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# The timing of online lecture slide availability and its effect on attendance, participation, and exam performance

# Kimberley A. Babb\*, Craig Ross

Department of Psychology, University of Windsor, 401 Sunset Ave., Windsor, Ontario, Canada N9B 3P4

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#### ABSTRACT

The use of PowerPoint slides has become an almost ubiquitous practice in university classrooms, however little research has examined whether the timing of lecture slide availability to students (either before or after lecture) affects classroom behaviour or exam performance. Using a 2 (slide availability condition)  $\times$  2 (course type) between-subjects design, the present study examined lecture slide availability differences in attendance, participation, and exam performance in two courses – Research Methods and Cognitive Development – taught in both the Fall and Winter semesters. For each type of course, lecture slides were made available on the course website before lecture in one semester and after lecture in the other semester. Course material was held constant across semesters. Results showed that mean attendance was higher when slides were available before lecture, but only for the type of course that did not include attendance points as part of students' final grades. For students who participated in class, participation was more frequent when slides were available before lecture. No significant difference in exam performance was found between lecture slide availability conditions, however. These findings suggest that making lecture slides available to students before lecture may lead to better overall attendance and participation, but exam performance is determined by more than just whether or not students have lecture slides available for their note-taking.

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# 1. Introduction

In recent years, more professors have been making use of computer-based presentation tools, such as PowerPoint (Microsoft Corporation, 1998), to facilitate student note-taking and to increase student learning (Apperson, Laws, & Scepansky, 2006). Students often express a preference for PowerPoint presentations over traditional chalkboard lectures, and they have been shown to rate the course and the professor in a more favorable light when PowerPoint slides are used (Apperson et al., 2006). Students also have reported that being able to download lecture slides prior to class helps them focus on and comprehend lecture material, and this helps them study for exams (Austin, Lee, Thibeault, Carr, & Bailey, 2002; Frey & Birnbaum, 2002; Murphy & Cross, 2002; Pardini, Domizi, Forbes, & Pettis, 2005).

Many students have come to expect that if PowerPoint slides are used in class, they will have online access to these slides. Although this is becoming a more common practice, some professors do not offer access to slides at all. Those who do offer online access sometimes choose to provide them before class so that students can use them as a guide for note-taking, and some prefer to offer them after class so that they are used as a supplement, but not a substitute, for students' own note-taking. This can sometimes create conflict between students and professors because students may perceive that withholding lecture slides until after lecture is a disadvantage to their note-taking. Therefore, there is a need for empirical research on providing online lecture slides to students either before or after class sessions in order to inform professors how slide availability affects student learning and classroom behaviour. The purpose of this study is to examine the timing of slide availability and how it affects students' attendance, class participation, and exam performance.

# 1.1. Attendance

Class attendance is an important consideration when making the decision to provide lecture slides to students. Some professors may be concerned that if slides are made available to students, they will use them as a substitute for attending class. Teaching to a relatively empty classroom can be disheartening to a professor who has spent numerous hours preparing his or her lectures and activities, and it can create

E-mail address: kbabb@uwindsor.ca (K.A. Babb).





<sup>\*</sup> Corresponding author. Tel.: +1 (519) 253 3000x2221; fax: +1 (519) 973 7021.

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an overall unpleasant atmosphere for the students who do show up to class (Brauer, 1994). Furthermore, students who do not attend the lecture miss out on lecture-only information. This not only has disadvantages for student performance on exams (Devadoss & Foltz, 1996), but also makes it more likely that professors will be asked questions that were already covered in lecture.

Some studies have supported the claim that providing lecture notes reduces attendance (e.g., Grabe, 2005; Grabe, Christopherson, & Douglas, 2005; Pardini et al., 2005). For example, Grabe and his colleagues found that students who used lecture notes reported that having the notes available to them played a "very significant" role in their absence from lecture (Grabe et al., 2005). Consistent with these findings, Grabe (2005) showed that 79% of students in his study who used online lecture notes reported using them as a replacement for class attendance at least once, and 29% of these students reported using the notes as a replacement for attendance six or more times.

Other studies have suggested that providing lecture slides to students may have less of an effect, or no effect, on whether or not they attended class (e.g., Debevec, Shih, & Kashyap, 2006; Frey & Birnbaum, 2002). In a survey on student perceptions about their professor's use of PowerPoint in lecture, Frey and Birnbaum (2002) found that only 15% of students reported that they were less likely to attend lecture when provided online lecture slides. Furthermore, Debevec et al. (2006) found no significant main effect of the frequency of lecture slide access on students' attendance.

The differences in the findings of these studies may be due to the use of different measures of attendance. Many of these studies assessed attendance through retrospective self-report, rather than using students' actual attendance. Students might not be accurate in reporting their absences because they simply forget how many classes they missed. Furthermore, students might report a greater association between their absences and having access to lecture slides in order to avoid taking responsibility for not attending class. Objective measures of attendance, such as those used in the Debevec et al. (2006) study, are not subject to these biases, and therefore may be the reason why their findings differed from others' results.

Most studies that examine how providing online lecture slides affects attendance are usually completed within one term, during which online lecture slides are made available before class. What may be more useful to professors, however, is knowing whether providing lecture slides either before lecture or after lecture can affect overall class attendance. If students perceive lecture slides merely as a substitute for taking their own notes, classes that have lecture slides available before class should not differ in average attendance from classes that have slides available only after class. Alternatively, allowing students access to slides before class may actually increase attendance. Students have reported that using lecture slides during class fosters a better learning environment by increasing their focus in class and drawing their attention to important information in the lecture (Pardini et al., 2005). If students perceive a benefit in using slides during lecture to improve their performance in the course, we would expect that students who are able to download slides before lecture would be more likely to attend class than if they were only able to download them after lecture. In this study, to test whether the timing of providing slides to students leads to differences in overall attendance, we compared the average class attendance of two classes with identical material that varied in the timing of slide availability.

#### 1.2. Class participation

Another important issue to consider is how class participation may be affected by the availability of lecture slides. Although participation may not be required for all types of classes, it is often an essential part of the dynamics of smaller or seminar-style classes. Professors who teach these types of classes want to encourage student participation for the exchange of ideas and different perspectives, and they may require participation as part of students' grades.

