Computers & Education 85 (2015) 14–22

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

To provide or not to provide course PowerPoint slides? The impact of instructor-provided slides upon student attendance and performance

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ARTICLE INFO

Article history:
Received 22 September 2014
Received in revised form
30 January 2015
Accepted 2 February 2015
Available online 11 February 2015

Keywords:
PowerPoint
Instructor-provided slides
Student notetaking
Class attendance
Student performance

ABSTRACT

As PowerPoint has pervaded today's college classrooms, instructors have struggled with the issue of whether or not to provide students' with copies of course PowerPoint slides (instructor-provided slides). While students report that such slides assist them academically, many instructors have expressed concerns that these slides encourage absenteeism and classroom passivity. To help assess the academic impact of instructor-provided slides, the present study examined two semesters of students' progress in a communication theory course. Across these semesters, the study charted the relationship between access/use of various types of instructor-provided slides on class attendance and exam performance. In its key findings, the study found that instructor-provided slides had no impact on class attendance and an adverse impact on course performance for students using these slides in their notetaking process.

1. Introduction

PowerPoint has become an omnipresent accompaniment to lectures in today's university classrooms. Unfortunately, its ever-expanding influence in the classroom has failed to produce a comparable expansion in learning outcomes. In their extensive review of research on the effects of PowerPoint in the classroom, Levasseur and Sawyer (2006) point out that the "majority of studies comparing computer-generated slide-based instruction (i.e. PowerPoint instruction) against other instructional methods have failed to find significant differences in learning outcomes" (p. 116). This review also uncovered another interesting fact. Specifically, the only studies to find learning improvements from PowerPoint involved more than merely adding slides to the classroom environment; in these studies students also had online access to copies of course slides. This would seemingly suggest that if instructors want their PowerPoint slides to lead to more learning, then they will also need to make the slides accessible to their students.

Providing such accessibility has become remarkably easy as integrated learning systems, such as Blackboard, Canvas, and Desire2Learn, have become a pervasive part of the learning process in higher education. One recent survey found that 99% of higher education institutions utilize a learning system and that roughly 85% of faculty use that system to store course content (Dahlstrom, Brooks, & Bichsel, 2014). Through such online platforms, instructors can effortlessly upload copies of course slides that students can subsequently download at their convenience. In fact, posting online copies of course slides has become so ubiquitous that students have come to expect easy access to them (Adams, 2005; Babb & Ross, 2009; Gabriel, 2008).

Running counter to these expectations, many instructors are hesitant to provide copies of their slides to students because of the many questions still circulating on the topic of instructor provided slides (IP slides). Such questions include: do IP slides have only positive pedagogical effects? Are some forms of IP slides better than others? And do IP slides benefit some students more than others? The present study seeks to shed light on these and related questions and thereby enhance our understanding of the overall pedagogical effects of bringing PowerPoint (PPT) into the classroom.

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http://dx.doi.org/10.1016/j.compedu.2015.02.002
0360-1315/

1.1. The pedagogical debate over IP slides

While the question of whether or not to provide students with copies of course PPT slides seems simple and straightforward, answering this question is actually quite complex. At the simplest level, an instructor's decision to grant students access to copies of course slides is likely to be popular. College students consistently report positive attitudes toward IP slides (Ahmadi, Dileepan, & Raiszadeh, 2007; Apperson, Laws, & Scepansky, 2008; Babb & Ross, 2009; Hill, Arford, Lubitow, & Smollin, 2012; James, Burke, & Hutchins, 2006). Why such positive attitudes? When IP slides are available, students report that they are better able to attend to class lecture (Gurrie & Fair, 2010; Mantei, 2000) and to compile a more complete set of course notes (Frey & Birnbaum, 2002).

The literature on student notetaking seems to support students' belief that IP slides will lead to improved course performance (see Armbruster, 2000; Williams & Eggert, 2002). This literature has been fairly consistent and conclusive on two points. First, there is a strong correlation between the quality of notetaking in a course and course performance. Second, students are ineffectual notetakers. Studies typically show that college students record "somewhere in the 30%–40% range of lecture points" (Williams & Eggert, 2002, p. 176). Thus, practically any help a professor can provide with regard to course notetaking is likely to enhance student achievement levels. One way instructors can help is by allowing students access to course PPT slides.

1.1.1. The function of notes

Understanding the effects of IP slides takes on an additional layer of complexity when one considers the two distinct learning functions served by course notes: an *external storage* function and an *encoding* function (DiVesta & Gray, 1972). As an external storage function, course notes essentially store course content so that students can later review that content in preparation for course exams and assignments. The encoding function refers to learning that takes place as students actively record and translate course lectures into course notes. Basically, both "the *process* and the *product* of notetaking affect academic achievement" (emphasis added, Williams & Eggert, 2002, p. 180). Optimal notetaking fulfills both functions (Fisher & Harris, 1973; Kiewra et al., 1991).

Since they generally contain detailed depictions of projected course content, IP slides should assist students with the external storage function associated with course notes. Thus, the debate over IP slides largely centers on whether supplying such slides undermines the encoding function fulfilled by active notetaking. Instructors have voiced the concern that students who come to class with IP slides become passive spectators rather than active learners (e.g. Craig & Amernic, 2006; Quible, 2002). In one survey of business school faculty members (O'Quigley, 2011), 63% of respondents indicated that giving students course slides discourages students from assembling their own notes. In short, many instructors fear that IP slides encourage less encoding and that less encoding will translate into less learning.

1.1.2. IP slides and student attendance

Additionally, some instructors fear that IP slides will lead to less classroom attendance. After all, if students supplied with IP slides perceive that they already have a full set of course notes, then why bother coming to class at all? Anecdotally, some professors have reported that providing students with class slides produced a discernible drop in class attendance (e.g. Weatherly, Grabe, & Arthur, 2002–2003; Young, 2004). Students, however, have consistently relayed that having access to course slides in no way alters their attendance decisions (Ahmadi et al., 2007; Burke & James, 2008; Cornelius & Owen-DeSchryver, 2008; Debevec, Shih, & Kashyap, 2006). The faculty/student divide over the relationship between IP slides and attendance is evident in a survey conducted by James et al. (2006). In their survey, which compared student and faculty impressions of PPT, most faculty expressed the opinion that students are "less likely to attend class when the professor posts PPT handouts to the Web" (p. 389), while most students disagreed. Unfortunately, studies attempting to uncover an attendance effect generated by IP slides have largely relied upon self-report data rather than tracking actual student attendance rates (e.g. Ahmadi et al., 2007; Burke & James, 2008; Grabe, 2005). Given students' and instructors' divergent viewpoints on how IP slides affect course attendance, the present study asks the following research question:

RQ1. Will attendance rates differ between students with access to course PowerPoint slides and students without access to course PowerPoint slides?

