Achieving PEAK POW: The Effects of Four PowerPoint Techniques on Student Learning and Retention

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Purpose of the Study: PowerPoint-based (PP) lectures are a ubiquitous technique used in marketing classes. Despite this popularity, there is little research which demonstrates that existing PP methods optimize student learning and retention. In order to address this gap, this study compares four different PP techniques used by the same instructor for the same materials and develops an active learning PP technique based on the multimedia learning, cognitive load and active learning literatures to optimize student performance.

Method/Design and Sample: In four Sales classes (n=331), lectures for each class exclusively used one of four PP presentation types throughout the semester: publisher-generated slides, instructor-generated slides, student group-generated slides and student group-generated slides that had been peer-critiqued.

Results: Results show that the active learning, student-group generated, peer-critiqued slides optimized student final performance on the comprehensive multiple choice and long answer final examination as compared to the other conditions.

Value to Marketing Educators: This study presents a new active learning PowerPoint technique which enhances student aided and non-aided recall learning and retention. The recommendations are easily implemented and can be used by instructors of all level of experience as well as for all types of classes (face-to-face, online). This method also prepares students to generate effective Powerpoint presentations for the workplace.

Keywords: Active learning, Powerpoint, multimedia, student performance, cognitive load.

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INTRODUCTION

Despite the fact that optimizing long-term information retention and learning of students through active and experiential learning techniques is a continuous, critical goal for marketing instructors worldwide (e.g. Goby & Lewis, 2000; Dahl, Peltier & Schibrowsky, 2018), a considerable proportion of course materials are still delivered through traditional, non-active learning 'sage on the stage' lecture methods (Foster, West & Angus-Bell, 2016). During these lectures, it is very common for instructors to use PowerPoint (PP) slide decks as a means of organizing and presenting class content even though there is a general lack of academic support for the efficacy of this technique in optimizing student learning (Kennett-Hensel, Sneath & Pressley, 2007; Buchko, Buchko & Meyer, 2012; Garrett, 2016). The question, therefore, is whether or not there are any modifications that can be made to existing PP techniques that can improve student learning and retention in marketing classes.

To address this question, this study developed and tested several new PP procedures which incorporated research findings from the multimedia design, cognitive load / information synthesis and active learning literatures. More specifically, students in four Sales classes (n=331) were exposed to course lectures which used one of four PP presentation types exclusively throughout the entire semester: publisher-generated slides, instructor-generated slides, student-generated slides or student-generated slides which were peer-critiqued. The results show that compared to the other conditions, the active learning student-generated, peer-critiqued PP method generated significantly better student performance in terms of the comprehensive final examination results for both multiple choice and long answer test components.

LITERATURE REVIEW AND HYPOTHESES

PowerPoint presentation (PP) software was first introduced in the late eighties and now, thirty years later, there are approximately 30-35 million PP presentations made each day (Parker, 2001; Amare, 2006; Paradi, 2018) and over 500 million users globally (PollEverywhere, 2016). PP is used by at least two-thirds of university faculty every year (Burke et al., 2009; Buchko, Buchko & Meyer, 2012) and has relatedly been employed in lectures for more than 93 percent of undergraduate students internationally (Garrett, 2016; Burke et al., 2009). PowerPoint slide decks are so widely used that they are virtually a mandatory publisher supplement for most university textbooks (Kennett-Hensel, Sneath & Pressley, 2007).

This pedagogical use of PP presentations is popular for a number of reasons. First, it is commonly assumed

by both students and instructors that student learning is enhanced by PP presentations (e.g. Hill et al., 2012; Williams et al., 2016; Onivehu & Ohawuiro, 2018). And although there is some research which supports this notion, particularly when students self-report their own perceived learning or when other factors are included such as additional Internet resource availability or the use of course management software for example (e.g. Lowry, 1999; Mantei, 2000; Atkins-Sayre, Hopkins & Mohundro, 1998; Gambari et al., 2016; Erdemir, 2011), the preponderance of literature shows that PP presentations do not, in fact, enhance student learning when compared to traditional 'chalk and talk' lecture-based classes (e.g. Rudow & Finek, 2015; Root-Kustriz, 2014; Daniels, 1999; Lowry, 1999; Savoy, Proctor & Salvendy, 2009; Parker, Bianchi & Cheah, 2008; Wilmoth & Wybraniec, 1998; Rankin & Hoaas, 2001; Moulton, Turkay & Kosslyn, 2017).