One obstacle for class participation is the time needed to take notes. Students do not always have efficient note-taking skills, and they often attempt to write down the professor's lecture, verbatim, rather than the more efficient way of synthesizing the lecture information and writing notes in their own words (Kiewra, DuBois, Christensen, Kim, & Lindberg, 1989). When more attention is directed toward verbatim note-taking, less attention is available for other learning activities. By making slides available for note-taking during lecture, this may reduce the cognitive effort of taking notes and increase students' attention toward asking and responding to questions about the lecture material (Austin et al., 2002; Barbetta & Skaruppa, 1995; Pardini et al., 2005). Furthermore, providing lecture slides before class can allow students the chance to formulate questions about the material prior to lecture.

Few studies have directly assessed the impact of the availability of lecture slides on class participation. Austin et al. (2002) found that providing guided notes (paper notes that were identical to the presented lecture slides) at the beginning of lecture led to more professor prompts and increased student responses, compared to when guided notes were not provided. These conclusions were limited by the fact that this study was done in a single class, with the different experimental conditions presented on different days. To truly assess the effects of providing lecture notes ahead of time, lecture material should be identical between the two experimental conditions. The between-subjects design used in the present study allows this comparison of slide availability conditions, holding constant the course material, to examine whether providing lecture slides before or after lecture facilitates class participation. To our knowledge, this is the first study to directly assess slide availability and class participation using this methodology.

## 1.3. Exam performance

Exam performance also may be affected by the availability of lecture slides. Research has identified two functions of note-taking that contributes to exam performance: encoding (learning through the process of recording notes) and external storage (having notes available for later exam review; DiVesta & Gray, 1972). Note-taking has been shown to be most beneficial for recall of material and test performance when these functions are used in combination (Kiewra et al., 1989, 1991; Knight & McKelvie, 1986). Simply put, students generally perform better on exams when they take notes during class (encoding) and use them for studying for exams (external storage) than if they only use notes for one of these purposes. The quality of the notes, however, is a factor in how well this process works. Students are known to be inefficient note-takers. In a review of note-taking studies, students were found to record as little as 20% of lecture ideas when taking independent notes (Armbruster, 2000). As a result, students' notes may not contain information they need to study for their exams.

With evidence indicating that students lack adequate note-taking skills, researchers suggest that providing professors' lecture slides to students can help maximize the usefulness of students' notes for both the encoding and external storage functions (Armbruster, 2000; Kiewra, 1985a, 1985b). By providing slides that contain key definitions and concepts, students can attend to, think about, and record the most

important ideas from the lecture, thus improving the quality of their notes for later exam review. Austin, Lee, and Carr (2004) found that when students were given a handout of the overhead lecture slides to use for note-taking, they showed the highest percentage of critical points in their notes, compared to when they were not given the handout or when they had no lecture slides at all. If providing lecture notes for students to use as note-taking guides leads to more efficient recording of the material, we would expect this to be reflected in students' performance on exams.

Research exploring differences in lecture slide usage and exam performance has recently gained momentum, however findings have been mixed. Some studies have demonstrated that when students were provided with paper copies of the lecture slides (e.g., Austin et al., 2002) or when they accessed the lecture slides online (e.g., Grabe et al., 2005) they had better exam scores than when lecture slides were not used. In contrast, other evidence suggests that students who used lecture slides had lower exam scores than those who did not use lecture slides (e.g., Murphy & Cross, 2002; Weatherly, Grabe, & Arthur, 2002–2003). Clearly, there is a need for more research on what factors involved in lecture slide usage explains these discrepancies in exam performance outcomes.

One possible factor that might account for these discrepancies is individual differences in prior academic achievement. When exam performance was measured in these studies, many of them did not take into consideration students' typical exam performance in other classes (e.g., Debevec et al., 2006; Grabe, 2005). This makes any observed group differences difficult to interpret as the result of lecture slide usage, rather than simply a difference in typical exam performance. In response to this limitation, the present study used students' cumulative grade point averages (GPAs) as a covariate in the analyses on slide availability and exam performance.

Another factor contributing to differences in findings could be the timing of when lecture slides are accessed by students. Some research on slide usage and exam performance has either not asked about lecture slide access (e.g., Weatherly et al., 2002–2003), or has not distinguished between those who used notes during lecture and those who used them after lecture (e.g., Debevec et al., 2006). Different operationalizations of lecture slide usage may lead to different results. For example, although Grabe (2005) found that students who used the online lecture slides had higher exam scores than did students who never used them, a closer examination of the group who used the slides revealed no differences in exam performance between those who accessed them before lecture and those who accessed them after lecture. This finding demonstrates the need for incorporating information about slide availability.

It is also important to consider what information about slide availability would be most beneficial to professors when they are making the decision of whether and when to post their lecture slides. Grabe's (2005) study compared groups that were characterized by when students decided to access the lecture slides on their own. This may, in fact, reflect motivational or learning style differences, and is not necessarily something that professors can control. Instead, what is more informative is knowing whether posting the lecture slides online before class or after class contributes to differences in average exam performance for the class. If lecture slides are most beneficial for exam performance by acting as a guide for note-taking (the encoding and external storage function), classes that receive slides before class should outperform classes who receive the notes after class. If simply having the lecture slides to use as a study tool is the main benefit of providing lecture slides (the external storage function), then the availability of slides should not affect exam performance.

# 1.4. Study overview

In this study, students in an introductory Research Methods course and a fourth-year Cognitive Development course, both taught in the Fall and Winter semesters, were provided with PowerPoint lecture slides either before lecture or after lecture (see Fig. 1 for a summary of the lecture slide availability conditions and student characteristics for each course). Course material was held constant within each type of class. We collected outcome measures of attendance, class participation, and exam performance. At the end of the semester, students completed surveys containing questions about how they used the slides and their perceptions about the slides. We also obtained information about students' GPAs and their typical attendance in other classes during the semester. We then examined whether providing lecture slides online before class or after class contributed to differences in the outcome measures, as well as contributing to how students used and perceived the lecture slides.

Although other lecture slide studies have examined attendance, participation, and exam performance, separately, to our knowledge, no study has examined the effect of lecture slide availability on all three outcomes by comparing classes with identical material. Furthermore, to avoid some of the common limitations in this type of research, we used typical class attendance and GPA as covariates in order to control for pre-existing differences in attendance and exam performance. Finally, this study provided a unique comparison of the effects of lecture slide availability for classes with different attendance and participation course requirements in order to see if slide availability affects these outcomes, even when attendance and participation are mandatory.



Fig. 1. Summary of lecture slide availability condition and student characteristics for each type of course by semester.

