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Full Length Research

Effects of Learning Styles on Learners' Preferences between PowerPoint and White/Chalkboard Lectures

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This study examined whether preferences for PowerPoint lectures versus white/chalkboard lectures were linked to learning styles as defined by the Learning Type Measure (LTM) of the 4MAT® system. Previous research has found mixed results regarding whether students preferred PowerPoint or white/chalkboard to deliver class lectures. An explanation of the mixed results has not been clear. Although acknowledging the growing research that there was no evidence from experimental research to justify the need to assess learning styles in classrooms, we still questioned whether student learning styles might offer an explanation to the contradictory findings regarding preferences between PowerPoint and white/chalkboard presentations. No previous studies were found to have examined this possibility. The results supported a general preference for PowerPoint lectures to white/chalkboard lectures, but indicated no significant differences in preferences for the two lecture delivery methods based on the four learning styles. Nevertheless, the participants' ratings and comments yielded useful information about what aspects of PowerPoint lectures they liked and disliked.

Keywords: Preference, PowerPoint Lecture, Whiteboard Lecture, Chalkboard Lecture, Learning Styles, 4MAT system, Learning Type Measure

INTRODUCTION

PowerPoint presentations have become popular because of their portability, availability, and ease of use (Cooper and Yoder-Wise, 2003). Educators have used PowerPoint to support content presentation, assist note taking, provide information clarity, and make lectures interesting (Reinhardt, 1999). Since their introduction, researchers argued that PowerPoint-type presentations had the potential to maintain and improve learners' attention to lectures (Clark, 2008) and to enhance their learning (Frey and Birnbaum, 2002).

Some studies (e.g., Lowry, 1999; Szabo and Hastings, 2000: second study) found in many disciplines students' test scores increased after using PowerPoint lectures compared to the test scores they received from the overhead/transparency lectures. However, Amare (2006) found in a technical writing class students' posttest

scores were higher in course sections with chalkboard lectures than the scores of students in course sections with PowerPoint lectures. Other studies (e.g., Bartsch and Cobern, 2003; Beets and Lobingier, 2001; Susskind, 2005; Szabo and Hastings, 2000: first and third studies) found no differences in grades between PowerPoint and overhead lectures.

Previous research that compared students' preferences between PowerPoint-type lectures and lectures supplemented with transparencies or white/chalkboards also presented mixed results. Some studies (e.g., Atkins-Sayre et al., 1998; Burke and James, 2008; Susskind, 2005) found students preferred PowerPoint slides to transparencies or white/chalkboard. Other (e.g., Novelli and Fernandes, 2007; Shallcross and Harrison, 2007) found students from different disciplines preferred chalkboard lectures to PowerPoint lectures.

An explanation of the mixed results in this research area has not been clear. Although acknowledging the growing research that there was no sufficient experimental evidence to justify the benefit of assessing learning styles for instructional purposes (Pashler et al., 2008), we still questioned whether student learning styles may offer an explanation to the contradictory findings regarding preferences between PowerPoint and white/chalkboard lectures. Based on reported perceptions, Pashler et al. found evidence that "students express preferences about how they prefer information to be presented to them" (p. 105). The other studies mentioned previously (e.g., Atkins-Sayre et al., 1998; Burke and James, 2008; Novelli and Fernandes, 2007; Shallcross and Harrison, 2007; Susskind, 2005) also indicated that students preferred one delivery method (PowerPoint or white/chalkboard) over the other method for learning information. To account for this difference, it would be informative to learn if students prefer to have information presented to them via a specific delivery method and if the preferences for the delivery methods are based on their learning styles.

No previous study has compared perceptions about PowerPoint lectures and white/chalkboard lectures in relation to learning styles. Therefore, the purpose of this study was to determine whether a specific learning style had an effect on students' preferences for a lecture delivery method (PowerPoint or white/chalkboard), that is, whether students preferred PowerPoint lectures or white/chalkboard lectures based on their predominant learning style(s). This study used the Learning Type Measure (LTM) of the 4MAT® system (McCarthy, 1990; McCarthy, 2000; McCarthy and McCarthy, 2006) that identified four learning styles, which was reviewed next.