1.1.3. Impact on student achievement

Thus far, this review has presented a rather mixed picture of the impact of IP slides—a picture that depicts such slides potentially assisting or undermining the notetaking process and adversely or inconsequently affecting class attendance. Only a handful of experimental studies have attempted to isolate the educational impact of IP slides. Austin, Lee, and Carr (2004) examined the effect that IP slides had on undergraduates enrolled in an applied psychology course. In the first of three conditions, students experienced traditional lectures. Next, class lectures incorporated PPT slides. Finally, students received partial copies of course PPT slides at the beginning of lecture. These partial slides "were essentially copies of the slides" presented in class "with parts missing" (p. 316). A review of student notes revealed that students who received IP slides compiled a more complete set of course notes. Similarly positive results for IP slides were obtained by Chen and Lin (2008). Monitoring IP slide use by Taiwanese students enrolled in a microeconomics course, they found that, on average, approximately 50% of the students downloaded the IP slides before coming to class, and that these students scored higher marks on course exams (roughly 4% better) than their counterparts who did not download the slides. Thus, Chen & Lin concluded that instructors can "help students improve their learning outcomes by supplying lecture PowerPoint slides before classes" (2008, p. 17).

This sentiment is not shared by all. For instance, Debevec et al. (2006) studied the impact of access to IP slides upon students taking a promotion strategy course. Survey results revealed no clear relationship between downloading course slides before class and course performance. In fact, their study uncovered a negative association between "taking notes in class using PowerPoint slides" and scores on course exams (p. 303). Such negative results also surfaced in a study conducted by Weatherly et al. (2002–2003). In their research, students enrolled in one section of an introduction to psychology class had online access to course PPT slides while the students enrolled in another section did not. Students with access to IP slides actually performed more poorly than their counterparts without access.

To date, the literature on the effects of IP slides presents a mixed picture of whether such slides positively or adversely affect student performance. Consequently, we ask:

RQ2. Will students with access to copies of course slides achieve higher scores on course exam questions pertaining to those slides than students without such access?

Of course, access to copies of course slides is not the same as actually making use of those copies. In fact, research has shown that many students with access to copies of course slides don't take advantage of that access (Chen & Lin, 2008; Debevec et al., 2006). Thus, in order to more fully explore how student use of IP slides relates to their course performance, the present study investigates the following research question:

RQ3. Will students utilizing copies of course slides in the notetaking process achieve higher scores on course exam questions pertaining to those slides than students who do not use copies of course slides to take notes?

1.2. What type of slides to provide?

As online delivery has become increasingly important in higher education, a number of studies have addressed the effects of various forms of online class notes (Murphy & Cross, 2002; Pardini, Domizi, Forbes, & Pettis, 2005; Vandehey, Marsh, & Diekhoff, 2005). However, far less research has examined the impact of various types of IP slides. An instructor who decides to provide his or her students with course slides still faces the critical decision of exactly what *type* of slides to provide. One body of research that might assist with this decision is the work on *full* versus *partial notes* (for a review see Kiewra, 1985). Full notes provide students with a complete, verbatim copy of course lecture, while partial notes provide students with only a portion of the overall lecture (e.g. key words, a basic outline, etc.). During class, students must flesh out partial notes to convert them into complete course notes. Given their notoriously poor notetaking skills, research has understandably revealed that students' academic performance tends to improve when they receive either a full set of notes (Kiewra, 1985; Knight & McKelvie, 1986) or a partial set of notes (Austin, Lee, Thibeault, Carr, & Bailey, 2002; Kauffman, 2004). Notably, students receiving partial notes often outperform those with full notes (Cornelius & Owen-DeSchryver, 2008; Grabe, Christopherson, & Douglas, 2004–2005).

Just as some research has endeavored to discern the effects of full versus partial instructor-provided notes, some researchers have explored the effects of full versus partial IP slides. For example, Cornelius and Owen-DeSchryver (2008) examined two introductory psychology classes. In one class, students could access IP slides containing a complete set of course notes, while students in the other class could only access slides made up "largely of headings and titles of definitions and concepts, which required students to add information to complete the notes" (p. 8). When the researchers compared academic performance across these two classes, they found that the students with access to partial IP slides outperformed their counterparts receiving full slides. Such research results may explain why a number of instructors have recommended that students should only receive partial copies of course slides (e.g. James et al., 2006; Quible, 2002; Young, 2004).

However, some research runs counter to such a suggestion. For instance, Stark-Wroblewski, Kreiner, Clause, Edelbaum, and Ziser (2006) gave one group of psychology students online access to copies of course PPT slides with missing words or phrases. Another group of students (students in another section of the same course) could access complete copies of course PowerPoint slides. No differences in student exam scores emerged across these two IP slide conditions. Similarly, Neef, McCord, and Ferreri (2006) conducted an experiment involving 46 graduate students enrolled in two separate sections of a behavioral research methods course. Students in one section could go online and access full copies of course PowerPoint slides. Students in the other section could only obtain partial copies of course slides. While the students in the study expressed a clear preference for partial IP slides, there was no discernible difference in student performance. Given the inconsistent results in the research examining different types of IP slides, the present study examines the following research question:

RQ4. Will students who can access copies of course slides containing a full set of class notes outperform students who can only access course slides containing partial class notes?

1.3. Do IP slides affect all students equally?

If an instructor decides to give students access to course slides, will such access affect all students equally? Perhaps IP slides disproportionately benefit those most in need of help with the notetaking process—weaker notetakers who need help assembling stronger notes. Conversely, downloading slides before class requires both organizational skills and academic motivation. Thus, any positive effects from IP slides may primarily be passed along to more organized and motivated students. If so, then IP slides might accomplish little more than making the academically rich (better students) even richer as they use these slides to make a strong set of class notes even stronger.

