were found for other quizzes, so they are not reported.

The results show that students in the PowerPoint section of the course scored higher on the Chapter 21 quiz than students in the traditional section. However, students with a higher habitual use of imagery scored lower in the PowerPoint section of the course. These later results are in the opposite direction of hypothesis 1a.

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[5] There was no significant correlation ($p>0.07$) between the covariates and the independent variable.

[6] Levene's test of the homogeneity of variance was not significant for all quizzes indicating that the error variance of the dependent variable was equal across both sections.

[7] The correlation between GPA and study extent was 0.005 ($p=0.97$), indicating no problem regarding multicollinearity in our study.

TABLE 2
Summary of Analysis of Covariance
Test of Hypothesis 1

Independent Variable	Chapter 15 Quiz				Chapter 17 Quiz				Chapter 19 Quiz				Chapter 20 Quiz				Chapter 21 Quiz				Chapter 22 Quiz			
	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p
Overall GPA (covariate)	7.01	1	3.29	.075	0.44	1	0.30	.584	22.49	1	5.23	.026	4.71	1	1.13	.293	18.41	1	9.64	.003	16.20	1	6.53	.014
Study Extent (covariate)	1.31	1	0.61	.437	0.31	1	0.22	.645	3.76	1	0.87	.354	14.78	1	3.55	.065	0.72	1	0.38	.543	2.57	1	1.04	.314
Treatment	1.61	1	0.75	.389	6.41	1	4.48	.032**	1.50	1	0.35	.558	2.31	1	0.56	.459	0.35	1	0.18	.670	24.66	1	9.95	.003*
Error	115.18	54			70.77	49			223.66	52			208.10	50			99.33	52			121.51	49		
Model R-Square	0.085				0.092				0.109				0.090				0.164				0.286			

Least Squares Cell Means[b]

Independent Variable	Chapter 15 Quiz Score	Chapter 17 Quiz Score	Chapter 19 Quiz Score	Chapter 20 Quiz Score	Chapter 21 Quiz Score	Chapter 22 Quiz Score
Traditional Treatment	8.786	8.533	5.836	8.163	8.055	8.988
PowerPoint Treatment	8.444	9.291	6.175	7.741	8.219	7.575
P-value	0.389	0.032**	0.558	0.459	0.670	0.003*

[a] All reported SS are the SS adjusted for the covariates.
[b] P-value tests the null hypothesis that the least-squares mean for traditional treatment is equal to the least-squares mean for PowerPoint treatment.

* $p<.01$ ** $p<0.05$

TABLE 3
Interactive Regression Analysis
Test of Hypothesis 1a

Panel A, Chapter 21 Quiz (Quiz 7)

Regression Model: Quiz 7=$\beta_0 + \beta_1$OGPA + β_2SEBTQ + β_3SEC + β_4HUOI + β_5SEC*HUOI + e

Variable	Coefficient	t	Pr
Intercept	4.791	2.809	0.0071
OGPA[a]	1.353	3.623	0.0007
SEBTQ[b]	-0.146	-1.422	0.1614
SEC[c]	4.754	2.194	0.0330
HUOI[d]	-0.015	-0.175	0.8617
SEC*HUOI	-0.394	-2.162	0.0356*

$R^2 = 0.28$, Adjusted $R^2 = 0.21$, $F(5,49) = 3.81$, $p = 0.005$

Panel B, Chapter 15 Quiz (Quiz 2)

Regression Model: Quiz 2=$\beta_0 + \beta_1$OGPA + β_2SEBTQ + β_3SEC + β_4UISP + β_5SEC*UISP + e

Variable	Coefficient	t	Pr
Intercept	9.095	5.117	0.0001
OGPA[a]	0.396	1.138	0.2604
SEBTQ[b]	-0.111	-1.192	0.2389
SEC[c]	-3.704	-2.466	0.0107
UISP[e]	-0.678	-1.383	0.1726
SEC*UISP	1.848	2.339	0.0233*

$R^2 = 0.17$, Adjusted $R^2 = 0.08$, $F(5,51) = 2.03$, $p = 0.09$

[a] OGPA = Overall GPA
[b] SEBTQ = Study extent before taking quizzes
[c] SEC = Section of the course (0 = Traditional; 1 = PowerPoint)
[d] HUOI = Habitual use of imagery
[e] UISP = Use of imagery to solve problems

* $p<0.05$

The second preferred representation style factor tested was the use of imagery to solve problems. This factor had a mean of 1.76 (theoretical range 0-2; actual range 0-2) and a standard deviation of 0.55. The coefficient alpha for this factor was 0.60, which is low for a two-item scale. The factor consisted of two similarly worded items: "By using mental pictures of the elements of a problem, I am often able to arrive at a solution" and "I often use mental pictures to solve problems." Therefore, hypothesis 1a posits that students high on this factor who attend the PowerPoint section may be able to recall and solve accounting issues better.