The 4MAT® System

The 4MAT® system is an eight-step cycle of instruction that capitalizes on individual learning styles and preferences. The Learning Type Measure (LTM) is the instrument used by the 4MAT® system (McCarthy, 2000) to determine four major types of learners—Imaginative (Type 1), Analytical (Type 2), Common-Sense (Type 3), and Dynamic (Type 4).

Type one: Imaginative learners. The learners "perceive information concretely and process it reflectively" (McCarthy, 1990, p. 32). Imaginative learners value their own experiences, seek meaning and clarity, work for harmony, and need to be personally involved (McCarthy, 1990). This type of learner finds school to be fragmented and disconnected from their personal issues.

Type two: Analytic learners. The learners "perceive information abstractly and process it reflectively" (McCarthy, 2000, p. 91). They need continuity, coherence, certainty, details, and structure. They want to know what experts think. They are comfortable with school because it is designed for this type of learner.

Type three: Common-sense learners. The learners "perceive information abstractly and process it actively" (McCarthy, 2000, p. 95). They try to apply theories in a real-life setting. They learn through testing the theories and applying common sense to them. They find school to be frustrating because of the lack of an immediate real-world application (McCarthy, 1990).

Type four: Dynamic learners. The learners "perceive information concretely and process it actively" (McCarthy, 2000, p. 99). They integrate experience and application. They learn through trial and error. They are risk-takers, adaptable, flexible, and enthusiastic about new things. They usually find the structure of school to be very disappointing because they need diverse ways in their learning (McCarthy, 1990).

This study was guided by two research questions: Were there any differential preferences between PowerPoint lectures and white/chalkboard lectures based on student learning styles? What were students' perceptions about the effectiveness of PowerPoint lectures compared to white/blackboard lectures?

METHOD

Participants

The participants were graduate and undergraduate students who enrolled in two sections of a learning styles course (HRD 4405/5405) offered in spring 2010 at a public university in Idaho. The two class sections were taught by the same instructor, who had many years of

experience teaching this class. Fifty-three graduate and undergraduate students agreed to complete the survey. Five surveys were excluded because of insufficient responses. As a result, only 48 surveys were included in data analysis.

The participants completed the Learning Type Measure (LTM) to identify their learning styles and reported their most predominant style in the survey. Instead, three participants each reported two learning styles. This was probably because they had a tie score between the two types of learning styles. The coin toss results allowed the researchers to assign one participant to the Type 1 group, one to the Type 4 group, and one to the Type 3 group.

Forty two participants (87.5%) were undergraduate students, and six participants (12.5%) were graduate students. Nineteen students (39.6%) were females, and 29 students (60.4%) were males. Seven participants (14.6%) were classified as Type 1 learners. Fourteen participants (29.2%) were classified as Type 2 learners. Eighteen participants (37.5%) were classified as Type 3 learners. Nine participants (18.8%) were classified as Type 4 learners. Four participants (8.3%) indicated they had *always* seen PowerPoint lectures in class. Seventeen participants (35.4%) have seen *very frequently*. Twelve participants (25%) said *frequently*. Ten participants (20.8%) said *occasionally*. Five participants (10.4%) said *rarely*

Instruments

Learning Type Measure (LTM)

This study used the Learning Type Measure (LTM) to identify four learning styles. The publisher of the instrument claimed that LTM had construct validity (St. Germain et al., n.d.), concurrent validity, and content validity (McCarthy et al., 2002). The internal consistency (Cronbach's alpha) was .85 for Learning Type 1, .84 for Learning Type 2, .77 for Learning Type 3, and .89 for Learning Type 4 (McCarthy et al., 2002). There was 61.1% agreement between LTM and the Kolb's Learning Style Inventory, and LTM had significant relationships with the Myers-Briggs Type Indicator (McCarthy et al., 2002). It is noted the studies on its reliability and validity were not published in a peer-reviewed journal. However, LTM has been used to measure learning styles in many studies (e.g., Bitner, 1996; Blue, 2009; Croker et al., 1995; Vare et al., 2000).