On the other hand, PP presentations have been associated with student and instructor perceptions of improved course organization (Leider & Jarvenpaa, 1995), usefulness for student note-taking (Sussakind, 2005; James, Burke & Hutchins, 2006; Hill et al., 2016) and greater student enjoyment (Levasseuar & Sawyer, 2009; Cassidy, 1998; Mattar & El Khoury, 2011; Moulton, Turkay & Kosslyn, 2017; Xingeng & Jianxiang, 2012; Tang & Austin, 2009; Burke, James & Ahmadi, 2009). Instructors also tend to receive more favorable teaching reviews and are perceived as more effective and likeable by students when PP presentations are used (Koeber, 2005; Susskind, 2005; Weinraub, 1998; Mackiewicz, 2008; Apperson et al., 2006; Cassidy, 1998; Kennett-Hensel, Sneath & Pressley, 2007). Finally, instructors and students are both comfortable and familiar with PP technologies which also likely contributes to the high usage rates (Hill et al., 2012; Williamson, Clow & Stevens, 2011; Moulton, Turkay & Kosslyn, 2017; Cameron, 2001).

Thus, even though there is a lack of empirical support for optimized student learning arising from PP presentation-based lectures, because of these additional outcomes, it is highly probable that PP presentations will be an enduring feature of pedagogical practices in the future. Given this likeliness, the question that needs to be addressed is how to design PP presentations so as to optimize student learning. The literature on multimedia design, cognitive load / information synthesis and active learning provide insights on how to accomplish this objective, as follows.

First, the literature on multimedia design shows that factors such as layout, textual / graphical content and proportionality, number of slides used and other similar issues can contribute to the effectiveness of PP presentations. These findings are important because many marketing instructors are self-taught in terms of PP design or alternatively, are part-time lecturers, inexperienced, lack knowledge, are under time constraints (due to issues such as unexpected course assignments) or are simply unmotivated to develop their own PP presentations. As a result, poorly designed self-produced slides or even original, unchanged publisher-provided slides are sometimes used in the classroom (Kennett-Hensel, Sneath & Pressley, 2007; Garett, 2016).

More specifically, according to the principles of multimedia design, there are a number of errors that can sub-optimize PP presentations, (Hogan, 2009). These errors can include, inter alia, 'conceptual dumps' of both relevant and irrelevant information (Tufte, 2003; Pratt, 2003; Bumiller, 2010, Williams et al., 2016), overuse of 'bells and whistles' including graphics and pictures (Bumiller, 2010; Jordan & Papp, 2014; Ortegren, Serra & England, 2015), inconsistent backgrounds or themes (Mackiewicz, 2007; Ricketts, 2018) inconsistent fonts and font sizes (Alley et al., 2006) inconsistent densities of information on slides (too much or too little textual information: Kalyuga & Sweller, 2014; Mayer & Fiorella, 2014) as well as the use of too many slides: only one or two slides should be used approximately every 5-7 minutes or about 10 to 24 slides per hour of presentation (de Wet, 2006; Rickett, 2018). In addition to these empirically supported factors, there are many other suggestions on PP design that can be found in the popular literature: there are over 2000 books dealing with PP presentation design listed on Amazon.com alone (e.g. Alman, 2019; Parkinson, 2018; Duarte, 2008; Pollard, 2017) Although a full review of this literature will not be completed here, instructors should note that the consideration and adoption of research validated PP best practices could help to enhance student learning in the marketing classroom. This issue will be further considered in this research.

In addition to PP design issues, another factor that can also impact student learning is the fact that students are required to both listen and process the lecture information (verbal cues) as well as read and process the PP slide content (nonverbal cues) simultaneously. Specifically, this multimodal communication requires dual channel synthesis as well as the mental integration of the different types of cue data to facilitate information encoding and long-term memory storage of materials (Chandler & Sweller, 1991; Sweller & Chandler, 1994; Mayer & Fiorella, 2014; Ricketts, 2018). If the concurrent verbal and visual cues are so divergent or distinct as to increase the cognitive load and related mental processing sequences significantly, learning and retention will be reduced (Ortegren, Serra & England, 2015; Garrett, 2016; Williams et al., 2016). Thus, when using PP presentations in the classroom, instructors must ensure that verbal and visual cues are sufficiently similar to optimize student learning and retention (Williams et al., 2016; Mayer, 2005; Mayer & Johnson, 2008). The specific effects of varied cognitive load on student learning will not directly be measured in this study although this is an area of future research.

