Eurasia Journal of Mathematics, Science & Technology Education, 2007, **3**(4), 297-304

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Evaluating Gender Differences of Attitudes and Perceptions Toward PowerPoint™ for Preservice Science Teachers

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Received 10 February 2007; accepted 17 August 2007

Microsoft PowerPoint™ has become the generic name used when describing slideware applications. This study analyzed the gender differences of participant attitudes and perceptions of various components of PowerPoint™ presentations. Preservice science teachers (none licensed, mostly undergraduates) viewing PowerPoint™ presentations of science content provided the data. The components of the presentations studied were: text, graphics, the combination of text and graphics, narration, and appropriate use of PowerPoint™ for teaching and learning science content. The affect of animations viewed in prior participant PowerPoint™ experiences was also ascertained. A Kruskal-Wallis test was calculated to analyze the differences between genders for the perceived effectiveness of aforementioned components of PowerPoint™. Results showed a significant difference (H<0.05) for the affect of graphics in PowerPoint™ on gender. Females found the integration of graphics in PowerPoint™ to be a more effective approach to learning science than did males.

Keywords: Gender, Multimedia, Powerpoint, Eye Tracking, Preservice, Attitudes

INTRODUCTION

Siegele (2001) defined slideware as "those glowing overhead presentations given by software salesmen that rarely deliver what they seem to promise." Although there are many slidewxare applications on the market today (i.e., Corel Presentations™, Macintosh Keynote™, etc.), Microsoft PowerPoint™ has become the generic name used when describing slideware applications. In 2002, Brandon-hall.com reported that 66% of the 500 largest companies of the Dow Jones Stock Exchange use PowerPoint™ for e-learning content (Chapman, 2003). Although designed for the corporate sector, PowerPoint™ has increasingly crept into educational settings over the last decade. This trend is consistent with the increased use of PowerPoint™ as a presentation and teaching tool in traditional instructional settings.

As PowerPoint™ is becoming mainstream in educational settings, it is critical for its effectiveness to be studied. This study analyzed the gender differences

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E-ISSN: 1305-8223

of participant attitudes and perceptions of various components of PowerPoint™ presentations. Preservice science teachers (non licensed, mostly undergraduates) viewing PowerPoint™ presentations of science content provided the data collected through post session survey and through participant eyetracking of the presentation. The components of the presentations studied were: text, graphics, the combination of text and graphics, narration, and appropriate use of PowerPoint™ for teaching and learning science content. Appropriate use of PowerPoint™ was defined in this study as how the media was delivered and for what purpose. For example, is PowerPoint™ an effective delivery method for teaching all aspects of science content? The affect of animations viewed in prior participant PowerPoint™ experiences was also ascertained. The research question thus became: Which components of PowerPoint™ (text, graphics, the combination of text and graphics, narration, and appropriate use of PowerPoint™ for teaching and learning science content) do female preservice teachers perceive to be the most effective for presenting science content? It was hypothesized that females would have more positive attitudes toward text, the combination of text and graphics, narration, and the appropriate use of PowerPoint™ than males, while male preservice teachers would have more positive attitudes toward graphics and animation embedded in PowerPoint™ than females.

LITERATURE FRAMEWORK

The Nature of PowerPoint™

Peterson (2003, p.5) suggested, "In order to excite students about science and mathematics, you must first excite science and mathematics teachers." Technology can be a tool for initiating excitement; if used correctly. Embedding technology into instruction should ultimately be for the improvement of student learning (Osguthorpe, 2003). One of the most commonly used technologies today is PowerPoint™. Tufte (2003), who has arguably performed the most research on PowerPoint™, views PowerPoint™ as entirely presenter oriented; not audience or content oriented. He sees this application as a presenter organizational tool and nothing more than something for the audience to follow.

Alternatively, embedding text, graphics, and video can make a presentation flashy and exciting for the learner. Slide templates allow for variations of text and graphic integration that aim to display the desired content in a varied and meaningful manner. Traditionally, text is considered more suitable for abstract concepts or for asserting assumptions than embedding animations, graphics and/or video. Graphics are more well suited to represent spatial or spatial-temporal relations, particularly in the case of animations (Seufert, 2003).