#### 1.5. Hypotheses

Our study was guided by three hypotheses. First, we hypothesized that students in classes that had slides available before lecture would show a higher attendance rate compared to students in classes that had slides available only after lecture. Given that students often perceive having lecture slides before lecture as an advantage for their learning and exam performance, we would expect that this would motivate students to attend class in order to use this tool effectively. Second, we hypothesized that students in classes that had slides available before lecture would participate more in class than students in classes that had slides available only after lecture. With less cognitive effort directed toward taking notes, we would expect students who were able to use lecture slides as a note-taking guide to have more time to generate and respond to questions in class than those who did not have access to the slides before lecture. Third, we hypothesized that students in classes that had slides available before lecture would perform better on exams than students in classes that had slides available only after lecture. Given the findings that using notes for both encoding and external storage leads to better exam performance, students who had access to the lecture slides before class should have had more of an advantage for learning material for the exam. This advantage would be reflected in higher exam scores.

# 2. Methods

## 2.1. Participants

One-hundred eighty-eight Social Science undergraduates from four classes at the University of Windsor in Ontario, Canada were given the opportunity to participate in this study. Of these students, 10 declined to participate in the study, and three students were dropped from the analysis because of both incomplete exam data and unusual circumstances that resulted in atypical class attendance. The remaining 175 students' demographic information by class is shown in Table 1. All students received extra credit for their participation in the study.

# 2.2. Courses

The study was conducted in four classes taught during the 2006–2007 academic year. There were two types of courses: an introductory Research Methods course, and a fourth-year Cognitive Development course. As a condition of the study's approval, the University Research Ethics Board requested that course requirements for these two classes were not altered for the sake of the study, except for the timing of when the lecture slides were made available on the website.

The lecture portion of the Research Methods course met twice a week for 50 min each time. Students were told they were expected to attend all lectures and that attendance would be taken, but, attendance was not a part of their final course points. Class participation (e.g., asking questions, volunteering examples) was not recorded during lecture. Exams for this class included a 40-question multiple-choice midterm and an 80-question multiple-choice final exam. The remainder of students' course points consisted of laboratory assignments and a quiz given during the lab portion of the course.

The Cognitive Development course was a combination lecture-seminar class that met twice a week for 80 min each time. Students were told that attendance at every class was mandatory and that they were expected to participate at least once per class meeting. Students received points for attendance and participation that counted toward their final course grade. Exams included a 40-question multiple-choice and short essay midterm and a 50-question multiple-choice final exam. In addition to the exams and points for attendance and participation, students' grades were also determined by a short thought paper, a group presentation, and a term paper.

# 2.3. Materials

### 2.3.1. Lecture slides

Lecture slides shown during the lecture portion of these classes were created by the professor on Microsoft's PowerPoint software (Microsoft Corporation, 1998). These slides were also made available to students on the course website in electronic form in PowerPoint

#### Table 1

Demographic characteristics by class type and slide availability condition.

	Research methods		Cognitive development	
	Before lecture	After lecture	Before lecture	After lecture
n	53	48	39	35
Gender (% females)	74%	75%	92%	91%
Mean age (SD)	24.04 (8.02)	21.23 (3.02)	22.55 (2.79)	22.60 (3.88)
Age range	19–51	19–37	21-35	21-44
Ethnicity				
Asian	3	2	2	3
Black	3	2	1	3
Caucasian	46	43	34	25
Hispanic	0	0	0	2
Middle-eastern	1	0	1	0
Other	0	1	1	2
Year at university				
First	6	7	0	0
Second	18	17	0	0
Third	18	17	0	0
Fourth and beyond	11	7	39	35

and PDF formats in order to ensure that students who did not have the PowerPoint program on their computers could still access them. Slides contained definitions, basic outlines of major points of the topics presented in lecture, and visual graphs or examples demonstrating key concepts. On average, 15–20 slides were shown per lecture.

#### 2.3.2. Lecture slide survey

A 50-question paper-and-pencil survey was used to assess students' use of and attitudes toward the classroom technology used during the semester, as well as to collect information about GPA and typical class attendance. On the front of the questionnaire packet was a place to provide student identification numbers on a tear-off cover sheet that served as a means to provide students extra credit points and to link their class performance with their responses on the questionnaire. A background information survey contained questions about demo-graphic information, as well as about students' cumulative GPA prior to the semester and their percentage of attendance at other classes during the same semester. Terminology used in the questionnaire was explained in the instructions (e.g., specifying that "lecture slides" referred to the projected slides in the class that were also available on the class website). In addition to questions about the use of lecture slides used in this study, other questions covered the use of videos in class, the use of the course website to download assignments, and the use of the website message board. Only the questions pertaining to lecture slide usage were used in this study, however.

The target questions about lecture slides used for this study are presented in the Appendix. Part I of the questions examined how and when students used the lecture slides during the semester. Students were asked to indicate when they typically downloaded the lecture slides, how they typically made use of the downloaded slides, how often they downloaded slides prior to lecture, how often they used them instead of attending class, and how often they used the slides as a review after lecture. We also asked students to report which format of the lecture slides they used (PowerPoint or PDF). Part II of the questions required students to rate their satisfaction with the content, delivery, and availability of the lecture slides. Three additional questions assessed students' perceptions of the helpfulness, thoroughness, and complexity of the slides. Part III of the questions free-response questions that allowed students to elaborate on their perceptions of the lecture slides. Finally, there was a permission form on which students indicated whether or not they would allow the researchers to verify and use their GPA, course points, and class attendance in the study.

#### 2.4. Design and procedure

This study used a 2 (slide availability condition)  $\times$  2 (course type) between-subjects design. In each semester during the academic year, the same professor (the first author) taught a Research Methods class and a Cognitive Development class. Each course had its own website, which was created on a learning management system developed specifically for the university using Lotus Notes/Domino software (IBM Corporation, 2006). Because all required course materials were only available in electronic form on the website, all students had to access the website with their university login name and had to learn how to obtain files from the website. Lecture slides were available for download in either PowerPoint or PDF format in a section on the website clearly labeled "Lectures."

Two slide availability conditions – before-lecture and after-lecture – indicated when the lecture slides were made available on the website. For the before-lecture condition, each week's slides were available to be downloaded from the website at approximately 12:00 p.m. the day before the first day of lecture for the week. For the after-lecture condition, each week's slides were available on the website the day after the last day of the week's lectures, also at approximately 12:00 p.m. Each type of class was matched with each availability condition once, but in a counterbalanced order. Specifically, in Fall 2006, the Cognitive Development course had slides posted before the lectures and the Research Methods course slides were available after the week's lectures. For Winter 2007, the slide availability conditions were reversed.