Interestingly, even though too much divergence between verbal and visual cues can reduce student learning, too much repetition of the same information can also have a negative impact on student performance. Specifically, if information is identical for both verbal and nonverbal communication channels, even though student *attention* will strongly be directed

to the content being communicated, the actual transfer of information to long term memory will not optimally occur (Mayer & Johnson, 2008; Ortegren, Serra & England, 2015 Mayer & Fiorella, 2014; Ricketts, 2018). For example, a meta-analysis of multimedia and redundancy communication research found that, as compared to lectures using extensive, equivalent visual content, the highest levels of student aided and unaided recall occurred when the multimodal, spoken-written presentations used only key textual cues extracted from the verbal lecture (Adesop & Nesbit, 2011). Thus, in order to optimize student learning, instructors must also not be overly verbally and visually redundant while using PP presentations in the classroom. Although the direct effects of redundancy on student learning will not be specifically addressed in this research, this is also an area of future study.

Combining the cognitive load and redundancy literature findings, it is clear that while instructors cannot simply read PP presentations word-for-word, they also cannot present highly content-varied verbal and nonverbal cues that require overly demanding information synthesis or cue integration. And although the effects of variations in verbal and non-verbal cues levels on student learning will not be specifically measured in this study, the general findings in the cognitive load and redundancy literatures should be considered by instructors when designing PP lectures. It is hypothesized that if PP presentations are designed to be consistent with the multimedia design and cognitive load / redundancy principles reviewed here, student learning will be enhanced:

H1: Compared to lectures given using publisher-generated slides, lectures which used instructor-generated slides improve student final examination performance.

The final and perhaps most important research area that can be examined for empirically-supported ideas on how to optimize student learning when PP presentations are used is the active learning literature. It is an extremely well supported finding that active and experiential learning activities optimize student learning in the classroom (e.g. Goby & Lewis, 2000; Dahl, Peltier & Schibrowsky, 2018) Unfortunately, because of their 'sage on the stage' nature, (Foster, West & Angus-Bell, 2016) traditional PP presentations tend to entrench passive learning for students (Cameron, 2001; Bartch & Cobern, 2003; Amare, 2006; Craig & Amernic, 2006; Buchko, Buchko & Meyer, 2012; Akugun, Babut & Albayrak, 2016). In particular, instead of engaging in critical thinking about concepts and having thoughtful discussions about the inter-relationships and implications of the information presented, students can just sit back and experience 'death by PowerPoint' where their 'eyes glaze over' as they listen to yet another bulleted 'storyboard-style' presentation, (Hogan, 2009; Bumiller, 2010; Jordan & Papp, 2014). This lack of active student learning may even be one of the factors contributing to the neutral or even negative student learning performance results that have been documented when PP presentations are used in lectures (e.g. Cassidy, 1998; Bartsch & Cobern, 2003; Filak & Short, 2005; Susskind, 2006; Amare, 2006; Savoy & Salendy, 2008; Krippel et al., 2010; El Khoury & Mattar, 2012; Jordan & Papp, 2014; Garrett, 2016). Given this possibility, are there any steps that can be taken to mitigate this problem? Are there active learning modifications that can be implemented for PP presentations which would improve student engagement and relatedly student learning? The extant active learning literature provides a number of solutions as follows.

As a first step, student learning arising from PP based lectures could be enhanced if students were more involved with the organization and preparation of the course-related materials - in this case, the preparation of the PP presentation slides (e.g. Hansen, 2003; Gurung and Daniel, 2005; Reigeluth, 1983; Bianco and McCromick,1989; Saber, 2010). For example, since the preparation of the PP slides would require high levels of mental elaboration and deep, complex information processing, student learning and performance should improve with the implementation of this task (e.g. Darley & Glass, 1975; Young, Klemz, & Murphy, 2003; Brennan, 2014; Dahl, Peltier & Schibrowsky, 2018; Valdez & Valdez, 2018; Labrecque, Markos & Darmody, 2019) Specifically, in order for students to produce these PP presentations, they first have to review the textbook materials, decide which topics are relevant and important for each chapter, prepare the actual content of those topics and then organize and place the content onto slides. Most likely, even after the slides are initially produced, the PP would have to be reread/ reworked a number of times for content, grammatical or spelling errors, appropriate layout and other factors. The student involvement and mental elaboration with the course content would be substantial for this supplemental task and therefore would likely improve recall, comprehension and student learning performance. The repetition literature also generally supports this modification, since repetition has been shown to enhance learning via increased student familiarity with course materials (e.g. Hintzman, 2004; Warburton, 2003; Saber & Johnson, 2008; Saber, 2010; Adesop & Nesbit, 2001: see Donovan & Radosevich,1999 for a meta-analysis). It is thus hypothesized therefore that when students prepare the PP presentations for the class lectures themselves, student learning will significantly increase as compared to both publisher and instructor-prepared PP presentations:

H2: Compared to lectures using instructor-generated slides, lectures which used student-generated slides significantly improve student final examination performance.