Tufte (2003) claims that most presentations are projected in front of a large audience and thus inherently the projected graphics are of such low resolution they create incomplete statements by the presenter. If this is true, than why do so many educators use this application in their teaching practice? The answer to this question might be the *Bullet*. PowerPoint™ presentations are inherently driven by bulleted text with occasional images and/or clip art embedded on a slide. Shaw (1998) suggested *Bullet* lists encourage laziness, *Bullets* are usually too generic, *Bullets* have critical relationships unspecified, and *Bullets* leave critical assumptions unstated. Basically, *Bullets* allow disorganized presenters to get organized (Tufte, 2003).

Much of what has been written about the use of PowerPoint™ is of a negative nature. Whether it is for presentations purposes or for instructional purposes, PowerPoint™ is being used, and arguably overused, in both traditional and online settings. Oftentimes asynchronous courses use PowerPoint™ as the sole content communication vehicle (Carrell, 2001). The reality is that technology is being used more competently by more people from all nationalities, age groups, and socioeconomic levels (Murray, 2003) and PowerPoint™, along with the other applications that are part of the Microsoft Office Suite™, is debatably the most universally known technology.

Learning from PowePoint™

Digital learning is the educational approach that integrates technology, connectivity, content and human resources. A collaborative of major corporations and educational organizations reported to congress (CEO Forum, 2000, June) suggesting digital learning is critical if we are dedicated to preparing students with necessary technological and critical thinking skills. In the field of teacher education, it is crucial that instructors understand the ramifications of PowerPoint™ integration as a component of digital learning. Focusing professional development on specific content and how students can learn that content has greater effects on student conceptual understanding and achievement than more general pedagogical activities (Kennedy, 1998). Furthermore, technology and interactions with experts can play a role in providing experiences with real world applications (Petersen, 2003). Teachers need to learn how to most appropriately and effectively integrate technology into their teaching methods. If a teacher models poor use of technology in the classroom, especially in teacher education, then it is likely the student will assimilate those modeled methods and ultimately integrate technology incorrectly into their classrooms.

In a study that compared learning in classes integrating PowerPoint™ with embedded audio, traditional live classes, and classes that were video based, Carrell and Menzel (2001) found short term learning was significantly higher for audio-PowerPoint™ classrooms.. These results can be argued due in part to the design of the presented PowerPoint™. Students obtain higher level learning from well-designed multimedia presentations than from traditional verbal or text only presentations. This has been shown on test scores and problem solving transfer activities (Mayer, 2001).

A well-designed multimedia presentation can be defined by the level of engagement the students have during a presentation. Mayer (1997) suggests when the learner is engaged in the active process of learning, the learned material is stored in long-term memory. Active learning assumes that learners engage in active cognitive processing which includes attention to incoming words and images, mentally organizing them into coherent verbal and graphical representations, and mentally integrating them with prior knowledge.

Attitudes as a marker for learning

The learner's affective domain has been to a large extent reported throughout recent educational research. "The key to successes in education often depends on how a student feels toward home, self and school" (Simpson, 1994). The instruction a student receives, and often times the technology integrated into instruction, can be a determining factor on satisfaction. Science researchers have given much attention to attitudes because of assumed relationships between attitude and other variables, such as academic achievement (Koballa, 1988). Ajzen (1980) stated the most important reason for studying attitudes is the relationship of attitude to behavior. The behavior a student exhibits during the instructional process can be strongly associated with student satisfaction of a course (Arbaugh, 2000). Most notably, interaction is most influential on student attitudes toward course satisfaction.

When a student is engaged in a highly interactive learning environment, learning and satisfaction usually result (Menzel, 1999). Swan (2001) reported factors such as design clarity, interaction with instructors, and active discussion significantly influenced satisfaction and perceived learning of material. The incorporation of PowerPoint™ into instruction does not inherently promote or discourage interaction. Although the use of PowerPoint™ often promotes discussion, it is primarily a tool that encourages a teacher-centered environment (Tufte, 2003). If PowerPoint™ is used to support active learning, than it must be used in a student-centered environment where interaction between all students and the instructor in prevalent. "Interaction between instructor and student is possibly the most important function of distance learning support" (Wheeler, 2002).

Gender differences with textual and visual stimuli

It is increasingly more noticeable that males enter and persist in science and technology fields then females (Long, 2001). Jakobsdottir (1994) suggested the importance of investigating learning and preferences for graphics and illustrations for gender differences as we enter the digital age. The literature provides evidence the there are gender differences in perceptions of visual stimuli (L. Chanlin, & Chuang, A., 2001). Freedman (1989) suggested females are more concerned with color and color compatibility than males. Males, however, are generally more sensitive to visual stimuli (i.e., graphics, images, charts, etc.) than females (L. Chanlin, 1999).