Self-administered survey

We designed a self-administered survey to collect demographic and perception information. The participants rated their preferences between PowerPoint lectures and white/chalkboard lectures on a four-point Likert scale (1 for "*Strongly Disagree*," 2 for "*Disagree*," 3 for "*Agree*," and 4 for "*Strongly Agree*").

Five subscales formed the 33 Likert-scale questions. The first three questions (Q1, Q2, and Q3) were designed to address the characteristics of the Type 1 learners described in the 4MAT® system (McCarthy, 1990; McCarthy, 2000; McCarthy and McCarthy, 2006). These questions were named the *Imaginative* subscale. Questions 4, 5, and 6 addressed the Type 2 learners, and the scale was named the *Analytic* subscale. Questions 7, 8, and 9 addressed the Type 3 learners, and the scale was named the *Common-Sense* subscale. Questions 10, 11, and 12 addressed the Type 4 learners and this scale was named the *Dynamic* subscale. Questions 13 to 33 asked about the general characteristics of PowerPoint lectures compared to white/chalkboard lectures. These questions formed the *General* subscale.

We calculated the total score of each subscale for each respondent. For example, the total score for the *Imaginative* subscale was the sum of the ratings for questions 1, 2, and 3 for each response. The same procedure was followed to calculate the total scores for other subscales. We treated the total scores as quasi-interval data. The means and standard deviations of the subscales were in Appendix.

Cronbach's alphas for the subscales were: .90 for the *Imaginative* subscale, .84 for the *Analytic* subscale, .75 for the *Common-Sense* subscale, and .91 for the *Dynamic* subscale. Cronbach's alpha for the *General* subscale was .96. The coefficients indicated the survey had sufficient internal consistency among items within each subscale.

Procedure

The participants completed the Learning Type Measure (LTM) to identify their predominant learning style at the beginning of the semester. During the semester, the class instructor used both PowerPoint and white/chalkboard (in mixed orders) to teach content on the eight-step cycle of instruction of the 4MAT® system. Six short PowerPoint lectures were mainly used to provide new information, reinforce instructional content, and stimulate thought. The white/chalkboard was used in the same manner as PowerPoint but less frequently. In addition, chalk/whiteboard was also used in hands-on activities. PowerPoint lectures were mostly used at the beginning of semester and less frequently toward the end. Both PowerPoint lectures and chalk/whiteboard lectures consumed approximately 50% of the total classes.

The participants completed the survey at the end of

semester to express their preferences. The participants may answer the survey questions based on their past as well as their current class experiences.

It is important to note that this study was not an experiment that manipulated presentation formats with the expectation that it would influence preferences. We only measured learning styles and student preferences toward the two types of delivery methods to examine if they were related. The instructional context merely provided people with an opportunity for recent experience with both types of instruction before expressing their general preferences.

Research Design and Data Analysis

This study employed a descriptive research design and non-experimental group comparisons. We used the analysis of variance (ANOVA) to analyze the total score for each subscale to answer the first research question by comparing preferences for delivery methods (PowerPoint versus white/chalkboard) based on learning styles. We calculated the median and frequency for each Likert-type item to answer the second research question about students' preferences. The participants' responses to Strongly Disagree (SD) and Disagree (D) were added together to represent preferences toward chalkboard lectures. The responses to Strongly Agree (SA) and Agree (A) were added together to indicate preferences toward PowerPoint lectures (see Appendix).

RESULTS

Preferences over the Lecture Methods based on Learning Styles

The homogeneity of variance assumption was met for all subscales. The scores of some subscales departed slightly from normality based on their skew and kurtosis values (larger than 1). To consider the effects of potential outliers and non-normal data on the study results, Montgomery (2009) recommended ranking the original data and using ANOVA to analyze the ranks. The ANOVA results of the ranks were identical to the ANOVA results of the original data. Therefore, the analysis of the original data was acceptable.