Another active learning modification that would likely further enhance student learning in PP-based classes would be if students not only produced the PP presentation slides but they also evaluated the PP slide decks prepared by other students in their class. Since

peer-to peer evaluations and critiques have been proven to be excellent experiential methods to optimize student learning because of the extensive information elaboration and information processing that is required to evaluate the work of others (e.g. Ballantyne, Hughes & Mylonas, 2002; Brammer & Rees, 2007; Odom et al., 2009; Forrer, Wyant & Smith, 2015) this modification would likely enhance student learning to an even greater extent than student-generated PP presentations alone. Thus, it is hypothesized that compared to publisher, instructor and student-generated PP presentations, student learning performance will be significantly higher when the PP presentations are student-generated and peer-critiqued as well:

> **H3:** Compared to lectures given using student-generated slides, lectures which use student-generated slides which have been critiqued by student-peers improve student final examination performance.

The iterative development and the procedures used for the PP presentation techniques investigated in this study are described below.

PROCEDURE

The four PP methods examined in this research were developed in an attempt to optimize student learning and retention of course materials in a Sales class. The instructor's interest in this subject initially arose because an updated version of the textbook was introduced which effectively made the instructor's previously-developed PP slide deck obsolete even though the new content was quite similar to the materials the instructor had taught numerous times in the past. A review of the publisher-provided PP slide deck revealed that the quantity of slides provided per chapter was very unwieldly: the publisher had provided approximately 40-60 slides per chapter which is a relatively typical amount provided by publishers, based on a convenience review of 15 marketing textbooks and their supplemental PP materials. In addition to the large quantity of slides, there were many unnecessary and irrelevant graphics, illegible (given the size of the lecture theater) and inconsistent fonts, varying slide structure in terms of too much or too little informational content and finally, too many slides that were irrelevant to the concepts the instructor wanted to cover in her classes. Interestingly, informal discussions with several experienced marketing colleagues revealed that they too had noticed many of these undesirable issues in their own publisher-provided slides. Notwithstanding this fact, however, the instructors also all agreed that having publisher PP presentations provided with textbooks was extremely helpful as a starting point for the customization and development of their own PP presentations.

But why couldn't unmodified publisher PP presentations be used in the classroom? Would this usage cause any deleterious effects on student performance? Clearly, if no negative significant differences in student learning occurred due to the use of unmodified publisher PP presentations, there would be little incentive for an instructor to allocate significant efforts into customizing PP presentations, particularly when there are many other time-consuming research and service requirements for instructors at most contemporary universities (Austin & Gamson, 1983). Would the instructor's PP customization investments truly make a difference in student learning?

To test this proposition, the instructor decided that she would teach one section of the semester using shortened but otherwise unmodified publisher-provided PP presentations (n=84) and teach the other section (n=85) using the customized slides that she had produced which had been modified in quantity, structure and content according to the multimedia design and cognitive load / redundancy literatures reviewed previously. In particular, the instructor reduced the total number of slides to between 15-25 slides per chapter, ensured that textual density and legibility were improved and consistent, removed all animations and reduced unnecessary graphics. The instructor also ensured that she would not be directly repeating the content of the slides in her lecture but on the other hand also ensured the verbal and visual information was not so divergent as to be problematic with respect to overly demanding student cognitive loads.

To further reduce student cognitive load, all slides utilized for each respective class section were available for download on the course management software approximately one week before the lecture was given. Unfortunately, only about 10% of students in either section actually downloaded the PP materials in advance and only about 5% of students in both the classes self-reported actually reviewing the materials on a regular weekly basis. Because the number of downloads and self-reported review behaviours were almost identical for both class sections, no differences in student cognitive load were likely and as a result, this issue was not further addressed in this study. Despite this failure in the instructor's attempt to reduce student cognitive load, as a first attempt at optimizing student learning from PP presentations, the instructor proceeded to compare student learning results for the shortened but otherwise unmodified publisher-provided PP presentations against her own instructor-customized slides.