The results of regression analysis, presented in Panel B of Table 3, show a significant interaction for the Chapter 15 quiz. No statistically significant interactions were found for other quizzes, so they are not reported. The findings reveal that students in the PowerPoint section of the course scored lower on the Chapter 15 quiz than students in the traditional section. However, students with higher use of imagery to solve problems scored higher in the PowerPoint section of the course. The significant interaction may suggest that for more difficult and challenging chapters such as Chapter 15 (debt and equity financing) that require more problem-solving skills, students with greater use of imagery to solve problems in the PowerPoint section performed better than did students in the traditional section.

The results of the interaction analysis, in general, do not support an interaction between students' preferred representation style and section. The interaction term was significant for only two quizzes, one in the opposite direction and one in the hypothesized direction. These results indicate that the interaction between representation style and section on students' performance may depend upon the topic under discussion.

Hypothesis Two and Two(a)—Longer-Term Performance Effects

Hypothesis 2 investigates the effect of PowerPoint presentations on students' long-term memory. To examine whether the use of PowerPoint enhances students' long-term memory, ANCOVA was conducted with exam scores as the dependent variable, overall GPA as the covariate, and section as the independent variable. The effects of section were statistically insignificant for both conceptual exams and for exercise/problem exams ($p<0.70$); thus, they are not reported in the study. Hypothesis 2 is not supported.

Hypothesis 2a predicts an interaction between students' preferred representation styles and the section affecting the exam scores. Regression analyses were run with exam scores as dependent variables, and overall GPA, section, preferred representation style, and interaction between representation style and section as independent variables. None of the interaction terms was significant. Therefore, the results do not support hypothesis 2a.

Hypothesis Three—Media Effects on Attitudes Toward Class Presentation

Hypothesis 3 deals with subjects' attitudes toward the class presentation. Data for this hypothesis were gathered through a questionnaire administered at the end of the semester. Factor analysis was used to identify factors underlying subjects' attitudes toward the class presentation.

Similar to Butler and Mautz (1996), initial principal factor analysis of subjects' responses to the ten-item questionnaire revealed two factors with eigenvalues greater than 1.0, accounting for 66.2% of the observed variation in attitudes. This was followed by a VARIMAX rotation to facilitate interpretation of the underlying factors. The two factors were named understandability and

entertainment. The two factors had internal consistency reliability coefficients of 0.83 and 0.89, respectively. The results of the factor loadings are presented in Table 4.

Hypothesis 3 posits that students in the PowerPoint section are likely to report higher understandability about class presentations and better entertainment than are students in the traditional section. To test this hypothesis, two ANCOVAs were conducted. Understandability and entertainment scores served as dependent variables, total exam grades for the first and second midterm as the covariate, and section as the independent variable.

Results presented in Table 5 show that students in the PowerPoint section reported higher understandability of the presented materials. However, these results must be interpreted cautiously, as the model R^2s are low. There were no significant differences on the entertainment factor between the PowerPoint and traditional sections.

Hypothesis Four—Attitudes Towards the Instructor

Hypothesis 4 deals with subjects' attitudes toward the course instructor. A procedure similar to hypothesis three was used to analyze the 17-item questionnaire regarding the course instructor. One question dealt with time efficiency, so it was dropped from factor analysis.[8] The initial principal factor analysis of the sixteen items yielded three factors with eigenvalues greater than 1.0 that accounted for 64.0% of the observed variation. After VARIMAX rotation, the three factors were named informativeness, effectiveness, and preparedness. The three factors had internal consistency reliability coefficients of 0.89, 0.82, and 0.78, respectively. The results of the factor loadings are presented in Table 6.