Previous research in this area provides little guidance on this question. While some evidence does exist to suggest that better students are more likely to make use of IP slides (Chen & Lin, 2008; Grabe, 2005), no study has yet explored how the effects of providing IP slides vary across academic achievement levels. To further such an exploration, the present study incorporates the following research question:

RQ5. Does the effect of instructor-provided slides upon class performance vary by academic achievement levels?

2. Methods

2.1. Participants and setting

Participants were 204 students enrolled in a large lecture communication theory course at a northeastern university. The first group completed the class during the spring semester ($n = 108$), while the second group completed the course the following fall semester ($n = 96$). Data from students who dropped the class or stopped attending the class were excluded from the study. Students tended to be female (78%), approximately 20 years old (*Mean* = 20.41, *SD* = 3.01), and most were sophomores (41.8%), with the remaining students evenly divided across the other three student classifications (1st year, 20.4%; juniors, 19.4%; seniors, 18.4%). Students volunteering for the study reviewed an informed consent statement prior to their participation, and received extra credit for their time.

The communication theory class utilized in this study is a gateway course in a highly competitive process leading to admittance into the communication studies major. Thus, the grades students achieve in this class have personal consequences for being admitted to the major; the class produces a wide grade distribution.

Lectures consume the vast bulk of actual class time, and each lecture is accompanied by a set of PPT slides. The slides projected in class reflect general principles for effectively using PowerPoint (e.g. Doumont, 2002, 2005; Gross & Harmon, 2009). Such principles include using text sparingly on slides (i.e. bullet points made up of only key words or brief phrases), making slides visual, ensuring that any slide visuals are integrated with the verbal lecture message, avoiding non-relevant sounds and animations, etc. As part of this study, students were provided access to IP slides for the first time in the spring semester.

2.2. Experimental conditions and procedure

This study revolved around three separate lecture units focusing on elements of three distinct theories: Expectancy Violation Theory (EVT), the Interactional View (IV), and Face-Negotiation Theory (FNT). Each unit consumed approximately three days of class time.

This study utilized the same across sections/semesters quasi-experimental design employed in previous research to study the differential pedagogical effects of PPT (e.g. Daniels, 1999; Lumkes, 2009–2010; Mantei, 2000; Susskind, 2008; Weatherly et al., 2002–2003). In keeping with this design, the instructor and all course content, readings, and other materials were held constant across the two semesters incorporated into this study. Only the availability and type of course PPT slides varied across the conditions.

As seen in Table 1, there were three experimental conditions: No Slide, Partial Slide, or Full Slide. In the *No Slide* copy condition, students could not access any copies of the slides projected during course lecture. In the *Partial Slide* copy condition, students could log into the course website and download/print a copy of course slides formatted as PPT "handout" pages (i.e. three slides on the left side of the page with notetaking space on the right). Paralleling the "partial notes" concepts from the notetaking literature, these slides provided only key words/phrases. Thus, students attempting to assemble a complete set of course notes needed to expand on this slide content while listening to course lecture. Finally, in the *Full Slide* copy condition, students were able to download/print "handout" pages of slides to accompany course lecture. Paralleling the "full notes" design from the notetaking literature, these slides contained greater detail (i.e. a bulleted term along with a complete definition and explanation). Table 1 outlines the experimental conditions across each semester.

To examine the effects of providing students with partial slides, students enrolled in spring semester had *no* access to class slides for either the Expectancy Violation Theory (EVT-No PPT) or the Interactional View (IV-No PPT) lecture units, while their counterparts the following fall semester had access to *partial* slides (EVT-Part PPT and IV-Part PPT). To explore the effects of providing students with copies of different types of PPT slides, students enrolled in the spring semester had access to partial slides on Face-Negotiation Theory (FNT – Part PPT), while those enrolled the following fall semester, could print/download a set of full slides (FNT-Full PPT).

2.3. Dependent measures

2.3.1. Course attendance

Student attendance was compiled by distributing sign-in sheets during each class and tallied for the three days associated with each lecture unit.

2.3.2. Student performance

Student performance was measured by totaling correct responses to objective (i.e. multiple choice) questions from course exams. The course exams incorporated into this study included both the three non-cumulative exams given periodically throughout the semester as well as the cumulative final exam given at the end of the course. Thus, for each theory unit involved in this study, the researchers tabulated a student composite score reflecting the number of correct responses to questions on each unit across course exams. Some exam questions asked for simple regurgitation of material contained on course slides, while other questions demanded that students apply complex theoretical concepts to novel cases and conditions.

2.3.3. Student reactions to course slides/lectures

At the completion of each lecture unit involved in this study, subjects completed a survey assessing their reactions to course lecture and associated slides. This survey instrument was primarily comprised of 5-point Likert scales asking subjects their opinion (5/strongly agree to 1/strongly disagree) on statements such as "The class unit on Expectancy Violation Theory was informative" or "I found it difficult to take notes during the class unit on Expectancy Violation Theory." Students were also asked if they accessed copies of course slides (yes/no) and, if so, did they take them to class to take notes (yes/no) and/or did they use copies of course slides to study for course exams (yes/no).

3. Results

This study addressed five research questions. Research Question One asked whether attendance rates would differ between students who received access to course PPT slides and those who did not. To test this question, two independent t-tests were conducted. The first t-test compared the spring (No PPT) and fall (Part PPT) semester attendance rates of students for the lecture days associated with the

Table 1
Experimental conditions by semester/lecture unit.

	Expectancy Violation Theory Unit (EVT)	The Interactional View Unit (IV)	Face-Negotiation Theory Unit (FNT)
Spring semester	No slide copies	No slide copies	Partial slide copies
Fall semester	Partial slide copies	Partial slide copies	Full slide copies

Expectancy Violation Theory (EVT) Unit. Similarly, a second t-test compared student attendance rates associated with the two Interactional View (IV) Units (spring, No PPT; fall, Part PPT). As noted previously, three days of lecture were devoted to each lecture unit, and attendance for each day was totaled. Results of the t-tests revealed no significant difference in student attendance for either the EVT unit, $t(213) = 1.86$, $p > .05$, $d = .05$, or for the IV Unit, $t(213) = -.766$, $p > .05$, $d = .10$ (see Table 2). Thus, no statistical difference in attendance was found between students who had *no* access to course PPT slides and those who could access *partial* slides.