Next, partly because of the low rates of student PP download and review and partly because of the research findings in the active learning and repetition literatures, in the following semester the instructor decided to apply principles of active learning to enhance the deep and elaborative processing and related learning that students acquired from the lectures. After a one-hour lecture presenting best practices from the PP multimedia design and cognitive load / redundancy literatures, the instructor distributed an assignment whereby groups of 4-5 students prepared their own PP presentations of the weekly lecture materials (two textbook chapters per week) and submitted them to the

instructor twelve days before the lecture. Students were instructed to prepare 10-15 PP content slides for each of the two chapters and were told that the best PP presentation would be used by the instructor for that week's lecture and that the 'winning group' of the weekly assignment would also receive a one percent bonus added to each group member's final grade in the class, (see Appendix A: Recommended Grading Rubric). This assignment replaced the group assignment from the previous semesters where groups of 4-5 students would submit a weekly 3-5-page written summary of each of the two chapters covered in the class. Similar to the student-generated PP condition, the best student submissions for the previous assignment had also received a one percent bonus as well. Group projects for both semesters were worth 30% of the students' final course grade and there were ten total textbook chapters that were the target content for the assignments. The instructor had also provided general verbal and written instructions on how to do either the summaries or the PP slides and provided written examples of the tasks using materials from the first chapter of the textbook.

Because this condition provided a supplemental active learning task for the students that was directly related to the lecture content, this modification was expected to generate significantly improved student learning outcomes compared to the previous experimental condition. Again, since the students had to actively review the chapter materials, discern important and unimportant topics, think extensively about what specific details concerning these topics should be included and finally design effective PP presentations to facilitate the communication of these concepts, it was expected that this technique would increase student learning. The findings from this comparison will be discussed in the results section of this paper, below.

A final iteration of the PP techniques was also designed to improve student learning from PP lectures by getting students review the course materials even more thoroughly than in the previous student-generation of PP presentation condition. Here, besides preparing the PP slides for the lectures, part of the group assignment was to also provide a critique of the PP slides of one other group (See Appendix A: Recommended Grading Rubric). This critique was due 3 days before the lecture took place and similar to the previous assignments, the best PP slide deck and critique received a one percent bonus. A one-hour lecture presenting best practices from the PP multimedia design and cognitive load / redundancy literature was again given to the students at the beginning of the semester and a rubric for the critique was also provided. In this iteration, greater student learning performance was expected in this PP task compared to the previous condition because not only did students have to review and extensively think about the materials to produce the slides themselves but they also had to grade and analyze the quality and content of another group's presentation and also fully justify their assessments. It was anticipated that as a result of these active learning task requirements which further enhanced student's interactions with and consideration of the course materials, this condition would generate the highest student learning and retention results compared to the other techniques employed in this study.

PARTICIPANTS AND METHOD

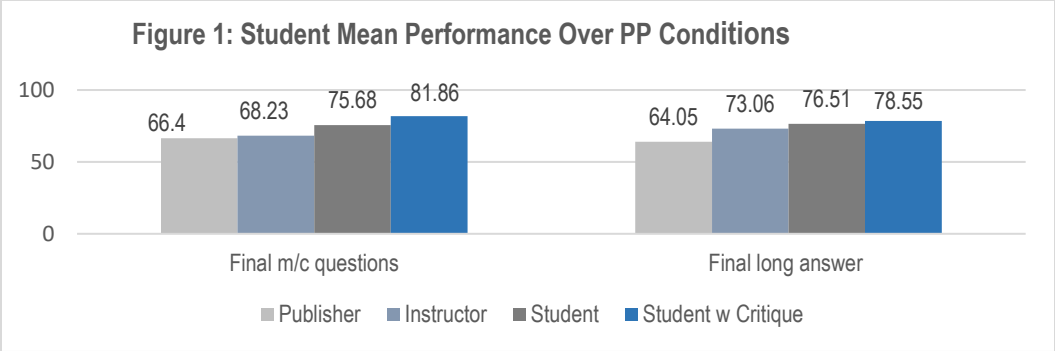
Participants in this research were 331 undergraduate students enrolled in four separate Sales class sections at a large AACSB accredited university. Fifty-three percent of the respondents were female, 52.1 percent were in their third year of university, and 61.2 percent were business majors. Students were evaluated through a 20 percent midterm, a 40 percent comprehensive, cumulative final, a 10 percent individual project and a 30 percent group project. Examinations utilized half multiple choice and half long answer questions and all examinations were identical except for being order-scrambled. In each of the four sections, the instructor verbally reviewed approximately 25 general topics that were potential final examination long answer question content areas to try to ensure that students studied those particular concepts. All other course materials and assignments were identical across the sections. The experimental condition was the PP-based technique employed: one section was exposed to publisher- provided slides, (n=84), the second section was exposed to instructor-generated slides (n=85), the third section was exposed to student-generated slides (n=85) and the final section was exposed to student generated slides which had been critiqued by their student peers (n=76). All classes were taught by the same experienced instructor and all assignments and long answer components of the examinations were graded by the same experienced teaching assistant who was unaware of the differences in PP lecture types within this study. Students were informed at the start of the semester that all final letter grades would be assigned using a normal distribution curve thus avoiding any grade disparities due to the experimental conditions.