Every effort was made to keep the context (e.g., classroom layout, graduate teaching assistants) and materials (e.g., lecture slides, exams) consistent between classes of the same type. Lecture slides were identical within each type of course, except for minor semester-specific information (e.g., exam date information). Lectures were administered using scripted notes and any deviations from the script (e.g., a brief discussion arising from a student question) were noted and evaluated to ensure these deviations did not constitute enough of a dissimilar class experience to affect the results. Deviations from the script were judged to be minor and unlikely to be a factor in any group differences in outcomes. Exams were identical across semesters for each type of course.

Because the start of classes each semester fell on different days of the week, the days of the Research Methods lecture had to be changed for Winter semester in order to ensure each lab was taught after the topics were covered in the week's lectures. As a result, slides were posted before this class on Sunday. To ensure that this change was not affecting whether students downloaded slides before lecture, we compared this class with the before-lecture Cognitive Development class from Fall semester that had slides posted on a Monday. The overall percentage of students who downloaded slides ahead of class was comparable between the two classes (about 80%), therefore it was decided that this change did not affect students' ability to download slides.

Another difference between semesters was that in the Winter semester, there was a one-week administrative break in between the seventh and eighth week. Midterms for each of the classes occurred before this break, and although there was one small lab assignment due on the week following the break in the Research Methods class, this assignment was not used for the outcomes in this study. Attendance and participation points for the day following the break were excluded from the analyses.

Students were not aware that they would have the opportunity to participate in the study until the week before the survey was administered in class. The study was described as a survey on classroom technology and learning outcomes, but students were not told the specific nature of the slide availability conditions. On the last day of class, the professor left the room while a research assistant who was not affiliated with the course read scripted instructions about how to complete the survey. Students were informed that their responses on the survey would not be viewed until after their final course grades were submitted and that a graduate student who was not affiliated with the course would be collecting and entering the data. They also were told that they could opt-out of the study at any time, without penalty. Students who chose to participate in the study were then given packets that contained the consent form and the survey. Study materials were administered on paper, rather than online, in order to conduct the study during the regularly-scheduled class time. This maximized the likelihood of student participation and assured that students completed the survey in a similar environment and could ask the research assistant any clarification questions. The survey took approximately 30 min to complete, and all students who completed it in class turned in their form before leaving. Students who missed class that day were allowed to complete the survey at a later date. Students who chose not to participate in the study were given the opportunity to earn the same number of extra credit points as those who did participate by completing an alternative extra credit assignment.

At the completion of the semester, students' exam scores, attendance, and participation points were matched with their survey responses. To ensure confidentiality, students' survey responses were entered separately from their course points and then matched by study identification number. Course information was removed from students who indicated on the permissions form that they did not want it used in the study, and GPAs were verified for only those who gave permission to do so. Only five students declined permission to use course information and to allow GPA verification. These students' questionnaire responses were retained for the analyses on the usage and satisfaction of lecture slides, however.

# 3. Results

#### 3.1. Overview

The findings are presented in three parts. The first part describes how students from the different availability conditions reported using the class slides during the course of the semester. The second part presents group differences in students' satisfaction with the content, delivery, and availability of the class slides. The third part presents the findings on differences between availability conditions within each course type for the outcome measures of attendance, participation, and exam performance.

#### 3.2. Students' use of lecture slides

We first examined the question of when students typically downloaded slides for class. For the before-lecture classes (Fall Cognitive Development class and Winter Research Methods class), 46% downloaded the slides the day before lecture when they became available, 20% downloaded them on the day of lecture, 13% downloaded them just before going to lecture, and 18% usually or always downloaded them after lecture. For the after-lecture classes (Fall Research Methods and Winter Cognitive Development) 74% usually or always downloaded them after lecture. Despite the fact that slides were not posted prior to lecture, 11% of students in the after-lecture classes reported downloading them before class. Upon further inspection of their other responses related to slide use (e.g., answering "Never" to the question of "How often did you download slides before they were used in lecture?"), we suspected that these students were likely referring to downloading the slides from the previous lecture when they came to campus the following week. Nineteen percent of students from the total sample indicated that they never downloaded the slides. The large majority of these students' answers on other questions about their slide use indicated that they had used slides, and most likely obtained them in other ways. Only two of these students (1% of the total sample) reported other answers consistent with not using slides at all. These students were therefore dropped from the remaining analyses.

Next, we examined mean ratings of how often students in the before-lecture classes were accessing the slides prior to lecture. On average, both the Research Methods class (M = 4.49, SD = 1.65) and the Cognitive Development class (M = 4.51, SD = 1.72) downloaded the slides before they were used in lecture between half to most of the lectures. Only four students from each class reported never downloading the slides before lecture. Taken together, these findings suggest that almost all students who had the option of downloading slides before coming to lecture did, in fact, download them, and they brought them to the majority of lectures.

Given that 99% of students did use the lecture slides in some way during the course of the semester, we then explored the way that these students used them. Of the students who downloaded the slides, 68% used the PowerPoint format, whereas 32% used the PDF format. Table 2 shows the percentages of responses given by students who downloaded the slides to the question, "Which of the following statements best describes the way in which you used the downloaded lecture slides?" For the classes that received slides before lecture, most students reported using the slides as a guide for note-taking. For the classes that received slides after lecture, most students in the Research Methods course used the slides as their main notes, whereas most students in the Cognitive Development class used them either as a double-check for their own notes or as a guide. Approximately one-tenth of students in the two after-lecture classes reported not using the slides much, whereas none of the students in the before-lecture classes reported this.

In addition to asking students to report the predominant way in which they used the slides, we also asked two questions about how often students used slides instead of attending class and how often they used slides as a way of reviewing notes after lecture. We ran two 2 (slide availability condition) × 2 (course type) ANOVAs using each of the questions as the dependent variables. For the question about how often students used slides instead of attending class, a significant main effect of class type was found, F(1,167) = 39.95, p < .001,  $\eta_p^2 = .19$ . Students in the Research Methods course used the slides instead of attending class more often (M = 2.58, SD = 1.32) than did students in the Cognitive Development class (M = 1.56, SD = 0.71). In addition, a significant interaction was found, F(1,167) = 7.11, p = .008,  $\eta_p^2 = .04$  (see Fig. 2). Post-hoc Tukey tests revealed that the Research Methods class in which slides were posted after class used slides as a substitute for attending class most often, compared to the other classes (all ps < .05). On average, students in this class reported using the lecture slides as a substitute for attending "some of the lectures" (M = 2.91, SD = 1.38). No main effect of slide availability condition was found, however.