Research Question Two asked whether students who had access to course slides performed better on related exam questions than those that did not. Students received one point for each correct exam question. For each unit, scores of students who received no PPT slides (spring) and those who received partial PPT slides (fall) were compared. Results of the two independent t-tests reveal no significant difference between exam scores for the Expectancy Violation Theory Unit, $t(197) = -.801$, $p > .05$, $d = .11$, or for the Interactional View Unit, $t(197) = -1.58$, $p > .05$, $d = .22$. Access to partial slides did not result in greater academic achievement.

Research Question Three asked if students who utilized course slides to assist with their class notetaking outperformed classmates who did not. To address this question, students were divided into two groups – those who brought copies of the slides to class and those who did not – for each lecture unit where they were provided access to slides. Results of the independent t-test revealed that students who took EVT Unit slides with them to class as a notetaking aid (*Mean* = 9.93; *SD* = 2.44) scored lower on their exam questions than those who did not utilize the slides (*Mean* = 11.29; *SD* = 2.45), $t(90) = 2.67$, $p < .05$, $d = .56$. Next, exam scores of students who took slides to class to take notes on the IV Unit were compared against those who did not. As seen in Table 3, students who took slides to class achieved slightly lower exams scores than those who did not, $t(84) = .703$, $p > .05$, $d = .15$. However, this difference was not statistically significant. With regards to the FNT Unit, students in the spring semester received partial slides, while those enrolled the following fall semester received full slides. Results of the independent t-test for spring semester found that students who brought partial slides to class had lower scores on exam items testing them on this theory, than students who did not bring slide copies with them to class, $t(92.8) = 1.99$, $p < .05$. $d = .41$. When they brought the full slide copies of the same lecture to class, students again scored slightly lower than those who did not bring the slides to class. However, as seen in Table 3, this difference only approached significance, $t(91) = 1.67$, $p = .08$, $d = .35$.

Table 3 presents results of analysis for Research Question Four, which asked whether students with access to full slides would outperform students with access to partial slides. To test this question, FNT exam scores of students receiving a partial set of PPT slides (spring) were compared to those who received full slides (fall). Reflecting the findings for Research Questions One and Two, results of the independent t-test were not significant, $t(199) = -1.16$, $p > .05$, $d = 16$. Students with access to copies of full PowerPoint slides did not outperform those with access to only partial slides.

The final research question explored whether students with differing GPA achievement levels (high/medium/low) benefited differently based on the type of slides they could access (none vs. partial; partial vs. full). Student participants were divided into three academic achievement groups based upon a tertile split of their cumulative GPA: high (GPA = 3.20–4.00), medium (GPA = 2.71–3.19) and low (GPA = 2.7 or lower). A series of factorial ANOVAs were conducted using the summated exam scores for the dependent variable. The first two ANOVAs addressed the EVT and IV Units [3 (high/medium/low GPA) by 2 (no slide/partial slides)], while the second addressed the FNT Unit [3 (high/medium/low GPA) by 2 (partial slides/full slides)]. No significant interaction between GPA and slide condition was indicated for any of the three units – EVT, $F(2, 197) = 1.04$, $p > .05$, $\eta_p^2 = .011$; IV, $F(2, 197) = 1.28$, $p > .05$, $\eta_p^2 = .013$; FNT, $F(2, 197) = .58$, $p > .05$, $\eta_p^2 = .006$. Similarly, no significant differences were found for the main effect of slide condition for any of the lecture units: EVT, $F(1, 197) = 1.00$, $p > .05$, $\eta_p^2 = .006$; IV, $F(1, 197) = 2.39$, $p > .05$, $\eta_p^2 = .012$; FNT, $F(1, 197) = .69$, $p > .05$, $\eta_p^2 = .004$.

Not surprisingly, a main effect was indicated for GPA for each theory unit: EVT, $F(2, 197) = 15.77$, $p < .05$, $\eta_p^2 = .014$; IV, $F(44.38) = 1.28$, $\eta_p^2 = .031$, $p < .05$; FNT, $F(2, 197) = .58$, $p < .05$, $\eta_p^2 = .125$. Students with higher GPAs averaged higher exam scores (EVT, $M = 11.47$; IV, $M = 12.41$; FNT, $M = 7.45$), than students with a medium (EVT, $M = 10.15$; IV, $M = 11.05$; FNT, $M = 7.20$), or a low GPA (EVT, $M = 9.39$; IV, $M = 9.39$; FNT, $M = 6.46$). However, as noted above, no interaction between slide condition and GPA was found for any of the lecture units.

To further understand how academic achievement levels might relate to the use of course slides, we compared students based on their self-report responses to two survey items: whether they took the slides on a particular unit with them to class to assist in taking notes (yes/no), and if they utilized the slides when preparing for course exams (yes/no). A chi-square analysis was conducted to assess differences in responses on these survey items across the three GPA groups. The vast majority of students reported using slides, no matter the type, to study for exams. In comparison, far fewer students indicated that they brought the slides to class to assist in notetaking. However, as seen in Table 4, no statistically significant difference was found in student responses across GPA categories.

Table 2
Descriptive results of attendance and exam scores by semester/lecture unit.[a]

	Spring			Fall		*t*	*p*	*d*
	Mean	*SD*		*Mean*	*SD*			
Attendance[b] n = 108			Attendance[b] n = 96					
EVT: no PPT	2.23	.94	EVT: partial PPT	2.18	.93	1.86	.54	.25
IV: no PPT	2.34	.85	IV: partial PPT	2.53	.72	.76	.09	.10
FNT: partial PPT	2.31	.81	FNT: full PPT	2.38	.74	.18	.85	.02
Exam score[c] n = 104			Exam score[c] n = 95					
EVT: no PPT	6.99	1.28	EVT: partial PPT	7.12	1.09	−.80	.23	.11
IV: no PPT	10.75	2.30	IV: partial PPT	11.25	2.17	−1.58	.12	.22
FNT: partial PPT	10.21	2.15	FNT: full PPT	10.59	2.53	−1.16	.39	.16

[a] EVT = Expectance Violation Theory Unit; IV = Interactional View Unit; FNT = Face-Negotiation Theory.
[b] Number of days of lecture for each condition = 3.
[c] Number of exam questions for each condition: no PPT = 8; partial PPT = 14; full PPT = 14.