RESULTS AND DISCUSSION

After ensuring data normalcy, the hypotheses were tested using repeated-measures multivariate analysis of variance procedures. Scores on the long answer and multiple-choice portions of the comprehensive final examinations were the dependent variables and the within-subject factor was the task type, (multiple choice versus long answer). The between-subject variable was the PP lecture-type experimental condition. There was no significant main effect for task type indicating no significantly statistical differences in grade achievement between multiple choice and long answer questions. This result is consistent with research that suggests that students tend to perform equally well on examinations no matter what type of testing procedures are used, (Haynie, 1994) and is also not unexpected, given the extensive final examination long-answer content review

that was verbally provided by the instructor to all class sections.

There were no significant main effects when the covariates year of program, major, class attendance levels, teaching rating, student self-reported time studying, self-reported time spent completing group work or final course letter grade were added to the model nor were there any significant interaction effects for the PP lecture conditions or the task type and these covariates. There was a main effect for the PP experimental condition, $F_{(3, 326)} = 39.026$, p=.000, indicating that the type of PP-lecture technique was significantly different amongst the sections and a significant main effect of the PP-lecture technique on the examination grades, $F_{(3, 323)} = 3.469$, P=.000. This effect demonstrated that student examination performance was significantly impacted by the PP presentation method. Student means for both the multiple choice and long answer conditions increased for each progressive iteration of the PP technique and a graphical representation of these means of each PP condition by task type is shown in Figure One below:



Follow-up Bonferroni post hoc tests were used to determine if these mean differences were statistically significant and revealed that there were significant differences amongst all of the conditions collapsed over task type: the publisher-slide condition had the lowest examination score results, followed by instructor generated slides, the student- generated slides and the student generated slides with critiques as shown in the following table:

Table 1: Post Hoc Bonferroni Comparison of Final Examination Performance by Condition

Class I	Class J	Mean Diff. (I-J)	Standard Err.	Sig.
Publisher	Instructor	-6.63*	1.279	.000
	Student	-11.64*	1.279	.000
	Student-Critiqued	-17.99*	1.316	.000
Instructor	Publisher	6.63*	1.279	.000
	Student	-5.01*	1.275	.001
	Student-Critiqued	-11.36*	1.312	.000
Student	Publisher	11.64*	1.279	.000
	Instructor	5.01*	1.275	.001
	Student-Critiqued	-6.35*	1.312	.000
Student-Critiqued	Publisher	17.99*	1.316	.000
	Instructor	11.36*	1.312	.000
	Student	6.35*	1.312	.000

Based on the table above, it is evident that the three hypotheses that were proposed in this research were supported by the data. Specifically, the first hypothesis proposed that as compared to lectures using publisher-generated slides, lectures using instructor-generated slides would improve student learning. There was a significant difference of 6.63 examination score points, p=.000, indicating that this hypothesis was supported: student performance for the instructor-generated presentation was significantly better than in the publisher PP condition. The instructor's customizations and modifications which incorporated findings in the multimedia design and cognitive load / information synthesis literatures tended to enhance the level of student learning performance.

Next, the second hypothesis tested whether or not lectures using student-generated slides would improve student learning as compared to lectures using instructor-generated slides. This hypothesis was also supported with a mean difference between the conditions of 5.01 examination score points, p=.001: student learning performance was greater when student-generated PP presentations were used. The improvement in examination performance likely

occurred because the student-generation of PP lecture slides was an active learning which gave the students the opportunity to classify (relevant / irrelevant), interpret, interact and communicate the course materials via the PP slide content. These enhanced active-learning activities required both significantly greater mental processing as compared to simply listening to an instructor's lecture on content and also provided even more repetition of the course materials. And although this study does not specifically examine the contribution of each of the repetition and active learning factors independently, (an area of future research), together, these factors appeared to contribute to the significantly improved student learning found here.