We ran ANOVA on all subscales—*Imaginative*, *Analytic*, *Common Sense*, *Dynamic*, and *General*. The results indicated that there were no significant differences in preferences between PowerPoint lectures and white/chalkboard lectures on any of the subscales based on learning styles—for the *Imaginative* subscale, $F(3, 44) = .69$, $MSE = 3.92$, $p = .56$, $\eta^2 = .05$; for the *Analytic* subscale, $F(3, 44) = 1.44$, $MSE = 3.63$, $p = .24$, $\eta^2 = .09$, for the *Common-Sense* subscale, $F(3, 44) = .88$, $MSE = 3.92$, $p = .46$, $\eta^2 = .06$, for the *Dynamic* subscale, $F(3, 44) = .19$, $MSE = 4.37$, $p = .90$, $\eta^2 = .01$, and for the *General* subscale, $F(3, 44) = .47$, $MSE = 154.75$, $p = .70$, $\eta^2 = .03$. The means and standard deviations of each subscale were in Appendix.

Overall Students' Preferences of the Lecture Methods

Overall, the participants favored PowerPoint lectures over white/chalkboard lectures (see Appendix). About 62% said that they had a more positive attitude toward PowerPoint than white/chalkboard lectures. About 68% believed that PowerPoint was a more effective method. Fifty-six percent believed that PowerPoint lectures helped improve their learning more effectively. The participants said that PowerPoint helped them remember more information (63%), allowed for synthesizing information more effectively (68%), helped them understand the content better (66%), reviewed content more effectively (77%), and prepared for exams more effectively (58%).

The participants agreed that PowerPoint lectures provided a better structure (76%), taught more content (81%), and were more concise (60%) than white/chalkboard lectures. Seventy-six percent agreed that with PowerPoint slides they had more opportunities to listen to lectures. They agreed that PowerPoint lectures made it easier to follow important points (73%), were more interesting (64%), and drew better attention to important information (68%). About 72% believed that PowerPoint slides assisted them in note taking. About 84% agreed that PowerPoint slides should be made available before class to assist learning. Approximately 64% would like the instructor to use PowerPoint slides when teaching the class.

However, 66% of the participants felt that PowerPoint was not a more effective method in teaching problem-solving skills. Only 47% believed that PowerPoint motivated them to learn new information. Approximately 74% agreed that having PowerPoint slides did not affect class attendance, but only 25% said that PowerPoint lectures motivated them to attend the class.

Based on the natural breaks in total scores and the responses to the rated statements, the participants were divided into three groups—a group of 22 students (45.8%) who liked PowerPoint slides (Group A), a group of 12 students (25%) who did not like PowerPoint slides (Group B), and a group of 14 students (29%) who had mixed opinions about PowerPoint slides (Group C). The responses of these groups to the open-ended questions were then examined. When asked, "what do you like the most about PowerPoint slides," the majority of the students in Groups A and C said that the PowerPoint slides provided a good structure and outline to the material. PowerPoint slides allowed the instructor to write down main ideas, incorporate graphics and pictures,

audio and video, and present materials legibly. Many students in both groups agreed that PowerPoint slides assisted in note taking and were colorful. Some said that PowerPoint lectures helped them review for exams and allowed the instructor to present more information. Only a few of the students in Group B had the same opinions about PowerPoint lectures.

When asked, "what do you like the least about PowerPoint slides," most students from Groups A and C said that they did not like PowerPoint lectures when there was too much information, when it was overused, and when the instructor read word by word. Many students thought that PowerPoint slides were boring. Some said PowerPoint discouraged note taking, produced a dark room, and did not present enough information.

When asked for suggestions to improve the quality of PowerPoint lectures, the students from Groups A and C and a few students from Group B said the following: "don't read from slides," "make color readable," "make it available before class," "include graphics and pictures," "don't use for lectures but as supplemental materials," "make them short," "don't use too much," and "be creative when creating slides."