Table 3
Independent t-tests: impact of student slide use on academic performance.

Took slides to class	*Mean*	*SD*	*t*	*df*	*p*	*d*
Lecture (type of slide)						
*E*xpectancy violation (partial)						
Yes (n = 44)	9.93	2.44	2.67	90	.009	.56
No (n = 48)	11.29	2.45				
Interactional view (partial)						
Yes (n = 31)	11.09	2.71	.70	84	.48	.15
No (n = 55)	11.43	1.76				
Face negotiation: spring semester (partial)						
Yes (n = 44)	6.81	1.04	1.99	93	.04	.41
No (n = 51)	7.29	1.25				
Face negotiation: fall semester (full)						
Yes (n = 44)	6.95	1.16	1.67	91	.08	.35
No (n = 49)	7.32	.98				

Note: Correct responses to exam questions for each lecture were tallied; Number of exam questions for each condition: partial PPT = 14; full PPT = 14.
$^{*}p < .05$; $p = .08$.

Our research questions primarily focused on the differential effects that different types of PowerPoint slides may have on student attendance and performance. As seen above, these tests were primarily nonsignificant. To more fully explore what variables contributed to student performance, we ran a standard multiple regression analysis using exam performance for each lecture unit as the dependent variable and student cumulative GPA, use of slides in class, use of slides to study for the exam, and class attendance (for that lecture unit) as independent variables. These analyses utilized subjects from the Fall semester who had access to slides for all three topic areas. The goal was to explore the unique contribution that each variable had on exam performance. Results of each regression analysis are presented in Table 5. Not surprisingly, in all three analyses GPA was the strongest predictor of student performance. More specifically, EVT exam performance was predicted by GPA, class attendance, and taking slides (partial) to class, while FNT exam grades were predicted by GPA and bringing (full) slides to class. GPA and lecture attendance predicted IV exam performance. Reflecting the tests of difference above, bringing slides to class negatively impacted FNT and EVT exam performance. Of note, the variance accounted for by the regression models was much lower for the FNT analysis ($R^2 = .16$), than for the EVT ($R^2 = .39$) and IV ($R^2 = .40$) models. In summary, a student's overall academic ability as measured by GPA was the primary predictor for performance for all three communication theory topics, attending class was a predictor of performance on the EVT and the IV exams, and bringing slides to class negatively affected student performance on both EVT (partial slides) and FNT (full slides) exams.

4. Discussion

As PowerPoint has come to pervade today's college classrooms, it has sparked an ongoing debate as to whether or not instructors should supply their students with copies of course PPT slides. On one side of this debate are the students who want access to course slides and feel entitled to such access. Confirming this fact, 84% of students participating in the present study felt they should have access to copies of course PPT slides.

If students have such a strong desire to access course PPT slides, then why are many instructors hesitant to fulfill that desire? Our review of the literature revealed that many instructors are concerned about the academic impact of IP slides (e.g. James et al., 2006; Weatherly et al.,

Table 4
Chi-square analysis of slide utilization by lecture topic and student GPA.

Lecture/use of slides	GPA			
	Low n %	Medium n %	High n %	X^2 (df = 2)
Expectancy violation				
Took to class				
Yes (n = 44)	14 (31.8%)	14 (31.8%)	16 (36.4%)	.254
No (n = 48)	16 (33.3%)	13 (27.1%)	19 (39.6%)	
Study for exam				
Yes (n = 76)	24 (31.6%)	23 (30.3%)	29 (38.2%)	.268
No (n = 16)	6 (37.5%)	4 (25.0%)	6 (37.5%)	
Interactional view				
Took to class				
Yes (n = 32)	11 (34.4%)	11 (34.4%)	10 (31.3%)	.679
No (n = 55)	17 (30.9%)	16 (29.1%)	22 (40.0%)	
Study for exam				
Yes (n = 73)	24 (32.9%)	24 (32.9%)	25 (34.2%)	1.35
No (n = 14)	4 (28.6%)	3 (21.4%)	7 (50%)	
Face negotiation				
Took to class				
Yes (n = 90)	34 (37.8%)	22 (24.4%)	34 (37.8%)	3.48
No (n = 101)	27 (26.7%)	35 (34.7%)	39 (38.6%)	
Study for exam				
Yes (n = 167)	54 (32.3%)	49 (29.3%)	64 (38.3%)	.083
No (n = 25)	8 (32.0%)	8 (32.0%)	9 (36.0%)	

Note: GPA groups are based on a tertile split: high GPA = 3.20–4.00; medium GPA = 2.71–3.19; low GPA = 2.7 or lower; p > .05 for all X^2 results.

Table 5
Regression analysis predicting student performance on lecture exams.

Lecture area	*B*	*SE B*	*Beta*	*t*	*p*
Expectancy violation (partial slides)					
$R^2 = .39$; $F(4, 87) = 14.16$, $p < .001$					
GPA	1.66	.38	.38	4.31	.001
Lecture attendance	1.01	.31	.29	3.33	.001
Brought slides to class	−1.24	.44	−.25	−2.85	.005
Used slides to study	.65	.57	.09	1.14	.25
Interactional view (partial slides)					
$R^2 = .40$; $F(4, 81) = 13.84$, $p < .001$					
GPA	1.75	.35	.47	4.92	.001
Lecture attendance	.78	.28	.27	2.81	.006
Brought slides to class	−.27	.40	−.06	−.68	.49
Used slides to study	.33	.52	.05	.63	.52
Face negotiation (full slides)					
$R^2 = .16$; $F(4, 88) = 4.23$, $p < .001$					
GPA	.55	.20	.30	2.75	.007
Lecture attendance	.13	.13	.12	1.08	.283
Brought slides to class	−.46	.23	−.21	−2.01	.05
Used slides to study	−.15	.33	.05	−.46	.64