The final hypothesis proposed was that as compared to student-generated slides, student-generated and peer-critiqued slides would increase student learning to even more than the other experimental conditions. This hypothesis was also supported with a mean difference of 6.35 examination score points, p=.000: student-generated / student-critiqued PP presentations had significantly higher levels of student examination performance. In this condition, besides producing the PP lecture slides, this modified active learning task additionally required the students to interact and contemplate the course content by having them also evaluate and critique the PP slides of other groups and justify their opinions. This modification allowed for even greater repeated, elaborated content interaction and information processing than the other conditions and this likely led to the optimized student learning found in this PP presentation technique.

In this research, all three hypotheses proposed in this study were supported and each iteration of the PP technique provided increased student final examination performance. And although every subsequent modification in the PP lecture technique increased student learning significantly, the task iteration with the highest active learning component which was the student-generated/ peer-critiqued condition clearly enhanced students' final examination grade performances the most.

Examining the difference in scores between the student performance results using publisher-provided slides as compared to student-generated, peer-critiqued slides, the difference is sizable: almost 18 points. For an examination worth 40 percent of the final grade this amounts to a difference of approximately seven percent on the student's final course grade, (even though a normal distribution of final letter grades was used here as previously described). As a result of this substantial improvement, the student-generated, peer-critiqued PP method developed here may be a very powerful tool for instructors to implement in their classes.

In summary, the overall results of this research show that instructors can utilize a number of different PP presentation techniques which can improve student learning. As a preliminary step, if an instructor customizes his or her slides, considering the multimedia design and cognitive load / information synthesis literature, student learning can somewhat improve. However, by increasing levels of the active learning components in student assignments which relatedly creates increased repetition and mental elaboration / information processing with course materials, student learning can be improved to an even greater extent. Based on the results found in this study, the more enhanced the active learning components of the PP generation tasks are the more there will be a corresponding increase in student learning, (although there are likely upper limits for this effect which is an area of future research). Nevertheless, here, the greatest improvements in student learning were generated from the technique which incorporated the greatest number of active learning modifications: the student-generated, student-critiqued PP presentation method. Thus as a generalized finding, in order to fully optimize student learning, enhanced active learning task modifications which have a positive impact on the amount of information processing, mental elaboration and repetition used by students in the classroom are the most more effective method to increase student learning when PP presentations and lectures are used in the marketing classroom.

CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

This study investigates whether or not a variety of modifications applied to commonly used PP-based lecture techniques can enhance student learning. The first modification was the use of instructor-customized PP presentation in the instructor's classes. The instructor-customized PP presentations had been designed to reflect the findings from the multimedia, cognitive load and information synthesis literatures and the student learning results were compared to those generated from classes in which effectively unmodified publisher-provided PP presentations were used. Here, student learning was greater in the instructor-customized condition. Although this modification did not increase student performance as much as the two other active learning techniques which will be discussed below, student learning improvements were still significant. Since this modification is relatively easy to implement and is clearly more effective in generating student learning than simply using the publisher-provided PP presentations in the classroom, this may be a useful technique for instructors to implement in their lectures.

Despite the usefulness of this first modification, however, by increasing the active learning characteristics of PP presentation techniques, student learning can be enhanced to even greater levels. More specifically, in the second PP presentation modification examined here, students themselves generated the actual PP presentations that were used in the instructor's lectures. Because this task entailed significantly more cognition and elaboration as compared to simply listening to a PP-based lecture, student active learning was increased. As a result of this

change, even greater gains in student learning performance were achieved, compared to the instructor-customized PP presentations. Thus, this assignment where students generate their own PP presentations for course content can also be a helpful method to enhance student learning performance in the classroom.

As much as student learning increased using from student-generated PP technique above, the final active learning- based modification generated even greater increases in student learning compared to the previous conditions. For this technique, not only did the students generate PP presentations for use in the lectures but they also had to critique other student-prepared PP slides. This student-generated / peer-critiqued PP method had the largest positive impact on student learning. Since one of the main goals of instructors is to maximally improve student learning and if factors such as very large class size, time constraints and other issues do not prevent the implementation of this technique, this modification may be an excellent method to improve student learning in the classroom.

Finally, in addition to the student learning results described above, another benefit of having students generate PP presentations and critiques is that after students are shown examples of how to generate the PP presentations and have themselves prepared the presentations / critiques and received critical peer feedback on their work, it will be much more likely that they will be able to produce additional excellent, well-thought-out PP presentations in the future. Given the prevalent use of this software in business and related settings, this an extremely important skill set for the students to have. Care must be taken in the implementation of these techniques, however, to ensure that every member of each student group is fully involved in the weekly PP slide generation / critiques in order to facilitate improved learning and workplace experience for each and every student in the classes.