In a study of sex differences in navigation strategy and geographic knowledge, 90 men and 104 women completed cognitive spatial tests, gave directions from local maps, and identified places on a world map. On the spatial tests, men were better than women in mental rotation skill, but men and women were similar in object location memory. In giving directions, men were more abstract and Euclidian, using miles and north-south-east-west terms, whereas women were more concrete and personal, using landmarks and left-right terms. Older subjects of both sexes gave more abstract Euclidian directions than younger subjects did. On the world map, men identified more places than women did. The data fit a causal model in which sex predicts world map knowledge and the use of Euclidian directions, both directly and indirectly through a sex difference in spatial skills. The age effect, which was independent of sex, supports a developmental view of spatial cognition (Dabbs, Chang, Strong, & Milun, 1997)

MacArthur and Wellner (1996) reported educational practices designated to improve spatial abilities should not be a female-only endeavor. In their study males significantly out performed females on 8 of the 22 spatial structure tasks. However, as with other gender studies, similarities between male and female performances far outweighed any differences. The clinical interview results provided evidence to support the overall poor spatial ability of both males and females.

Butler (2000) reported, males generally have a more positive attitude toward computers, the primary medium for digital images, than females. Finally, gender may play a larger role in the skills of spatial visualization at later ages. However, it is not known whether instruction incorporating spatial visualization will persist in having an effect over time or whether both sexes are affected comparably over time (Smith & Schroeder, 1979). In contrast, Voyer and Voyer (1995) suggested gender