2002–2003; Young, 2004). One of these concerns centers on course attendance. If students perceive that IP slides amount to a fairly full set of lecture notes, then going to lecture becomes a superfluous academic endeavor. Results of the present study found that making course slides available to students had no discernible effect on attendance. This finding is notable on two counts. First, much of the previous research on the possible attendance effect generated by IP slides relied upon student self-report data (e.g. Ahmadi et al., 2007; Burke & James, 2008; Grabe, 2005); students have been asked if having access to course slides alters their class attendance patterns, and they have repeatedly answered no. By tracking *actual* student attendance, our study confirms what students have been saying all along (Ahmadi et al., 2007; Burke & James, 2008). Second, the present study was unable to uncover any attendance effect associated with IP slides — even when those slides provided students with a *full* set of class notes. Student class attendance decisions, it appears, have little to do with whether or not students can access course lecture slides. While the present study did not find a link between IP slides and attendance, it did confirm the importance of such attendance; regression analyses revealed that attendance, along with student GPA, were the strongest predictors of students' performance on course exams.

Course attendance is only one of the many issues in the debate over making course slides available to students. A second, and perhaps more consequential, issue centers on the relationship between providing access to course slides and course performance. On this issue, students have consistently contended that IP slides are academically advantageous; students believe that such slides enhance their attention to class lecture and their accumulation of class notes (e.g. Ahmadi et al., 2007; Apperson et al., 2008; Babb & Ross, 2009; Hill et al., 2012; James et al., 2006). The present study found no such academic benefits from IP slides. When student exam scores on the EVT and on the IV units were compared, students taking the class in the spring (no slides) did just as well as their fall semester counterparts (partial slides).

What explains IP slides' inability to produce any improvement in students' academic performance? After all, the long accumulated literature on student notetaking suggests that any aid designed to assist students with their notetaking should lead to better notes and ultimately to better grades (Kiewra et al., 1991; Williams & Eggert, 2002). Nonetheless, a notetaking aid can't render any assistance if students fail to use that aid as part of the notetaking process. In one of its more surprising findings, our data revealed that the percentage of students taking IP slides with them to class was relatively low. This percentage, across course units, ranged from 36% (the Interactional View Unit) to approximately 47% (both the Expectancy Violation Unit and the Face-Negotiation Theory Unit). Such low percentages fall in line with previous studies reporting that roughly 50% of students download course slides prior to class (Chen & Lin, 2008; Debevec et al., 2006). It appears that while instructors can produce a pool of online academic aids, such as online copies of class slides, they ultimately cannot make students drink from that pool.

Are students better off if they partake in that pool? If one group of students in a class brings IP slides with them to take notes and another group of students does not, which group has made the better educational decision? Some instructors have maintained that such slides elevate student notetaking while others have professed that such slides promote classroom passivity (see for example, O'Quigley, 2011; Williams & Eggert, 2002). The results of our study suggest that bringing IP slides to class either has no effect (FNT-Full PPT and IV-Partial PPT) or actually has an adverse effect (EVT-Partial PPT and FNT-Partial PPT) on student performance. The results obtained in these latter two experimental conditions are consistent with other research that has uncovered a negative relationship between students' use of IP slides and course performance (Debevec et al., 2006; Weatherly et al., 2002–2003; but not Chen & Lin, 2008).[1]

Bringing IP slides to class as a notetaking aid should allow students to assemble a more thorough set of course notes, thereby helping to facilitate the external storage function of notes (DiVesta & Gray, 1972). So, what explains our finding that bringing IP slides to class either has no impact or a detrimental impact on students' exam scores? Perhaps the answer resides in the student cohort that actually uses such slides; that is, perhaps it is poorer students who bring IP-slides with them to class. Here again, the findings from the present study undercut this

[1] Results of the two statistical analyses on academic performance of the full slide condition of the FNT lecture varied slightly. Results of the independent t-test for students bringing/not bringing slides to class, found that students scored slightly lower than those who did not bring the slides to class, but this difference only approached significance, $t(91) = 1.67$, $p = .08$, $d = .35$. The results of the regression analysis also indicated that students perform more poorly when bringing slides to class. While this variable met the threshold of statistical significance ($p = .05$) in the regression analysis, the amount of variance accounted for was quite small (see Table 5).

possibility: no significant difference in students' use of IP slides was found across the various GPA groups. Stronger students were just as likely as weaker students to bring slides with them to class.

One potential explanation for the intriguing relationship between students' use of IP slides and course performance may be that the slides are actually altering students' in-class experience in some meaningful way. More specifically, when IP slides become a part of the notetaking process, students may simply become, as some researchers have suggested (e.g. O'Quigley, 2011; Quible, 2002), more passive in the learning process. If bringing IP slides to class encourages classroom passivity, then one might expect to see the sort of results that emerged in the present study. That is, in some cases this increase in passivity may have been offset by the benefits of having a notetaking aid in the classroom (the no effect conditions), while in other instances this rise in passivity may have more-than-offset the benefits of having IP slides as a notetaking aid (the negative effect conditions).

5. Limitations and future research

Several considerations should be taken into account when reviewing our results. First, the present study only examined one course over a two-semester time frame. While every effort was made to maintain consistency across the semesters, differences in class discussion and other elements of presentations may have affected our results. Undoubtedly, our understanding of the effects of IP slides would be enhanced by looking at additional course-related elements (e.g. course management systems, when slides become available, etc.), by adopting alternative research designs (e.g. paired designs, discourse analysis, etc.), and by collecting more detailed individual level data (e.g. analyzing the effect of slide type on student notetaking, examining how exactly slides are used for exam preparation, etc.).

Second, the present study relied upon self-report data from students regarding how they made use of IP slides in the course. Evidence that moves beyond self-reports (e.g. collecting actual student notes in the course, etc.) would provide a firmer foundation upon which to base future studies examining the effects of IP slides.

Third, the present study only examined how IP-slides generated by one computer program (PowerPoint) shaped learning outcomes. While PowerPoint is the most utilized slide presentation program (Garner, Alley, Gaudelli, & Zappe, 2009), it is not the only such program. Many have expressed concerns about the exceedingly linear and segmented way that PowerPoint presents subjects (e.g. Adams, 2005; Farkas, 2006; Gabriel, 2008). Thus, research examining how IP slides operate in a course that relies upon an alternative slide presentation program, such as Prezi that operates on alternative principles, might yield different results.