As a final practical matter, the adoption of the techniques proposed here is quite simple and the modifications can be adopted in whole or in part depending on the instructor's preferences, interests and limitations. Further, these techniques can be integrated into almost all types of classes: in-class, online or distance education. One limitation on adoption might be in the case of extremely large class sizes specifically for the student-generated and student-generated / peer review conditions due to the grading commitment involved in these techniques. In those cases, the assistance of a grader would ensure the feasibility of these methods.

There are a number of limitations and areas of future research that arise from this study. First, the results may not be generalizable to other student samples or other student learning evaluation methods. Second, even though all sections were taught by the same experienced instructor who had taught very similar materials many times before, there may have been differences in instructor presentation which contributed to the student performance differences and relatedly results may also vary for other instructors or class content. Third, this study does not compare results from classes that do not use PP-based lectures and also does not examine or directly measure student motivations or attitudes, the effects of cognitive load or information synthesis and other possibly relevant factors. Fourth, the relative contribution of repetition compared to active learning influences was not measured or considered separately in this experimental design. Finally, other PP techniques which also increase repetitive, deep and elaborative student processing may also be at least or perhaps more effective for improving student learning. Many of these limitations are possible areas for future research. Despite these limitations, however, because these techniques are simple, easy to integrate and tend to enhance student learning and information retention and performance, the PP presentation techniques described here may be useful for adoption in the contemporary marketing class.

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Appendix A: Recommended Grading Rubric for Student PowerPoint Slides

Under each question, ½- ¾ of a page would be available for written comments (some format and content adapted from Rubistar, 2019: http: // rubistart.4teachers.org).

1. Did the PowerPoint presentation cover the main topics of the chapter? Please support your assessment with comments indicating which topics were missing, if any.

5 marks	4 marks	3 marks	2 marks	1 mark
All main topics of chapter covered	Most of the main topics covered	Some of the main topics covered	Few of the main topics covered	Very few of the main topics covered

2. How well were the selected topics covered: was the coverage accurate with no factual errors? Please support your assessment with comments as to where inaccuracies or factual errors were found in the presentation.

5 marks	4 marks	3 marks	2 marks	1 mark
All topics covered were accurate with no factual errors	Most of the topics covered were accurate with no factual errors	Some of the topics covered were accurate with no factual errors	Few of the topics covered were accurate with no factual errors	Very few of the topics covered were accurate with no factual errors

3. Did the PowerPoint presentation have grammatical or spelling errors? Please provide a list of all errors.

5 marks	4 marks	3 marks	2 marks	1 mark
Presentation has no misspellings or grammatical errors	Presentation has 1 misspellings or grammatical errors	Presentation has 2 misspellings or grammatical errors	Presentation has 3 misspellings or grammatical errors	Presentation has more than 3 misspellings or grammatical error

4. Did the text (font choice and formatting), background (colors and spacing) and graphics used ensure readability? Please provide specific comments on font choice / formatting utilized.

5 marks	4 marks	3 marks	2 marks	1 mark
Text font, format, background and graphics greatly enhanced presentation readability	Text font, format, background and graphics mostly enhanced presentation readability	Text font, format, background and graphics somewhat enhanced presentation readability	s Text font, format, background and graphics somewhat detracted from presentation readability	Text font, format, background and graphics greatly detracted from presentation readability

5. Was the information sequenced in a clear and logical way? Please provide details of how the sequencing of the materials was effective or ineffective.

5 marks	4 marks	3 marks	2 marks	1 mark
All information organized in a clear logical way.	Information mostly organized in a clear or logical way: 1-2 items out of logical place	Some information organized in a clear or logical way: 3-4 items out of logical place	Substantial amount of information not organized in a clear or logical way: 5-6 items out of logical place	Most of the information not organized in a clear or logical way: more than 6 items out of logical place

6. Overall, given the factors above and any other impressions that you had of the presentation, what grade would you give this presentation? Please give a justification / summary of why you assessed the presentation at this particular grade level including any additional factors not articulated above.

5 marks	4 marks	3 marks	2 marks	1 mark
Presentation was excellent	Presentation was very good	Presentation was good	Presentation was adequate	Presentation was inadequate

TOTAL: _____ / 30 marks