Hypothesis 4 posits that students in the PowerPoint section are more likely to report the instructor informative, effective, prepared, and time-efficient than students in traditional section. In

TABLE 4
Factor Loadings of Class Presentation Attitudes

Question	Factor 1 Understandability	Factor 2 Entertainment
The class presentations were:		
Well-documented	**0.87**	-0.11
Strong	**0.66**	0.38
Concise	**0.67**	0.18
Easy to understand	**0.73**	0.21
Professional	**0.69**	0.15
Clear	**0.70**	0.43
Enjoyable	0.31	**0.82**
Entertaining	0.27	**0.81**
Stimulating	0.18	**0.83**
Interesting	0.00	**0.91**

[8] Including this item for factor analysis will not allow interpretable factor solutions. Thus, it was dropped from factor analysis and was used as a separate attitude toward the instructor.

TABLE 5
Summary of Analysis of Covariance
Effect of PowerPoint on Student Attitudes Towards Presentation
Test of Hypothesis 3

Independent Variable	Understandability				Entertainment			
	SSs[a]	df	F	p	SS	df	F	p
Midterm Grades	9.997	1	0.36	0.5492	73.801	1	2.26	0.1386
Section	179.798	1	6.53	0.0133 *	42.925	1	1.31	0.2568
Error	1,541.888	56			1,831.037	56		
R^2		0.11				0.05		

Least Squares Cell Means[b]

Independent Variable	Understandability	Entertainment
Traditional Section	32.173	17.172
PowerPoint Section	35.698	15.449
P-value	0.0133	0.2568

[a] All reported SS are the SS adjusted for the covariate.
[b] p-value tests the null hypothesis that the least square mean for traditional treatment is equal to the least square mean for PowerPoint treatment.

* $p<0.05$

addition, students in the PowerPoint section are predicted to rate the overall performance of the instructor higher than are students in the traditional section. To test this hypothesis, a series of ANCOVAs were conducted. Informativeness, effectiveness, preparedness, time efficiency, and overall performance scores served as individual dependent variables, while total exam grades for the first and second midterm served as the covariate, and section as the independent variable in each analysis. The findings are presented in Table 7.

Results presented in Table 7 indicate that students in the PowerPoint section perceived the instructor as being more prepared than did students in the traditional section ($p<0.10$). While these results may suggest an effect of PowerPoint on instructor preparedness, the low model R^2s and alpha benchmarks require caution in interpreting the results. No differences were found on the students' attitudes toward the instructor on measures of informativeness, effectiveness, time efficiency, and overall performance.[9]

[9] Students' preferred representation style might interact with the section to affect their attitudes toward the class presentation and instructor. To test these possibilities, 14 regression analyses were run with attitudes toward the class presentation (understandability and entertainment) and instructor (informativeness, effectiveness, preparedness, time

TABLE 6
Factor Loadings of Attitudes Toward the Instructor

Question	Factor 1 Informativeness	Factor 2 Effectiveness	Factor 3 Preparedness
With respect to lecture presentation, the instructor was:			
Concise	**0.62**	0.13	0.52
Clear	**0.83**	0.07	0.33
Inspiring	**0.68**	0.38	0.16
Understandable	**0.81**	0.28	0.09
Interesting	**0.68**	0.38	0.00
Strong	**0.76**	0.31	0.23
Effective in use of materials	0.38	**0.65**	0.23
Prepared	0.12	-0.06	**0.81**
Professional	0.14	0.09	**0.76**
Credible	0.40	0.35	0.40
The instructor was receptive and responsive to student needs, questions, and concerns	0.17	**0.55**	0.41
The instructor assigns course work that is challenging and helps me to learn	0.11	**0.68**	0.23
The instructor presents course material in a manner that helps me learn	0.36	**0.79**	0.00
The instructor challenges me to think	0.41	**0.72**	0.01
The instructor presents material in a well-organized fashion	0.15	0.34	**0.65**
The instructor is well prepared for each class	0.16	0.49	**0.67**

DISCUSSION AND IMPLICATIONS

The purpose of this research was to examine the effect of PowerPoint presentations throughout a semester on short-term and long-term memory as well as on students' attitudes toward the presentation and the presenter. Overall, the results support the hypotheses that test the effect of PowerPoint on the presentation (hypothesis 3) and on the presenter (hypothesis 4).

efficiency, and overall performance) as dependent variables and midterm exam grades, representation styles (i.e., habitual use of imagery and use of imagery to solve problems), section, and interaction between representation style and section as independent variables. There were no significant interactions between representation style and section affecting students' attitudes toward the class presentation and instructor.