#### Table 2

Percentages of slide usage by class type and slide availability condition.

	Research methods		Cognitive development	
	Before lecture (%)	After lecture (%)	Before lecture (%)	After lecture (%)
I used them as my main notes – I added very little extra information	39	37	8	3
I used them mostly as guides – I added a fair bit of extra information	47	19	68	28
I downloaded them for reference – I had the slides but took separate notes	6	5	16	16
I downloaded them after lecture – I used them to double-check my own notes	6	12	5	31
I downloaded them after lecture – I did not use them much	0	12	0	9
Other	2	16	3	13



Fig. 2. Mean ratings of how often students used lecture slides instead of attending class by slide availability condition and course type.

#### Table 3

Means (and standard deviations) of satisfaction ratings by slide availability condition.

	Slide availability conditio	n	F(1,169)	
	Before lecture	After lecture		
How satisfied were you with the availability of formats for lecture slides (PowerPoint, PDF)?	4.36 (0.72)	4.15 (0.90)	2.25	
How satisfied were you with when the lecture slides were posted on the website?	4.43 (0.75)	3.22 (1.23)	62.63***	
How satisfied were you with the amount of material on the lecture slides?	4.08 (0.72)	3.81 (0.79)	5.21*	
How satisfied were you with the way material was written on the slides?	4.12 (0.66)	4.05 (0.69)	0.39	
How satisfied were you with the number of slides provided for each lecture?	4.10 (0.60)	3.99 (0.63)	0.88	
How satisfied were you with the pacing of the lecture slides during the lecture?	4.04 (0.73)	4.04 (0.81)	0.01	
How satisfied were you with the way lecture slides tied in with the lecture presentation (i.e., consistency of the slides with what was said in lecture)?	4.33 (0.68)	4.20 (0.66)	1.88	
How satisfied were you with the way the lecture slides represented material on the exams?	4.00 (0.88)	3.85 (0.74)	1.08	
How satisfied were you with the lecture slides, overall?	4.28 (0.62)	3.96 (0.77)	8.84**	

Note: Judgments were made on 5-point scales (1 = Very dissatisfied, 5 = Very satisfied).

p < .001.

The ANOVA of how often students used slides as a way of reviewing notes after lecture showed a significant main effect of availability condition, F(1, 169) = 9.20, p = .003,  $\eta_p^2 = .05$ . On average, students in the classes where slides were posted before lecture reviewed notes after lecture more often (M = 4.58, SD = 1.48), than did students in classes where slides were posted after lecture (M = 3.83, SD = 1.69).

#### 3.3. Students' satisfaction with lecture slides

In addition to looking at how students used PowerPoint lecture slides, we also examined students' satisfaction with and attitudes toward the content, delivery, and availability of the downloadable slides. Table 3 contains the mean ratings of the questions assessing student satisfaction by availability condition. For each question, we conducted a 2 (slide availability condition)  $\times$  2 (course type) ANOVA. Overall, students were generally satisfied with the content and the delivery of the slides. Significant main effects showed that classes in which slides were posted before lecture had greater satisfaction with the timing of slide availability, greater satisfaction with the amount of material on the slides, and greater overall satisfaction with the slides than classes in which slides were posted after lecture. Satisfaction with the availability of slide formats and most questions about satisfaction with the content and delivery of the slides (i.e., the way the information was written, the number of slides, the pacing of slides, and how slides tied in with lecture material and exams) showed no significant differences between groups (all *ps* > .05).

Students also were asked to rate how much they perceived the lecture slides to be helpful, thorough, and complicated. Three 2 (slide availability condition) × 2 (course type) ANOVAs were conducted using each rating as the dependent variable. A significant main effect of availability condition was found for helpfulness, F(1,167) = 13.32, p < .001,  $\eta_p^2 = .07$ . Students who had access to slides before class found the slides to be more helpful (M = 6.01, SD = 1.06) than those who had access to slides only after class (M = 5.30, SD = 1.36). Similarly, there was a significant main effect of availability condition for thoroughness, F(1,168) = 9.21, p = .003,  $\eta_p^2 = .05$ . Those who had access to slides before class also found the slides to be more thorough (M = 5.47, SD = 1.17) than did those who had access to slides only after class (M = 4.91, SD = 1.34). No significant main effects or interactions were found for students' ratings of slide complexity.

#### 3.4. Attendance, participation, and exam performance

Finally, we examined whether the timing of slide availability was related to attendance, class participation, and exam performance. Because attendance and participation in lecture was a part of students' overall grade for the Cognitive Development course, but not the Research Methods course, we chose to analyse the effects of slide availability condition within each course, separately.

p < .05.

<sup>\*\*\*</sup> *p* < .01. \*\*\*\* *p* < .001.

#### 3.4.1. Attendance

Attendance was measured by the percentage of days that students attended the lecture. Atypical days, such as the first day of class and the day following holidays, were removed from this calculation. A one-factor ANCOVA was conducted for each of the analyses on percent attendance. Because each class contained different students, we used their responses on the question about how frequently they attended lectures for their other classes as a covariate so that students' typical attendance would not explain differences between availability conditions. The mean percentage of student attendance for all four classes is shown in Fig. 3. For the Research Methods classes, which did not have an attendance requirement as part of students' overall grade, a significant difference was found, F(1,87) = 5.78, p = .02,  $\eta_p^2 = .06$ . On average, students in the class that had the slides posted before lecture attended approximately 77% of classes (M = 76.61, SD = 22.71), whereas the students who received slides only after class attended approximately 60% of classes (M = 59.74, SD = 26.09). For the Cognitive Development classes, in which attendance was required, although the before-lecture class had a relatively higher average percentage of attendance (M = 89.32, SD = 10.61) than the after-lecture class (M = 86.84, SD = 12.79), this difference was not significant, F(1,68) = 0.22, p = .64,  $\eta_p^2 = .003$ .

To further explore whether actually downloading slides before lecture was associated with how often students attended class, we ran a bivariate correlation for each of the before-lecture classes between percent attendance and how often they downloaded slides before they were used in lectures. For the Research Methods course, there was a significant positive correlation indicating students who more often downloaded slides before attending lecture also were more likely to attend class, r = .31, p = .03. In contrast, no association was found for the Cognitive Development course, r = .001, p = .99.

#### 3.4.2. Class participation

Participation was directly measured only in the Cognitive Development classes. For the dependent variable, we used a proportion created from each student's participation points divided by their attendance points for the days in which participation was recorded (participation points were not given on the first day, the day a film was shown, and on the days of the student presentations). This proportion represented the student's average participation points per class. As seen in Fig. 4, when considering the participation of all students in these



Fig. 3. Mean percentages of student attendance by slide availability condition and course type.