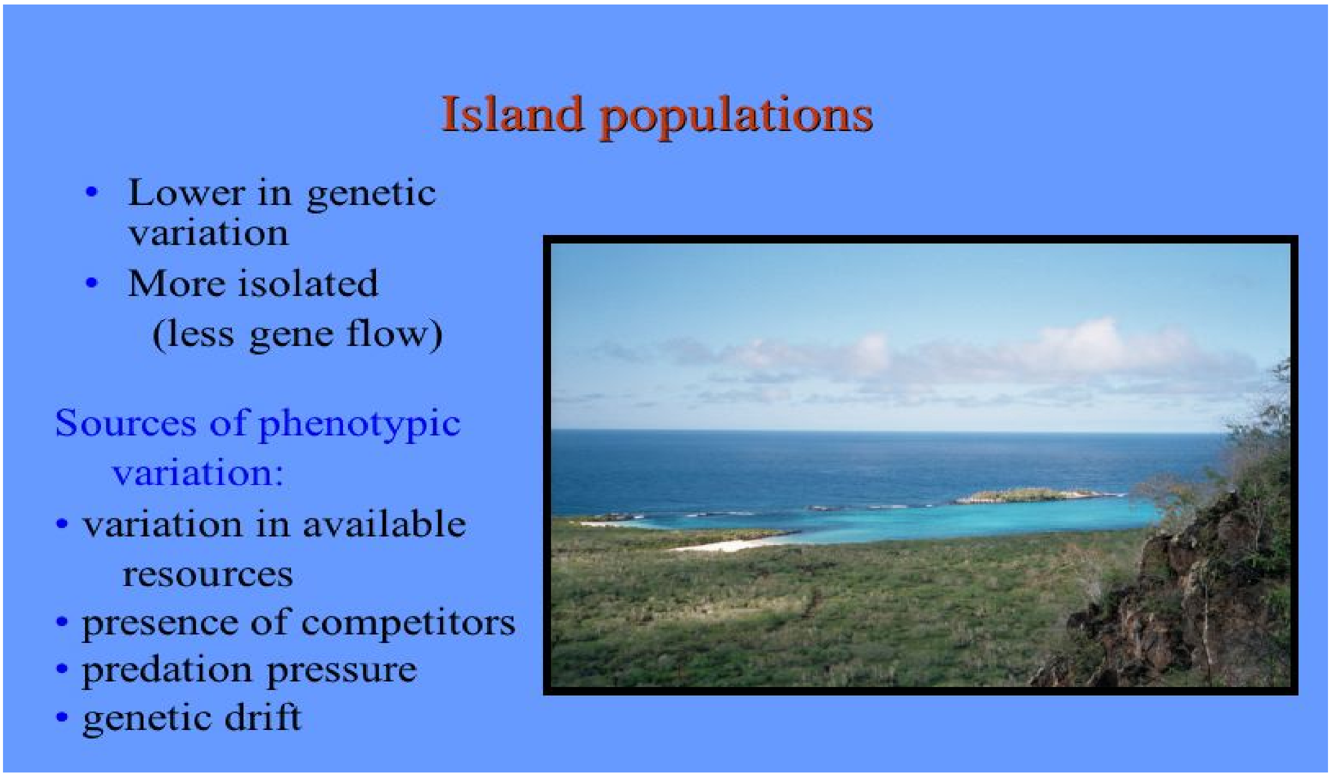

Figure 1. Example slide depicting irrelevant, yet appealing graphic

differences when referring to age depends heavily on the test used.

What follows are the method, results and discussion of the effect PowerPoint has on gender. Age was disregarded based on the Voyer and Voyer (1995) results.

METHODS

Twenty-five preservice teachers enrolled in an introductory science education course were the participants of this study. Fourteen females and 11 males provided gender differences among the participants. Of the 25 participants, 10 were declared science education majors, five declared middle grades science and/or math education as their major, and 10 had undeclared majors but had an interest in science teaching and/or technology education. The sample was stratified across three treatments: 10 participated in the PowerPoint™ without sound treatment, nine participated in the PowerPoint™ with sound treatment, and six participated in the PowerPoint™ embedded in streaming video treatment. The PowerPoint™ presentations were created with a content expert in tropical ecology presenting the material. The crux of the presentation was to offer elementary school teachers an exciting and informative view of recent research of the Galapagos Islands and how the results of this research can inform instruction of ecology and environmental science. The slides were created with interlaced text and graphics. There were specific slides where the graphics and/or animations had no relevance to the text or the audio narration (Figure 1).

Procedures

One aspect of the data collected for this study was through the use of an ASL Model 501 Eye-Tracker that was purchased by funds from the *North Carolina GlaxoSmithKline Foundation*[1]. The eye-tracking equipment allows analysis of individuals interacting with physical models, paper-based materials and all manner of interactive computer-based products. Data collected with this equipment includes: eye fixation paths, video with eye gaze overlay, and numerical data of the pixel location of the point of gaze with statistical calculations. In this study, this equipment was used for data collection of relative to the point of gaze that is suggestive of a subject's reactions to computer stimuli[2]. These data were used as supplement to the quantitative analysis.

Participants entered the eye-tracking lab and after a brief visual acuity test were fitted with the headgear apparatus and their eye movements were calibrated on a computer screen. They then engaged in their given

[1] The authors would like to acknowledge the technical assistance of Bethany V. Smith in data collection, analysis, and facilitating the eye-tracking lab for this study.
[2] http://ced.ncsu.edu/vise/about/aboutthelab.html

PowerPoint™ presentation which was prepared by the lab facilitator prior to the participants' entering the lab. The participants were instructed to proceed through the presentation at their pace. Immediately following the presentation, the participants were asked to complete the attitudinal survey that was presented by the lab facilitator after the headgear was removed.

Data collection

Beyond the data collection through the eye-tracker, participant attitudes were collected via an online survey created in Macromedia Dreamweaver MX™, which allowed for anonymity and easy conversion of the participant responses to the statistical software (SPSS v.11.1) used for analysis. Using the online survey not only allowed for straightforward, instant feedback on a particular session, but it was incorporated with hopes that it would also increase the technology comfort level of the preservice teachers involved. This was not important to the study, but rather as another mechanism for modeling technology integration into the classroom.

The online survey created for this study was modified from the Flashlight Current Student Inventory™. The Flashlight Current Student Inventory™ was designed with a flexible array of survey questions for probing the relationship between new technologies and students' experience learning with them. The survey creator can choose from the inventory that consists of over 5000 items in a database. The items have been shown to be 90+% reliable[3]. The survey for this study chose only those items in the database that were specific to PowerPoint™. Attitudes about PowerPoint™ were ascertained from the participant prior experiences with PowerPoint™, including the presentation on tropical ecology (Appendix A).