TABLE 7
Summary of Analysis of Covariance
Effect of PowerPoint on Student Attitudes Towards Instructor
Test of Hypothesis 4

Independent Variable	Informativeness				Effectiveness				Preparedness				Time Efficiency				Overall Performance			
	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p	SS[a]	df	F	p
Midterm Grades	0.64	1	0.02	.900	12.11	1	0.76	.386	0.07	1	0.02	.885	0.08	1	0.07	.786	0.13	1	0.01	.910
Treatment	1.97	1	0.05	.825	1.27	1	0.08	.779	12.27	1	3.53	.065*	0.57	1	0.50	.481	0.00	1	0.00	.979
Error	2,223.41	56			889.50	56			194.56	56			62.98	56			54.12	56		
Model R-Square	0.0001				0.015				0.059				0.010				0.00			

Least Squares Cell Means[b]

Independent Variable	Informativeness	Effectiveness	Preparedness	Time Efficiency	Overall Performance
Traditional Treatment	31.173	29.535	25.551	6.264	5.776
PowerPoint Treatment	31.542	29.142	26.472	6.059	5.783
P-value	0.925	0.7080	0.0654*	0.4650	0.9794

[a] All reported SS are the SS adjusted for the covariates.
[b] P-value tests the null hypothesis that the least-squares mean for traditional treatment is equal to the least-squares mean for PowerPoint treatment.

* $p<.10$

The first hypothesis examines whether the PowerPoint enhances *short-term* memory such that students will recall more information than do students in a traditional classroom presentation. The results show that the impact of PowerPoint on *short-term* memory might depend on other factors such as the topic under discussion and the students' preferred representation styles.

For more difficult and challenging chapters (those that require more problem-solving, such as debt and equity financing topics), students with higher use of imagery performed better on quizzes in the PowerPoint section than did students in the traditional section. For the chapter that was more discussion-oriented (i.e., the chapter with human resources topics), students in the PowerPoint section outperformed students in the traditional section, irrespective of students' preferred representation style. For the chapter that required walk-through solutions (i.e., firm performance probability), students in the traditional section outperformed students in the PowerPoint section on quizzes. While Butler and Mautz (1996) found a statistically significant interaction between students' preferred representation style and the use of multimedia, our analysis suggests that the interaction between PowerPoint presentations and preferred representation style on students' *short-term* memory is complex, and that it also depends on other factors such as the topic under discussion.

This study also examined whether PowerPoint presentations improve *long-term* memory such that students will recall more information in exams than students in traditional classroom presentations. The results indicate that there were no differences between the two sections on exams and, therefore, the use of PowerPoint had no effect on students' *long-term* memory. Neither was there any interaction between students' preferred representation styles and PowerPoint presentations affecting long-term memory, again suggesting that PowerPoint presentations had no effect on *long-term* memory.

Further, this study examined students' attitudes toward the classroom presentation and instructor. The results demonstrated that students in the PowerPoint section reported higher understandability about classroom presentation. No difference was found between the two sections on the measure of entertainment. Butler and Mautz (1996) find entertaining as a significant factor, with subjects in the multimedia group reporting presentations being more entertaining. The inconsistency between the two studies could be due to the repeated use of PowerPoint in this study. That is, Butler and Mautz (1996) conducted their study in a laboratory setting lasting thirty minutes, while the present study was conducted over a semester-long period. It is possible that since the PowerPoint presentations were made repeatedly throughout the semester, students did not perceive it as entertaining by the end of the semester. In other words, the significant results for the factor entertaining in the work of Butler and Mautz (1996) may be due to Clark's "novelty" effect of new media (Clark, 1983).

The results also showed that students in the PowerPoint section perceived the instructor as more prepared than did the students in the traditional section. However, no differences were found on the students' attitudes toward the instructor on measures of informativeness, effectiveness, time efficiencies, and overall performance.