Fig. 4. Mean proportions of daily student participation in the Cognitive Development classes by slide availability condition. The first group of bars represents all students from these classes, and the second group of bars represents only those students who participated one or more times during the semester.

classes, the before-lecture class had a higher mean proportion (M = 0.83, SD = 1.12) than did the after-lecture class (M = 0.47, SD = 0.59). However, an independent samples *t*-test revealed that this difference did not reach traditional levels of significance, t(59) = 1.74, p = .09.

Austin et al. (2002) have speculated that providing note-taking materials (e.g., lecture slides) may only benefit participation for students already inclined to participate, but not the less vocal students. To see if this was the case, we ran an additional analysis comparing participation levels of the two classes, excluding those who did not participate in class at all. First, we classified students as either participators (participated once or more) or non-participators (never participated). Then we ran a Chi-square that demonstrated that the non-participation rate in the before-lecture class (26%) was not significantly different from the after-lecture class (21%),  $\chi^2(1, N = 73) = 0.26$ , p = .61. Finally, we ran an independent samples *t*-test using just the data from the participators. A significant difference was found between the two slide availability conditions, t(42) = 2.11, p = .04. As seen in Fig. 4, participators in the before-lecture class (M = 0.60, SD = 0.60).

# 3.4.3. Exam performance

Exam performance was measured by the percentage of correct responses on the multiple-choice questions from the midterm and final exam. One-factor ANCOVAs were conducted for each type of class, using exam percentage as the dependent variable and students' cumulative GPA prior to the semester as a covariate. For the Research Methods classes, no significant difference in exam score was found (F[1,84] = 0.24, p = .63,  $\eta_p^2 = .003$ ), however, it was noted that the mean exam percentage of the before-lecture class (M = 69.49, SD = 11.61) was higher than the after-lecture class (M = 66.75, SD = 11.35). Similarly, for the Cognitive Development class, the difference between availability conditions was not significant (F[1,64] = 0.98, p = .33,  $\eta_p^2 = .02$ ), although the before-lecture class had a relatively higher average exam percentage (M = 70.25, SD = 11.75) than the after-lecture class (M = 68.91, SD = 12.49).

Although slide availability condition differences in exam performance did not emerge as significant, we also were interested in whether differences in slide use were related to exam percentage score. Therefore, we ran bivariate correlations on how often students downloaded slides before class and exam percentage for each of the before-lecture classes. For both the Research Methods course (r = .17, p = .26) and the Cognitive Development course (r = .11, p = .53), no significant associations were found.

We also examined whether exam percentage was associated with how often students used the slides instead of coming to class. Because of the differences between the types of classes in attendance and their use of the slides, we chose to conduct bivariate correlations for each class separately. For the Research Methods classes, a significant negative association was found for both the class that had slides posted before lecture (r = -.29, p = .05) and the class that had slides posted after lecture (r = -.41, p = .006). For the Cognitive Development classes, a significant negative association was found for the class that had slides posted after lecture (r = -.37, p = .04), but the negative association for the class that had slides an onsignificant trend (r = -.30, p = .08). Thus, for both Research Methods classes and the Cognitive Development class that received slides after lecture, the more students used the slides instead of attending class, the lower their exam score.

# 4. Discussion

This study investigated how the timing of online lecture slide availability affects student attendance, participation, and exam performance. Students in two courses that were taught in both semesters over the course of an academic year either had access to slides before lecture or had access to slides only after lecture. This made it possible to manipulate the time at which lecture slides were made available to students while keeping constant the course material. Results were partially supportive of our hypotheses that students with access to lecture slides before class would attend class and participate more frequently; however, no differences in exam performance were found.

#### 4.1. Attendance

Class attendance was found to be considerably higher in the Research Methods class that had slides available before lecture (77%) than in the Research Methods course that could only access lecture slides after class (60%). This difference was significant, even when taking into account students' attendance in other classes during the same semester. This suggests that these findings were not just differences in students' typical class attendance. Furthermore, we also found that students who more often downloaded slides before attending lecture also were more likely to attend class. These results paint a different picture than other studies that have suggested either a decrease or no difference in attendance rate when lecture slides are offered before lecture (e.g., Debevec et al., 2006; Frey & Birnbaum, 2002; Grabe, 2005; Grabe et al., 2005; Pardini et al., 2005). To our knowledge, this is the only study that has found more frequent attendance in a class that has offered slides before lecture.

One reason for this difference in attendance between the slide availability conditions could be that posting slides before class may alert students to material with which they expect to have difficulty and thus encourage them to attend lecture. This "forewarning" function may also help to explain why students were less likely to attend the Research Methods class when the slides were posted after lecture. Without having access to the lecture slides, these students lacked cues to indicate that difficult material was going to be presented in class and may have been less motivated to attend.

Another possible explanation for our findings may be related to the way that students perceived the usefulness of the lecture slides as a learning tool. Students prefer having lecture slides to use as a note-taking guide because it helps direct their attention to key information in the lecture (Austin et al., 2002; Frey & Birnbaum, 2002; Murphy & Cross, 2002; Pardini et al., 2005), and because they can add their own ideas to these critical points as the lecture progresses. Without this benefit, students must rely on their own note-taking skills, which may involve only copying down the information on the lecture slides or may result in incomplete information for exam review purposes (Armbruster, 2000; Austin et al., 2004). If students perceive the professor's lecture slides as more comprehensive than the notes they could generate on their own, they may be lulled into a false sense of security, knowing that they will later have access to a seemingly complete set of lecture notes, and not feel the need to attend lecture.

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In contrast to the findings with the Research Methods classes, the Cognitive Development classes showed no differences in attendance between the two availability conditions. Perhaps these more advanced students understood the importance of attending class, or had better note-taking skills, and thus were more motivated to attend class. A more likely explanation, however, is the difference in attendance requirements for these two types of courses. Unlike the Research Methods course, the Cognitive Development course required attendance as part of students' course points. Required attendance has been shown to be a major factor in students' decisions to attend classes (Devadoss & Foltz, 1996), and this may override any effect that providing lecture slides before class has on attendance. As evidence of this, attendance was considerably higher for the Cognitive Development classes (89% and 87%) compared to the Research Methods classes (77% and 60%). Future studies should explore the relative contributions of slide availability and required attendance in students' decisions to attend lecture.