Among the students who did not like PowerPoint (Group B), only some provided open-ended responses. Those students who responded to the questions gave limited responses, including: "[PowerPoint was] usually boring, "Boring! Nothing but Type," "I prefer chalkboard discussion," "I don't have much like for Power Point," and "[PowerPoint] lends itself to a stilted presentation."

DISCUSSIONS

Preferences over the Lecture Methods based on Learning Styles

The study did not find significant differences in preferences between PowerPoint lectures and white/chalkboard lectures based on specific learning styles. The non-significant results were consistent with a growing body of research on learning styles. Pashler et al. (2008) found no evidence from experimental research that met their criteria to warrant the application of learning style assessments for classroom practices. Their study result was not meant to conclusively refute the learning styles hypothesis—"presentation should mesh with the learner's own proclivities" (p. 108), but did not find core evidence to support it. Pashler et al. cautioned that learning styles (preferences) differed from learning aptitudes (abilities). These terms seemed to be used interchangeably in the literature and among the general public. According to Scott (2010), research has failed to show that learning styles informed effective teaching practice. Landrum and McDuffie (2010) concluded that there was not enough evidence to support the idea that learning styles were useful for differentiated instruction. Yilmaz-Soylu and Akkoyunlu (2009) and Zacharis (2010) found that learning styles had no significant effect on student achievement in different learning contexts. More studies (e.g., Duman, 2010; Hsieh et al., 2012; Wichadee, 2013) also found similar results.

The results of the present study provided an additional support to the literature that, based on the perception data, there was no evidence to support the benefit of assessing student learning styles in a classroom as a basis to select a specific delivery method (PowerPoint versus chalk/whiteboard) to deliver lecture to match their preference. The assumption that students would learn more effectively when information is presented in a format that matches their preference is not warranted by previous research. We tend to agree with Pashler et al. (2008) that the usefulness of learning style assessments is more like a belief rather than a claim that is supported by scientific research findings. Among other factors, this widespread belief may be due to the fact that it sounds intuitive that students learn differently; therefore, they would learn best if instruction is geared toward matching their individual learning style. However, other researchers (e.g., Alias and Siraj, 2012; Çakıroğlu, 2014; Cao and Nishihara, 2012; Brady, 2013; Hwang et al., 2013; Ren, 2013) found that learning styles had an important instructional application. Nevertheless, these studies did not met the research design criteria described by Pashler et al. (2008). To date, we are not aware of other studies that meet those criteria to justify the educational benefits of assessing learning styles. Therefore, we agree with Pashler et al. that the "use of learning-style measures in educational settings is unwise and a wasteful use of limited resources" (p. 117). We recommend the limited educational resources be invested in instructional practices that have been supported by sound experimental research findings or invested in acquiring educational resources and technologies that promote active and multimodality learning (Clark and Mayer, 2011, Mayer, 2009; Paivio, 2007).

It should be noted that the survey used in this study was designed to ask about features of lecture methods that ought to be explicitly linked to learning style preferences according to the 4MAT® system (McCarthy and McCarthy, 2006). The lack of significant differences in this study also failed to provide evidence for the concurrent validity of the Learning Type Measure of the 4MAT® system for differentiating learning preferences linked to instructional methods.

Overall Students' Preferences of the Lecture Methods

Overall, the participants preferred PowerPoint lectures to white/chalkboard lectures. This finding was consistent with previous studies (Amare, 2006; Frey and Birnbaum,