CONCLUSIONS AND LIMITATIONS

In summary, the results suggest that educational technology such as PowerPoint improves students' attitudes toward the instructor and course presentation. In addition, the results suggest that PowerPoint presentations may improve short-term memory depending on the topic under discussion

and the students' preferred representation style. Additional research with a larger sample might provide more conclusive evidence of the use of PowerPoint on short-term memory. No significant effect of PowerPoint presentations was found on *long-term* memory. These results are consistent with other studies that show media alone do not influence learning (Thompson et al. 1992; Clark 1983; 1994).

Our conclusions and findings are subject to several limitations. First, a significant limitation is the internal validity of the study. The experiment was conducted over a semester, and as a result, other factors beyond the control of the experimenter may have affected the results. Second, the quasi-experimental design (including non-random assignment) employed in the study may be subject to differences between the two sections that are fundamental to the groups but of which the experimenter is unaware. These threats were mitigated by the careful choice and inclusion of covariates in the analysis. Third, the same instructor taught both sections in back-to-back classes. This raises the possibility of instructor fatigue as an issue that biases against the null hypothesis. Fourth, the results should be applied cautiously to other settings since the demographics of students in this study may differ from students in other institutions.[10] Future studies can examine whether the same results emerge under different settings. Fifth, the findings also may have been affected by the way PowerPoint slides were constructed and organized. That is, poor PowerPoint slides could affect learning and satisfaction. This study used the PowerPoint slides that came with the textbook. Future research can examine whether different types of PowerPoint slides (poorly-designed vs. well-designed) affect students' learning and attitudes. Finally, the results of this study must be interpreted cautiously, given the low model R^2s and alpha benchmarks. More research would be required to establish stronger claims as to the effect of PowerPoint on memory and presenter/presentation effects.

REFERENCES

Ainsworth, P., D. Deines, C. X. Larson, and R. D. Plumlee. 1999. *Introduction to Accounting: An Integrated Approach (Volume 2)*. (New York, Mcgraw Hill/Irwin).

Allen, C. K. 1990. Encoding of Colors in Short-Term Memory. *Perceptual and Motor Skills*, (Vol. 71) 211-215.

Bartsch, R. A., and K. M. Cobern. 2003. Effectiveness of PowerPoint Presentation in Lectures. *Computers & Education* (Vol. 41) 77-86.

Bryant, S. M., and J. E. Hunton. 2000. The Use of Technology in the Delivery of Instruction: Implications for Accounting Educators and Education Researchers. *Issues in Accounting Education* (Vol. 15, No. 1) 129-162.

Bushong, S. 1998. Utilization of PowerPoint Presentation Software in Library Instruction of Subject-Specific Reference Sources. Unpublished master's research paper, Kent State University.

Butler, J. B., and R. D. Mautz, Jr. 1996. Multimedia Presentations and Learning: A Laboratory Experiment. *Issues in Accounting Education* (Vol. 11, No.2) 259-280.

Clark, J. M., and A. Paivio. 1991. Dual Coding Theory and Education. *Educational Psychology Review* (Vol. 3, No. 3) 149-210.

[10] For example, the average SAT score of students in this study was about 1200; this may differ from other institutions.

Clark, R. E. 1983. Reconsidering Research on Learning from Media. *Review of Educational Research* (Vol. 53, No. 4) 445-459.

_____. 1994. Media Will Never Influence Learning. *Educational Technology Research and Development* (Vol. 42, No. 2) 21-29.

Cohen, B. H., and M. Saslona. 1990. The Advantage of Being a Habitual Visualizer. *Journal of Mental Imagery* (Fall/Winter) 101-112.

Connor, M., and Irene F. H. Wong. 2004. Working through PowerPoint: A Global Prism for Local Reflections. *Business Communication Quarterly* (Vol. 67, No. 2) 228-231.

Cook, D. M. 1998. The Power of PowerPoint. *Nurse Educator* (Vol. 23, No. 4) 5.

Dwyer, C. A., and R. J. Lamberski. 1983. A Review of the Research on the Effects of the Use of Color in the Teaching-Learning Process. *International Journal of Instructional Media* (Vol. 10) 303-28.

Hanna, A., and R. Remington. 1996. The Representation of Color and Form in Long-Term Memory. *Memory and Cognition* (Vol. 24) 322-30.

Harrison, A. 1999. Power Up! Stimulating your Students with PowerPoint. *Learning and Leading With Technology* (Vol. 26, No. 4) 6-9.