Fourth and most importantly, while our findings point to the possibility that using IP slides in class encourages classroom passivity, we did not *directly* test for a link between IP slides and student passivity. Hopefully, future studies on the educational impact of IP slides will more directly probe this relationship and will adopt an expansive view of student passivity. After all, such passivity can take on a multitude of forms ranging from poorer notetaking, to less classroom participation, to less attention to class discussion.

6. Conclusion

Notwithstanding these limitations, the present study provides important insight into the literature on the pedagogical effects of PPT. In this sizable literature, only a small subset of studies has found that PPT lecture slides lead to more learning (Levasseur & Sawyer, 2006). The studies contained in this subset possess one common attribute; the instructors involved in these studies not only augmented course lectures with PPT, but they also gave students access to course slides (see Levasseur & Sawyer, 2006). This begs the question of whether the learning effects generated in these studies were the "result of using computer-generated slides in the classroom" or simply the consequence of providing students with a "thorough and organized set of class notes" (Levasseur & Sawyer, 2006, p. 112). An answer to this question begins to take shape when the results of this study are considered in conjunction with other extant research (Debevec et al., 2006; Weatherly et al., 2002–2003; but not Chen & Lin, 2008). Specifically, it appears that providing students with course slides is not the underlying source of any learning effects surfacing in the research on PowerPoint in the classroom. In fact, the results of the present study suggest that any academic effect attributable to IP slides is likely to be associated with less learning rather than more learning.

While computers can assist in the learning process in so many meaningful ways, not all of the ways that students and teachers make use of computers will actually lead to more learning. The present study indicates that when instructors turn to computers to upload copies of course slides and when students turn to computers to download these slides, their effort is unlikely to boost student learning. Sometimes old "tried and true" pedagogical lessons trump new ways of deploying classroom technology. While the present study found few educational benefits from the deployment of IP slides, it did confirm the long-established effect of class attendance. Thus, students may need to worry less about whether their instructors are providing IP slides to a class and instead worry more about simply going to that class.

References

Adams, C. (2005). What is the lived experience of a PowerPoint presentation for students? *Technology and Teacher Education Annual, 2*, 794–799, 978-1-880094-55-6.
Ahmadi, M., Dileepan, P., & Raiszadeh, F. (2007). Is PowerPoint evil? Students' perceptions. *Review of Business Research, VII*(4), 15–19. http://dx.doi.org/10.3200/JOEB.84.4.246-251.
Apperson, J. M., Laws, E. L., & Scepansky, J. A. (2008). An assessment of student preferences for PowerPoint presentation structure in undergraduate courses. *Computers & Education, 50*, 148–153. http://dx.doi.org/10.1016/j.compedu.2006.04.003.
Armbruster, B. B. (2000). Taking notes from lectures. In R. F. Flippo, & D. C. Caverly (Eds.), *Handbook of college reading and study strategy research* (pp. 175–199). Mahwah, NJ: Lawrence Erlbaum.
Austin, J., Lee, M., & Carr, J. (2004). The effects of guided notes on undergraduate students' recording of lecture content. *Journal of Instructional Psychology, 31*(4), 314–320.
Austin, J. L., Lee, M. G., Thibeault, M. D., Carr, J. E., & Bailey, J. S. (2002). The effects of guided notes on university students' responding and recall of information. *Journal of Behavioral Education, 11*, 243–254. http://dx.doi.org/10.1023/A:1021110922552.
Babb, K. A., & Ross, C. (2009). The timing of online lecture slide availability and its effect on attendance, participation, and exam performance. *Computers & Education, 52*, 868–881. http://dx.doi.org/10.1016/j.compedu.2008.12.009.
Burke, L. A., & James, K. E. (2008). PowerPoint-based lectures in business education: an empirical investigation of student-perceived novelty and effectiveness. *Business Communication Quarterly, 71*, 277–296. http://dx.doi.org/10.3200/JOEB.84.4.246-251.
Chen, J., & Lin, T. (2008). Does downloading PowerPoint slides before the lecture lead to better student achievement? *International Review of Economics Education, 7*(2), 9–18.
Cornelius, T. L., & Owen-DeSchryver, J. (2008). Differential effects of full and partial notes on learning outcomes and attendance. *Teaching of Psychology, 35*, 6–12. http://dx.doi.org/10.1080/00986280701818466.