2002; Seth et al., 2010). The participants believed that PowerPoint presentations were more effective than white/chalkboard lectures, which was supported by other studies (Burke and James, 2008; Burke et al., 2009). The participants perceived that PowerPoint slides were more organized compared to white/chalkboard lectures, consistent with Seth et al. (2010). Many participants also agreed that PowerPoint allowed for synthesizing information more effectively, similar to Frey and Birnbaum's (2002) and James et al.'s (2006) results that PowerPoint slides were a more effective tool to write down main ideas. The majority of the study participants also said that PowerPoint lectures helped them understand the course content better. Susskind (2005) also found that the psychology students perceived PowerPoint lectures as being more organized and easier to understand than whiteboard lectures. Seth et al. (2010) also reported that the majority of the medical students in their study believed PowerPoint lectures were clearer and more understandable than chalkboard lectures. About 63% of the study participants endorsed the idea that they remembered more with PowerPoint lectures than they did with chalkboard lectures. The endorsement for PowerPoint was probably due to the PowerPoint capability to structure content information in an organized manner to reduce student cognitive load level (Artino, 2008; Pass et al., 2003; Sweller, 2010).

The participants also found PowerPoint lectures more interesting than white/chalkboard lectures, consistent with what Mantei (2000) and Seth et al. (2010) found. James et al. (2006) found that the students thought PowerPoint lectures helped hold their attention during class better than chalkboard or transparencies lectures. It appears this is a common perception on the part of students across instructional content and course disciplines. The participants in the study also believed that PowerPoint slides assisted note taking (consistent with James et al., 2006). Around 58% agreed that PowerPoint helped them prepare for exam better, which was supported by other studies (Frey and Birnbaum, 2002; James et al., 2006). The majority suggested PowerPoint slides be made available before class (Ahmadi et al., 2007) and preferred the instructor to use PowerPoint slides when teaching the class. Atkins-Sayreet al. (1998) also found that the majority of the students agreed that PowerPoint enhanced the instructor's credibility and that they would like the instructor to use more PowerPoint. Nouri and Shahid (2005) found that the instructor was perceived as being more prepared with PowerPoint slides. Many participants agreed that PowerPoint slides did not affect their class attendance, as was found in Frank et al. (2009), Burke and James (2008), and Bowman (2009).

Also consistent with past studies (Novelli and Fernandes, 2007; Seth et al., 2010; Shallcross and Harrison, 2007), the present study showed that not all students preferred PowerPoint lectures to white/chalkboard lectures. In fact, the variation in students' attitudes toward PowerPoint presentations in the present study was large with 25% of the students indicating they disliked PowerPoint presentations, especially when there was too much information (Seth et al., 2010), when it was overused, and when the instructors read word by word. The students could feel insulted when the instructor read the slides to the class (Voss, 2004). Many participants thought that PowerPoint slides were boring, which was consistent with Clark (2008). Burke and James (2008) found the students who perceived PowerPoint slides as having high novelty did not think that PowerPoint was boring, but the group who perceived PowerPoint as having low novelty said PowerPoint was. The participants in the present study felt bored with PowerPoint slides probably because PowerPoint was usually seen to be used for passive learning rather than to promote critical thinking or to engage in hands-on activities. This may have created an impression associating PowerPoint with passive delivery of information rather than see PowerPoint as a tool that can be used to facilitate active and higher-order learning.

Educational Implications

Until new evidence is presented, we agree with Pashleret al. (2008) that educational resources should not be wasted with learning style assessments attempted to match the instructional format with student learning preference. This practice is expensive and is not warranted by the current research evidence. There is no guarantee that students would learn best when instruction is presented in a format that matches their learning style. The available resources should be invested in educational technologies to support pedagogical practices (e.g., scaffolding, personalized instruction, collaborative learning, etc.) known to have assisted student learning.

Instructors should not be concerned with whether to use PowerPoint slides or white/chalkboard to deliver lectures to try to accommodate different learning styles. Students' preferences for a delivery method are not related to their learning styles. However, since most students preferred PowerPoint slides to white/chalkboard, instructors may continue using PowerPoint, among other delivery methods, to deliver lectures. Nevertheless, this study also indicated that care should be taken to avoid a lack of novelty and the overuse of PowerPoint lectures. In addition, we suggest that PowerPoint should also be used for active learning such as to guide hands-on activities, to encourage critical thinking and reflection (e.g., questioning, presenting a case scenario), and to provide visual elements (e.g., text, image) along with auditory elements (instructor's voice or audio), rather than just for information presentation filled with

overwhelming text, small font size, overuse of colors, and inclusion of pictures or sound that are irrelevant to learning. PowerPoint or chalk/whiteboard is just a tool. Its use should be informed by pedagogical best practices to promote more active learning and less passive learning. Pedagogy should always take precedence over technology/tool. Interested readers may consult Horvath (2014) on how PowerPoint may be used to promote multimodal (visual and verbal) learning.