Harshman, R. A., and A. Paivio. 1987. "Paradoxical" Sex Differences in Self-Reported Imagery. *Canadian Journal of Psychology* (September) 287-302.

Kozma, R. B. 1994. Will Media Influence Learning? Reframing the debate. *Educational Technology Research and Development* (Vol. 42, No. 2) 7-19.

Mason R., and D. Hlynka. 1998. PowerPoint in the Classroom: What is the Point? *Educational Technology* (September-October) 45-48.

Mayer, R. E., and R. B. Anderson. 1991. Animations Need Narrations: An Experimental Test of a Dual-Coding Hypothesis. *Journal of Educational Psychology* (Vol. 83, No. 4) 484-490.

McInnes, W. M., D. Pyper, R.Van Der Meer, and R. A. Wilson. 1995. Computer-Aided Learning in Accounting: Educational and Managerial Perspectives. *Accounting Education* (Vol. 4, No. 4) 319-334.

Moore, D. M., J. K. Burton, and R. J. Myers. 1996. Multiple-Channel Communication: The Theoretical and Research Foundations of Multimedia. In *Handbook of Research for Educational Communications and Technology*, edited by D. Jonnasen. (New York: Simon & Schuster Macmillan).

Nowaczyk, R. H., L. T. Santos, and C. Patron. 1998. Student Perception of Multimedia in the Undergraduate Classroom. *International Journal of Instructional Media* (Vol. 25, No. 4) 367-383.

Olson, D. L., J. Eliot, and R. C. Hardy. 1988. Relationships Between Activities and Sex-Related Differences in Performance on Spatial Tests. *Perceptual and Motor Skills* (August) 223-232.

Oppenheim, L., C. Kydd, and V. P. Carroll. 1981. A Study on the Effects of the Use of Overhead Transparencies on Business Meetings. Working paper, Wharton Applied Research Center of the University of Pennsylvania.

Overby, L. Y. 1990. A Comparison of Novice and Experienced Dancers' Imagery Ability. *Journal of Mental Imagery* (Fall/Winter) 173-184.

Paivio, A. 1986. *Mental representations: A dual coding approach*. (New York: Oxford University Press).

_____. 1990. *Mental Representations: A Dual Coding Approach*. (New York: Oxford University Press). (Republished as Oxford Psychology Series No. 9).

_____, and R. Harshman. 1983. Factor Analysis of a Questionnaire on Imagery and Verbal Habits and Skills. *Canadian Journal of Psychology* (Vol. 37, No. 4) 461-483.

Parks, R. P. 1999. Macro Principles, PowerPoint, and the Internet: Four years of the Good, the Bad, and the Ugly. *Journal of Economic Education* (Summer) 200-209.

Peek, J. 1987. The Role of Illustrations in Processing and Remembering Illustrated Text. In D. M. Willows & H.A. Houghton *The Psychology of Illustration, (Volume 1): Basic Research.* (New York: Springer).

Pei, B. K.W., and J. H. Reneau. 1990. The Effects of Memory Structure on Using Rule- Based Expert Systems for Training: A Framework and an Empirical Test. *Decision Sciences* (Spring) 263-86.

Rebele, J. E., B. A. Apostolou, F. A. Buckless, J. M. Hassell, L. R. Paquette, and D. E. Stout. 1998. Accounting Education Literature Review (1991-1997), Part II: Students, Educational Technology, Assessment, and Faculty Issues. *Journal of Accounting Education* (Vol. 16, No. 2) 179-245.

Reynolds, R.E. and D. R. Baker. 1987. The Utility of Graphical Representations in Text: Some Theoretical and Empirical Issues. *Journal of Research in Science Teaching* (Vol. 24, No. 2) 161-73.

Rose, J. 2001. Web-Based Instruction and Financial Reporting: The Effect of Pictures on the Acquisition and Recall of Financial Information. *The New Review of Applied Expert Systems,* 13-31.

Steinbart, P. J., and W. L. Accola. 1994. The Relative Effectiveness of Alternative Explanation Formats and User Involvement on Knowledge Transfer from Expert Systems. Paper presented to AIS Research Symposium (February 3-5). Phoenix, AZ.

Thompson, A. D., M. R. Simonson, and C. P. Hargrave. 1992. Educational Technology: A Review of Research. (Washington, D.C.: Association for Educational Communications and Technology).