Craig, R. J., & Amernic, J. H. (2006). PowerPoint presentation technology and the dynamics of teaching. *Innovative Higher Education, 31*(3), 147–160. http://dx.doi.org/10.1007/s10755-006-9017-5.
Dahlstrom, E., Brooks, D. C., & Bichsel, J. (2014). *The current ecosystem of learning management systems in higher education: Student, faculty, and IT perspectives*. Research report. Louisville, CO: ECAR. Retrieved January 15, 2015 from https://net.educause.edu/ir/library/pdf/ers1414.pdf.
Daniels, L. (1999). Introducing technology in the classroom: PowerPoint as a first step. *Journal of Computing in Higher Education, 10*(2), 42–56. http://dx.doi.org/10.1007/BF02948722.
Debevec, K., Shih, M., & Kashyap, V. (2006). Learning strategies and performance in a technology integrated classroom. *Journal of Research on Technology in Education, 38*, 293–307. http://dx.doi.org/10.1080/15391523.2006.10782461.
DiVesta, F. J., & Gray, S. G. (1972). Listening and note taking. *Journal of Educational Psychology, 63*, 8–14. http://dx.doi.org/10.1037/h0034589.
Doumont, J.-L. (2002). The three laws of professional communication. *IEEE Transactions on Professional Communication, 45*(4), 291–296. http://dx.doi.org/10.1109/TPC.2002.805164.
Doumont, J.-L. (2005). The cognitive style of PowerPoint: slides are not all evil. *Technical Communication, 52*(1), 64–70.
Farkas, D. K. (2006). Toward a better understanding of PowerPoint deck design. *Information Design Journal, 14*(2), 162–171.
Fisher, J. L., & Harris, M. B. (1973). Effects of note taking and review on recall. *Journal of Educational Psychology, 65*, 321–325. http://dx.doi.org/10.1037/h0035640.
Frey, B. A., & Birnbaum, D. J. (2002). *Learners' perceptions of the value of PowerPoint in lectures*. Pittsburgh, PA: Center for Instructional Development and Distance Education, University of Pittsburgh. Retrieved from ERIC database. (ED467192).
Gabriel, Y. (2008). Against the tyranny of PowerPoint: technology-in-use and technology abuse. *Organization Studies, 29*, 255–276. http://dx.doi.org/10.1177/0170840607079536.
Garner, J. K., Alley, M., Gaudelli, A. F., & Zappe, S. E. (2009). Common use of PowerPoint versus the assertion-evidence structure: a cognitive psychology perspective. *Technical Communication, 56*, 331–345.
Grabe, M. (2005). Voluntary use of online lecture notes: correlates of note use and note use as an alternative to class attendance. *Computers & Education, 44*, 409–421. http://dx.doi.org/10.1016/j.compedu.2004.04.005.
Grabe, M., Christopherson, K., & Douglas, J. (2004–2005). Providing introductory psychology students access to online lecture notes: the relationship of note use to performance and class attendance. *Journal of Educational Technology Systems, 33*, 295–308. http://dx.doi.org/10.2190/G5RF-DMWG-WV1G-TMGG.
Gross, A. G., & Harmon, J. E. (2009). The structure of PowerPoint presentations: the art of grasping things whole. *IEEE Transactions on Professional Communication, 52*(2), 121–137. http://dx.doi.org/10.1109/TPC.2009.2020889.
Gurrie, C., & Fair, B. (2010). PowerPoint – from fabulous to boring: the misuse of PowerPoint in higher education classrooms. *Journal of the Communication, Speech & Theatre Association of North Dakota, 23*, 23–30.
Hill, A., Arford, T., Lubitow, A., & Smollin, L. M. (2012). "I'm ambivalent about it": the dilemmas of PowerPoint. *Teaching Sociology, 40*, 242–256. http://dx.doi.org/10.1177/0092055X1244071.
James, K. E., Burke, L. A., & Hutchins, H. M. (2006). Powerful or pointless? Faculty versus student perceptions of PowerPoint use in business education. *Business Communication Quarterly, 69*, 374–396. http://dx.doi.org/10.1177/1080569906294634.
Kauffman, D. F. (2004). Self-regulated learning in web-based environments: Instructional tools designed to facilitate cognitive strategy use, metacognitive processing, and motivational beliefs. *Journal of Educational Computing Research, 30*, 139–161. http://dx.doi.org/10.2190/AX2D-Y9VM-V7PX-0TAD.
Kiewra, K. A. (1985). Students' note-taking behaviors and the efficacy of providing the instructor's notes for review. *Contemporary Educational Psychology, 10*, 378–386. http://dx.doi.org/10.1016/0361-476X(85)90034-7.
Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., & Roskelley, D. (1991). Note-taking functions and techniques. *Journal of Educational Psychology, 83*, 240–245.
Knight, L., & McKelvie, S. (1986). Effects of attendance, note-taking, and review on memory for a lecture: encoding vs. external storage functions of notes. *Canadian Journal of Behavioural Science, 18*, 52–61. http://dx.doi.org/10.1037/h0079957.
Levasseur, D. G., & Sawyer, J. K. (2006). Pedagogy meets PowerPoint: a research review of the effects of computer-generated slides in the classroom. *The Review of Communication, 6*, 101–123. http://dx.doi.org/10.1080/15358590600763383.
Lumkes, J. H., Jr. (2009–2010). Survey of three different methods of delivering engineering content in lectures. *Journal of Educational Technology Systems, 38*(3), 349–366. http://dx.doi.org/10.2190/ET.38.3.e.
Mantei, E. J. (2000). Using Internet class notes and PowerPoint in the physical geology lecture. *Journal of College Science Teaching, 29*, 301–305.
Murphy, T. M., & Cross, V. (2002). Should students get the instructors' lecture notes? *Journal of Biological Education, 36*(2), 72–75. http://dx.doi.org/10.1080/00219266.2002.9655804.
Neef, N. A., McCord, B. E., & Ferreri, S. J. (2006). Effects of guided notes versus completed notes during lectures on college students' quiz performance. *Journal of Applied Behavior Analysis, 39*, 123–130. http://dx.doi.org/10.1901/jaba.2006.94-04.
O'Quigley, M. (2011, January). An investigation into the experience of lectures from the viewpoint of lecturers and students with particular emphasis on PowerPoint. *Networks, 14*, 1–7.
Pardini, E. A., Domizi, D. P., Forbes, D. A., & Pettis, G. V. (2005). Parallel note-taking: a strategy for effective use of webnotes. *Journal of College Reading and Learning, 35*(2), 38–55.
Quible, Z. K. (2002). Maximizing the effectiveness of electronic presentations. *Business Communication Quarterly, 65*(2), 82–85.
Stark-Wroblewski, K., Kreiner, D. S., Clause, C. B., Edelbaum, J., & Ziser, S. B. (2006). Does the generation effect apply to PowerPoint handouts? *Psychology of Education, 43*(2), 28–38.
Susskind, J. E. (2008). Limits of PowerPoint's power: enhancing students' self-efficacy and attitudes but not their behavior. *Computers and Education, 50*, 1228–1239. http://dx.doi.org/10.1016/j.compedu.2006.12.001.
Vandehey, M. A., Marsh, C. M., & Diekhoff, G. M. (2005). Providing students with instructors' notes: problems with reading, studying, and attendance. *Teaching of Psychology, 32*, 49–52.
Weatherly, J. N., Grabe, M., & Arthur, E. I. L. (2002–2003). Providing introductory psychology students access to lecture slides via blackboard 5: a negative impact on performance. *Journal of Educational Technology Systems, 31*, 463–474. http://dx.doi.org/10.2190/KRW7-QHFY-AY3M-FFJC.
Williams, R. L., & Eggert, A. C. (2002). Notetaking in college classes: student patterns and instructional strategies. *Journal of General Education, 51*, 173–199. http://dx.doi.org/10.1353/jge.2003.0006.
Young, J. R. (2004). When good technology means bad teaching. *Chronicle of Higher Education, 51*(12), A31–A32.