Directions of Future Research

In this study, about 25% of the participants disliked PowerPoint slides. Many thought it was boring. Like in other courses, most PowerPoint slides used in this class were mainly for information dissemination. Did students believe that PowerPoint was mainly used for passive learning? Students preferred to have PowerPoint lectures available before class (or after class) and to use them to prepare for exam. Was it because they did not have to (or did not want to) engage in a deeper cognitive processing, required by note taking when PowerPoint lectures were available in advance, or did they just want to pay full attention during lecture? Future study may investigate whether it is more valuable to provide students with copies of PowerPoint slides as handouts or to require students to be more engaged in their learning by taking notes. Similarly, future study may examine how effective PowerPoint lectures are in helping students to review for exams. It would be worthwhile to understand better how students made use of PowerPoint slides when studying for exams from a qualitative perspective. Future research may compare the effectiveness between PowerPoint lectures with white/chalkboard lectures in promoting active learning (e.g., encourage reflections, provide prompts for group discussion) using a large sample size.

Limitations

Besides the publisher's own studies (McCarthy et al., 2002; St. Germain et al., n.d.), no other studies have been found to empirically assess the reliability and validity of the Learning Type Measure used to measure student learning styles. The small sample size and restricted nature of the population of students is a limitation of this study. Therefore, our finding of the lack of a link between learning styles and lecture delivery methods may not generalize to other populations, such as younger students. It was possible that the participants' ratings were not based on their learning experience with the PowerPoint lectures and chalk/whiteboard lectures in this class alone, but on their other classes. This cross-over effect of learning experience may influence the result of study. Many other variables (e.g., age, gender, prior experience, lecture quality and purpose, instructional environment) could have influenced the results of the study that were not controlled. Future studies should consider including them in the analysis. This study focused on a specific aspect of PowerPoint versus chalk/whiteboard. Because of many potential variables, the study only gained understanding on one aspect of the complex issue.

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Appendix

Means and Standard Deviations for the Total Scores and the Subscale Scores

	N	*Range*	*Minimum*	*Maximum*	*M*	*SD*
Total	48	94.00	34.00	128.00	90.94	19.08
Imaginative	48	9.00	3.00	12.00	8.17	1.96
Analytic	48	9.00	3.00	12.00	8.63	1.93
Common-Sense	48	9.00	3.00	12.00	7.94	1.97
Dynamic	48	9.00	3.00	12.00	8.02	2.04
General	48	62.00	22.00	84.00	58.19	12.23