# 4.2. Class participation

Our study also demonstrated an availability condition difference in class participation. For the Cognitive Development classes, in which participation was measured, the class that had access to lecture slides before lecture had a greater average participation rate per person than did the class that could only access the slides after class. This finding is consistent with the idea that having lecture slides for note-taking during class frees up students' attention for other classroom activities (e.g., Austin et al., 2002). The difference between the two classes, however, was only statistically significant when we excluded students from the analysis who did not participate in class at all. Although we did not ask these students' to report their reasons for not participation (Neer & Kircher, 1989). Thus, the benefit of increased participation associated with providing lecture slides before class may only extend to those already inclined to participate. Students who regularly do not participate in class may never choose to participate, regardless of how much their note-taking demands are reduced. Future research on lecture slide usage and class participation should include measures that assess students' reasons for not participation incluses.

Although participation was not directly measured in the Research Methods class, anecdotal evidence suggested that students engaged in more discussion and asked more questions in the class for which lecture slides were available before class. Furthermore, students in this class (as well as the Cognitive Development class that had slides available before lecture) made comments in the free-response section of the questionnaire that were consistent with the explanation that having the lecture slides before class allowed them to pay more attention to the lecture. For example, one student from this class commented, "[It's] easier to pay attention and make my own notes rather than frantically copying overheads."

#### 4.3. Exam performance

Given that we observed differences between the lecture slide availability conditions for student attendance and participation, we would expect to find differences in other outcomes traditionally affected by these classroom behaviours, such as exam performance. The findings from this study, however, suggested that the timing of slide availability did not significantly affect students' exam scores in either of these two types of courses. This was surprising, especially because students reported that they felt their studying and exam performance was better when they had the slides before lecture. For example, one student wrote, "It made studying easier and helped me get a better mark." Although these results did not support our hypothesis, they are consistent with other research that found no difference between those who used slides during lecture and those who accessed slides after lecture (Grabe, 2005). Furthermore, because no advantage was found for students in the before-lecture classes who could use the lecture slides for both encoding and external storage purposes, our findings suggest that the main benefit for exam performance of providing lecture slides to students is external storage for later review.

Providing lecture slides to students before class may directly affect attendance and participation via motivational or attentional factors, but exam performance is more likely to be determined by several different factors working in combination. Individual learning styles and studying practices also contribute to how well students perform on exams. Having lecture slides for note-taking in lecture may provide an advantage to some students, but this may not account for as much variance in test scores as does, for example, time spent studying the text or working in study groups. Students who are only able to access lecture slides after class may compensate for any learning disadvantage by increasing their effort in other effective studying practices. Therefore, future studies on the availability of lecture slides should also assess the type and amount of time that students engage in these other studying practices in order to evaluate the unique contribution of slide availability on exam performance.

Another important finding from our study was that for both of the Research Methods courses and the Cognitive Development class who received the slides after lecture, the more students used the slides as a substitute for attending class, the lower their exam performance. Because this association was found for both slide availability conditions, this further suggests that individual factors play a larger role in exam performance than whether or not the slides are made available before class. However, it is important to note that even though the difference between slide availability conditions was nonsignificant, the before-lecture classes did have higher mean exam scores than their after-lecture counterparts. Taken together with the fact that other studies on exam performance and providing lecture slides have had mixed results, the relationship between slide availability and exam performance is a future avenue of research that is worth pursuing.

#### 4.4. Use of and satisfaction with lecture slides

The majority of participants downloaded the lecture slides, regardless of whether they were available before or after class. There were, however, some differences in slide usage that were associated with both class type and time of slide availability. When slides were available before class, for both types of classes they were used primarily as a guide for note-taking. When slides were available only after class, students in the Research Methods class were more likely to use the slides as their main notes, adding little of their own information, and were also more likely to use them as a substitute for attending class. In contrast, students in the Cognitive Development class were more likely to supplement the slides after class with their own information or to use them as a double-check of their own independent notes. This may illustrate a difference in the way that introductory- and advanced-level students make use of

online lecture slides after class. By using the lecture slides as their sole notes, the introductory-level students in the Research Methods class may be missing elaborative information. Although no differences were found for exam performance, it may be that exam score is a function of short-term learning that can be supplemented with cramming. To assess whether the way in which slides are used affects long-term retention of material, future studies should consider using designs that use longitudinal measures, such as a six-month posttest.

Other notable findings were how students in the different availability conditions used the lecture slides as a study tool. Students who had access to slides before lecture were more likely to use the slides as a way of reviewing notes after lecture compared to students who only had access after lecture. Furthermore, when asked to categorize how they used the notes, one-tenth of the students who only had access to lecture slides after class reported not using them much, whereas none of the students in the classes that received slides before lecture reported this. These findings may simply reflect that these students preferred to use their own notes, however we feel these results suggest that students who do not have access to slides prior to lecture may view them as less effective for exam review. For the professor who provides lecture slides for the purpose of enhancing students' study tools, our findings indicate that they would be more effective if offered before lecture.

We also found differences in students' satisfaction with the lecture slides. Consistent with the findings of other research (e.g., Apperson et al., 2006), students in this study reported higher overall satisfaction when lecture slides were posted before lecture. Students with access to slides before lecture were also more satisfied with the timing of the slides' posting and found them to be more helpful. Interestingly, despite the fact that slides were identical between semesters, students who had access to slides before class also perceived the slides to be more thorough and were more satisfied with the amount of material on them. Perhaps these students felt that the combination of the professor's notes and their own comments that they wrote on the slides during lecture produced a more thorough set of notes for studying purposes. This also may explain why more students who had access to slides only after lecture were less likely to make use of them when studying for exams.

#### 4.5. Limitations and future directions

The present study revealed differences between lecture slide availability conditions in class behaviour and also in how students used and perceived course slides. These findings are group tendencies, however, and should not be interpreted as indicators of how a single student's score would change if he or she were given the slides before class. The design of this study was meant to compare the impact of slide availability on class performance, as a whole – information that may be useful to professors when they are making decisions about what educational practices would benefit the majority of the students in the class. For the future, researchers may want to examine how slide availability is likely to impact individual students with different learning styles. This can help professors understand what kinds of recommendations they can give to students who are having difficulties with using the lecture slides effectively.

Although we controlled for typical class attendance in our analysis of attendance, it is possible that other factors that we did not measure could have contributed to the group differences we observed. A student's motivation for learning class material, for example, may play a role in attendance, participation, and exam performance. It is possible that different motivation levels for the class material could have accounted for the differences that we saw in attendance for the Research Methods class and in participation in the Cognitive Development class. If motivation were responsible for the effect, however, we would expect to see differences in all three outcome variables. This was not the case. Even so, motivation for learning the class material remains an important factor that future investigations should examine when looking at outcomes of slide availability.