Analysis

Responses to items on the post session survey were subjected to a Kruskal-Wallis analysis because N=21 because all of the assumptions of the parametric ANOVA were not met. The attitudinal factors of how participants perceived the effectiveness of PowerPoint™ presentations integrating graphics, text, text and graphics, animation and the pace of narration (if voiceover was used) and perceived appropriate use of PowerPoint™ as a teaching tool were treated as the dependent variables of the analysis that was used to test the null hypothesis of no difference in attitudes for different genders toward perceived science learning among participants who participated in the three treatments of PowerPoint™. Gender was the independent variable in each test for the afore mentioned factors

The eye-tracker data was analyzed descriptively to shed light on the results of the Kruskal-Wallis test. The gaze trail and mean time spent on each slide containing the 6-attiudinal factors for each gender was calculated as a t-test for comparisons between groups which were exposed to a PowerPoint™ with a voiceover narration and a group without narration.

RESULTS

A summary of the mean rank for gender across the 6-attitudinal factors can be found in Table 1. It is quite clear from these data that the variable of graphic integration in PowerPoint™ shows a substantial difference. Table 2 shows the Kruskal-Wallis results illustrating degree of freedom. However, the significance testing in the Kruskal-Wallis suggested only a higher H value (0.018) as compared to the critical value of the Chi-Square for the dependent variable graphic. Females perceived graphics in a PowerPoint™ to be a stronger correlation in that there is one effective approach to learning science than did their male counterparts (see table 2). What follows is a discussion of these results and the implications they have on the educational community using PowerPoint™ as a teaching tool.

The second component to data collection was the use of eyetracking equipment. Table 3 shows the mean time spent on each slide containing the 6-attitudinal factors studied. A t-test was performed to compare a group exposed to voice over narration and a group not

Table 1. Summary of mean rank of gender across the 6-attitudinal factors

	Gender	*N*	Mean Rank
Graphics	Male	9	7.72
	Female	12	13.46
	Total	21	
Text	Male	9	10.17
	Female	12	11.63
	Total	21	
Text & Graphic	Male	9	11.39
	Female	12	10.71
	Total	21	
Animation	Male	9	10.89
	Female	12	11.08
	Total	21	
Pace of Narration	Male	9	12.17
	Female	12	10.13
	Total	21	
Appopriate use of PP	Male	9	11.28
	Female	12	10.79
	Total	21	

[3] http://www.ctlsilhouette.wsu.edu

Table 2. Kruskal-Wallis test for gender differences on attitudes toward PowerPoint™

	Graphics	Text	Text & Graphics	Animaiton	Pace of Narration	Appopriate use of PP
Chi – Square	5.594	.772	.078	.006	.630	0.046
df	1	1	1	1	1	1
Sig.	.018	.380	.780	.937	.428	.830

Table 3. Comparisons of Mean Time Spent on Slides by Gender

Gender	T-G Correlation*	Sound	Mean Time	St. Dev.	Prob > |t|**
M	Low	No	15.49	5.45	.47
F	Low	No	18.29	4.65	
M	Low	Yes	43.55	26.74	.98
F	Low	Yes	43.55	11.83	
M	High	No	19.77	12.12	.78
F	High	No	18.03	4.69	
M	High	Yes	55.54	25.89	.30
F	High	Yes	70.17	1.84	

*Refers to the correlation between the text and graphic on the slide
** Value between males and females with T_G correlation and sound controlled

exposed to narration of the same PowerPoint™. Inspecting the gaze trail from text to graphic showed no significance between groups.

DISCUSSION

The affect of graphics in PowerPoint™ on gender is the focus of this discussion. Freedman (1989) suggested females are more concerned with color and color compatibility than males. The results of this study would support these claims as would the graphics that were embedded into the PowerPoint™ presentation used in this study. An interesting twist to these results is that many of the graphics were irrelevant to the content presented but were colorful and very appealing to the eye (see Figure 1).

Freedman's (1989) findings would suggest that these high-resolution images would be more striking to females and thus have a more profound affect on female attitudes than on males. However, in this study females did not have significantly more positive attitudes than males pertaining to this type of graphic when analyzing the differences of the gaze trail between text and graphic. As can be seen in Table 3, males and females did not spend significantly different amounts of time viewing slides with high-resolution graphics that were not strongly correlated with the text. As Chanlin (1999) reported, males are generally more sensitive to visual stimuli than females. It could be that the male population in this study were more sensitive to the irrelevance of these graphics and therefore thought of them as not effective.