Median (Mdn) and Percent of Responses for each Likert-Scale Item

	Questions	*Mdn*	SD (%)	D (%)	A (%)	SA (%)
1.	PowerPoint slides allow more opportunities to listen to lectures than white/chalkboard.	3.00	4.20	20.80	64.60	10.40
2.	PowerPoint lectures motivate me to be more committed to learning the course content than white/chalkboard lectures.	3.00	4.20	39.60	45.80	10.40
3.	PowerPoint lectures provide more clarity to the course content than white/chalkboard lectures.	3.00	4.20	31.30	52.10	12.50
4.	PowerPoint lectures provide more structure to the course content than white/chalkboard lectures.	3.00	4.20	18.80	62.50	14.60
5.	PowerPoint lectures allow the instructor to teach the course content more effectively than white/chalkboard lectures.	3.00	4.20	33.30	47.90	14.60
6.	PowerPoint lectures provide more detailed information on the course content than white/chalkboard lectures.	3.00	4.20	14.60	56.30	25.00
7.	PowerPoint lectures are a more effective way to teach skill-oriented tasks than white/chalkboard lectures.	3.00	2.10	43.80	37.50	16.70
8.	PowerPoint lectures allow the instructor to be more creative in teaching the course content than white/chalkboard lectures.	3.00	8.30	25.40	35.40	31.30
9.	PowerPoint lectures help the instructor to teach problem-solving skills more effectively than white/chalkboard lectures.	2.00	4.20	62.50	27.10	6.30
10.	PowerPoint slides allow me to synthesize information more effectively than white/chalkboard lectures.	3.00	4.20	27.10	60.40	8.30
11.	I am more motivated to learn new information from PowerPoint lectures than from white/chalkboard lectures.	2.00	6.30	45.80	33.30	14.60
12.	PowerPoint lectures help me to create a vision of the whole concept of content better than white/chalkboard lectures.	3.00	4.20	29.20	56.30	10.20
13.	PowerPoint slides help me recall more information in lectures than white/chalkboard.	3.00	6.30	33.30	41.70	18.80
14.	PowerPoint lectures are easier to understand than white/chalkboard lectures.	3.00	4.20	31.30	47.90	16.70
15.	PowerPoint lectures make it easier to follow important points of the course content than white/chalkboard lectures.	3.00	4.20	22.90	56.30	16.70

Continuation: *Median (Mdn) and Percent of Responses for each Likert-Scale Item*

16.	PowerPoint lectures help me to better understand the course content than white/chalkboard lectures.	3.00	4.20	27.10	54.20	14.60
17.	PowerPoint lectures help me to better prepare for an exam than white/chalkboard lectures.	3.00	4.20	37.50	43.80	14.60
18.	PowerPoint lectures help me review the course content more effectively than white/chalkboard lectures.	3.00	4.20	18.80	52.10	25.00
19.	PowerPoint lectures help me remember more information than white/chalkboard lectures.	3.00	4.20	31.30	45.80	18.80
20.	PowerPoint slides help me with notetaking more effectively than white/chalkboard lectures.	3.00	4.20	22.90	52.10	20.80
21.	Information in PowerPoint lectures is more concise than information in white/chalkboard lectures.	3.00	6.30	33.30	50.00	10.40
22.	Information in PowerPoint lectures is more consistent than information in white/chalkboard lectures.	3.00	2.10	29.20	52.10	16.70
23.	Attending class is not necessary when PowerPoint lectures are available.	2.00	41.70	33.30	20.80	4.20
24.	PowerPoint slides should be made available before class to assist learning.	3.00	2.10	12.50	43.80	41.70
25.	Having PowerPoint lectures motivates me to attend class.	2.00	14.60	60.40	18.80	6.30
26.	PowerPoint lectures are more engaging than white/chalkboard lectures.	3.00	4.20	41.70	43.80	10.40
27.	PowerPoint lectures help maintain my attention better than white/chalkboard lectures.	3.00	4.20	43.80	41.70	10.40
28.	PowerPoint lectures are more interesting than white/chalkboard lectures.	3.00	4.20	31.30	47.90	16.70
29.	PowerPoint lectures draw my attention to important information more effectively than white/chalkboard lectures.	3.00	4.20	27.10	54.20	14.60
30.	Overall, I believe PowerPoint is a more effective delivery method than white/chalkboard.	3.00	4.20	27.10	52.10	16.70
31.	Overall, I would like my instructor to have PowerPoint slides when teaching the class.	3.00	4.20	31.30	52.10	12.50
32.	Overall, I have a more positive attitude to PowerPoint lectures than to white/chalkboard lectures.	3.00	6.30	31.30	50.00	12.50
33.	Overall, I believe that PowerPoint lectures help improve my learning more effectively than white/chalkboard lectures.	3.00	4.20	39.60	39.60	16.70

Note. SD = Strongly Disagree, D = Disagree, A = Agree, SA = Strongly Agree