Our findings on the satisfaction with the lecture slides revealed some interesting patterns in the way that students perceived the slides, and one of our goals with the free-response questions was to further explore these perceptions. However, we were limited in our ability to analyse these qualitative data because there was little elaboration and variability in students' responses. For example, many of the responses about the quality of the slides consisted of a single word, such as "Good." Therefore, future research using free-response questions should take care in wording questions so that they are likely to elicit more than single-word responses. Furthermore, we recommend that future studies include free-response questions about a broader range of topics related to lecture slide usage and other factors involved in classroom behaviour and exam performance. Our findings provide a starting point for how the timing of slide availability affects these variables, but additional qualitative studies can provide a richer picture of how students perceive and use lecture slides in their classroom experiences.

Finally, there is a need to replicate these findings. To our knowledge, this study is the first to compare the effects of slide availability timing, controlling for course content. It is important to use this design in studies with other types of classes done over multiple semesters. By replicating our findings in different contexts, this would allow us to make stronger claims about the benefits of providing slides to students before lecture.

#### 4.6. Summary and conclusions

In recent years, there has been increased student demand for professors to use computer-based lecture slides and to make them available online. Empirical studies, such as this one, can help professors make informed choices about whether and when to provide these slides so that they can create the most adaptive learning environment for students. In our study, when slides were made available before lecture, students not only expressed a more favorable view of the lecture slides, but also reported using them as a more effective notetaking and study tool, compared to when slides were not made available until after lecture. When attendance was not a required part of students' grades, the class that received slides before lecture had more frequent attendance. Furthermore, when examining the relative participation rate of students who participated in class discussions, students in classes where slides were made available before lecture had more frequent participation than those in classes that received slides after lecture. These findings are perhaps the most relevant for instructors, especially for seminar-style courses. By posting slides before lecture, students have the opportunity to prepare in advance for class and perhaps feel more comfortable in volunteering thoughts and opinions. When slides were only available after lecture, a less adaptive pattern was found. Not only did these classes have lower attendance and participation, but they also used the slides less effectively. In addition, when attendance was not mandatory, students were more likely to report using the slides as a substitute for attending class.

In contrast to the findings on attendance and participation, exam performance did not significantly differ, regardless of whether or not students had access to slides before lecture. This notable finding suggests that there is more to exam performance than simply whether or not students have the lecture slides for note-taking. Although the quality of students' notes may be improved by having the lecture slides during class, students who do not have access to slides prior to lecture may be able to compensate for their relatively poorer notes by engaging in other effective studying practices.

Taken together, our results have many important implications for both professors and students. Mandatory attendance and participation may be one of the strongest predictors of whether students attend and are active participants in class (Devadoss & Foltz, 1996), but for professors who choose not to include this course requirement, providing notes to students prior to lectures would likely make students happier and make them feel as if they have a better understanding of the material. Furthermore, professors would probably enjoy the benefit of better attendance and participation in the classroom. Professors who typically provide slides after lecture with the reasoning that this will prevent students from using slides as a substitute for attending class may want to reconsider this policy. Our study showed the opposite effect. Students were more likely to use slides as a substitute for attending lecture if they received lecture slides after class.

If lecture slides are made available before class, students bear the responsibility for knowing how to use slides for notetaking so that they work best for their own learning style. This also includes understanding that not all lecture material will be contained on the online lecture slides, and therefore they should not be using them as a substitute for attending class. Most importantly, it is essential that students realize that having access to the professor's lecture slides before lecture does not always lead to better exam performance. Rather, slides are simply another tool that must be incorporated into effective study strategies.

# Appendix

Target Questions on the Classroom Technology and Learning Outcomes Questionnaire

Part I: Students' use of lecture slides

Which of the following statements best describes when you downloaded the lecture slides?

(a) I downloaded slides as soon as they were available on the website

(b) I usually downloaded slides before the lecture

(c) I usually downloaded the slides the day of the lecture

(d) I usually downloaded slides just before going to lecture

(e) I usually downloaded slides after the lecture

(f) I always downloaded slides after the lecture

(g) I never downloaded slides

Which of the following statements best describes the way in which you used the downloaded lecture slides?

(a) I used them as my main notes – I added very little extra information

(b) I used them mostly as guides – I added a fair bit of extra information

(c) I downloaded them for reference – I had the slides but took separate notes

(d) I downloaded them after lecture - I used them to double-check my own notes

(e) I downloaded them after lecture – I did not use them much

(f) I did not download the lecture slides

(g) Other – please describe:

The following three questions were rated on this 6-point Likert-type scale:

Never	Rarely	Some of	About half of	Most of	Every
		the lectures	the lectures	the lectures	lecture

How often did you download slides before they were used in lecture?

How often did you use slides instead of attending class?

How often did you use slides as a way of reviewing notes after lecture?

Which format of slides did you download and use the most? (a) PowerPoint

(b) PDF

#### Part II: Students' satisfaction with lecture slides

Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied			
How satisfied were you with the availability of formats for lecture slides (PowerPoint, PDF)?							
How satisfie	How satisfied were you with when the lecture slides were posted on the website?						
How satisfie	d were you with t	he amount of material	on the lecture	e slides?			
How satisfie	d were you with t	he way material was w	written on the	slides?			
How satisfie	d were you with t	he number of slides p	rovided for ea	ch lecture?			
How satisfie	d were you with t	the pacing of the lectur	re slides durin	g the lecture?			
How satisfie presentation	How satisfied were you with the way lecture slides tied in with the lecture presentation (i.e., consistency of the slides with what was said in lecture)?						
How satisfied were you with the way the lecture slides represented material on the exams?							
How satisfie	d were you with t	he lecture slides, over	all?				
Overall, how helpful did you find the lecture slides (circle one)?							
1 2 3 4 5 6 7 Not at all Very helpful helpful							
Overall, how thorough did you find the lecture slides (circle one)?							
1 2 3 4 5 6 7 Not at all Very thorough							

Overall, how complicated did you find the lecture slides (circle one)?

1	2	3	- 4	5 1	6 7
Simple					Complicated

Part III: Free-response questions

(a) What did you like about the lecture slides?

(b) If you had the opportunity, what would you change about the lecture slides?

(c) How did this course compare with other courses that did not post lecture slides at all?

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