These findings are critical for those who create PowerPoint™ presentations for instructional purposes. Often instructors embed graphics that are irrelevant to the presented content but are appealing to the eye. Unless the combination of text and graphics or the narration of each slide justifies the graphic, the desired transmission of knowledge might not be reached. Understanding the gender population of a class might be the most crucial design component of a PowerPoint™ presentation. Females are more in tune with color and the affect of color and animation is higher with females. If an instructor is trying to excite learning in females, colorful graphics embedded in a PowerPoint™ could be one method to pursue. Conversely, if the intent of the instructor is to excite males, than it is essential that the relevance of the graphics is made obvious.

In science, females are less likely to pursue careers in the physical sciences. One reason for this fact might be that traditionally textbooks and instruction of physical science are in black-and-white or drawn on a chalkboard. Females need to have a voice on layout and inclusion of graphics in textbooks and websites. As a formally male dominated area, publishing expository textbooks needs to consider the use of graphics and the population of who might interact with the textbooks.

As this study confirms, females perceive the use of high quality graphics to be an integral part of effective teaching and learning. As Mayer (2001) suggested, students learn at a higher level from well-designed multimedia presentations than from traditional verbal or text only presentations. Although Tufte (2003) would argue that PowerPoint™ is entirely instructor oriented, the reality is that PowerPoint™ needs to become, and can become, more student oriented. Understanding how different populations of students respond to varying components of PowerPoint™ is a vital piece of the educational puzzle that researchers of instructional technology need to continue to explore.

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Appendix A

Prompts for Likert Multimedia Feedback Survey

Section I: Functional Use

Answer the following questions based on your experience with the use of PowerPoint and/or video in THIS session.

1. The total amount of text on a slide is satisfactory.
2. The text on the screen is usually large enough to read.
3. There is so much text on the slides that it is hard to read them.
4. Long passages of text (3 lines or more) on the slides are easy to read.
5. Slide headings help in note taking.
6. Headings are clearer when they are accompanied by images.
7. Headings used alone are understandable.
8. Slide headings are clearly related to slide content.
9. The text on the screen is large enough to read.
10. Slide headings and text are sufficient for understanding.
11. The images on the screen are clear and identifiable.
12. Because the presenter used images to illustrate steps of a process, I understand these processes better.
13. Because the presenter used figures from the text in your slides it is easier for me to reference and review material later.
14. I would understand the lecture better if you showed additional images relevant to course content.
15. Images add interest to the material.
16. Images help me understand concepts.
17. Images help me focus my attention.
18. The use of animations helps me understand complex processes in particular.
19. Motion helps me understand concepts.
20. Motion adds interest to the material.
21. Motion helps to focus my attention.
22. The use of motion is confusing.
23. The pace of slides holds my interest.
24. There was an appropriate amount of time talking about the content of each slide.
25. The pace allowed me to take complete notes.
26. The slides in the video often advanced too quickly.
27. The use of sound with the slides provided a useful demonstration of what I might encounter in actual situations.
28. Audio narrations for the slides made it easier for me to comprehend the material.

Section II: Course Experience

Answer the following questions based on your experience with the use of PowerPoint in traditional classes.

29. Presentations usually cover course material in useful and sufficient detail.
30. Slide content helps me to ask relevant questions.
31. The order of slides usually relates to what I say or ask.
32. The slides seem to determine what we do in class, even when students need something not on those slides, or not in that order.
33. Because instructors used slides to illustrate steps of a process, I understand these processes better.
34. PowerPoint is appropriate for small classes.
35. PowerPoint is appropriate for large lecture sections.
36. I have been able to write notes for review and study from the PowerPoint presentations.
37. Being able to review the slides after class helps to reinforce my understanding of the material.
38. Being able to see slides before class helps me understand the material and content of the class.
39. When I reviewed slides or animation that illustrated a process in action, I could look at the process quickly or one step at a time. That helped me understand the idea.
40. It is generally easy to find and read the presentations from a computer outside the classroom.
41. Instructors generally balance attention to the screen and the class when using slides.
42. I need to interact less with the instructor because course material in slides lecture sessions is clearly presented.
43. I avoid asking for clarification when I don't understand something because I don't want to disrupt the flow of the slide presentation.
44. The slides are so complete; I usually don't need to read the textbook.