Effect of Differing PowerPoint Slide Design on Multiple-Choice Test Scores for Assessment of Knowledge and Retention in a Theriogenology Course

Margaret V. Root Kustritz

ABSTRACT

Third-year veterinary students in a required theriogenology diagnostics course were allowed to self-select attendance at a lecture in either the evening or the next morning. One group was presented with PowerPoint slides in a traditional format (T group), and the other group was presented with PowerPoint slides in the assertion-evidence format (A-E group), which uses a single sentence and a highly relevant graphic on each slide to ensure attention is drawn to the most important points in the presentation. Students took a multiple-choice pre-test, attended lecture, and then completed a take-home assignment. All students then completed an online multiple-choice post-test and, one month later, a different online multiple-choice test to evaluate retention. Groups did not differ on pre-test, assignment, or post-test scores, and both groups showed significant gains from pre-test to post-test and from pre-test to retention test. However, the T group showed significant decline from post-test to retention test, while the A–E group did not. Short-term differences between slide designs were most likely unaffected due to required coursework immediately after lecture, but retention of material was superior with the assertion-evidence slide design.

Key words: assessment, educational methods, outcomes, reproduction

INTRODUCTION

Traditionally, pre-clinical veterinary education has consisted of lectures and laboratories. While active learning strategies are a growing focus of education, many instructors still feel that a well-designed lecture, with or without accompanying lecture notes, is an efficient way to expose a large number of students to a body of information.

Most lectures in veterinary education are accompanied by a set of slides. Historically, slides were used to show images, including photographs and descriptive tables or graphs. With the advent of PowerPoint, people increasingly began to use that tool to show not only relevant images but also added text. Over time, PowerPoint slides have become a single tool used by many instructors to demonstrate important concepts to students through text and images, to prompt the speaker throughout the presentation, and to provide a quick handout for students by providing them with printed copies of the PowerPoint slides. This leads to the overloading of slides with too much text and the overuse of bulleted lists, which do not permit students to make connections between the data presented and instead oversimplify and fragment the information.[1–7] It has been suggested that use of PowerPoint removes the focus from the instructor, decreasing direct interactions with the students that would enhance learning by generating discussion within the class and prohibiting the instructor from demonstrating non-verbal behaviors such as eye contact, smiling, movement, relaxed body posture, and vocal expressiveness, all of which are associated with increased student learning.[8–10] The instructor's focus on the formatting of PowerPoint slides may be removed from reflection on how best to present the material, perhaps because for some instructors, formatting slides is more fun than concentrating on what they are going to say.[9,11] Finally, use of PowerPoint slides as handouts has not been shown to affect student ability on examinations, attention in class, or opinions regarding the teaching abilities of the instructor and may, in fact, be associated with decreased active engagement as students with such notes in hand feel that they have all the information that will be covered.[12,13]

Use of slides to support a presentation is not a bad pedagogical concept. The concern is that use of default templates in PowerPoint does not lead to best use of the tool. One author described it thus: "New ways of communicating call for new ways of thinking about the communication process."[14(p.264)]

Cognitive load is a theory describing how adults process and store information and is defined as the degree of effort, strategy, and processing capacity that an individual must exert to understand information (Figure 1).[15]

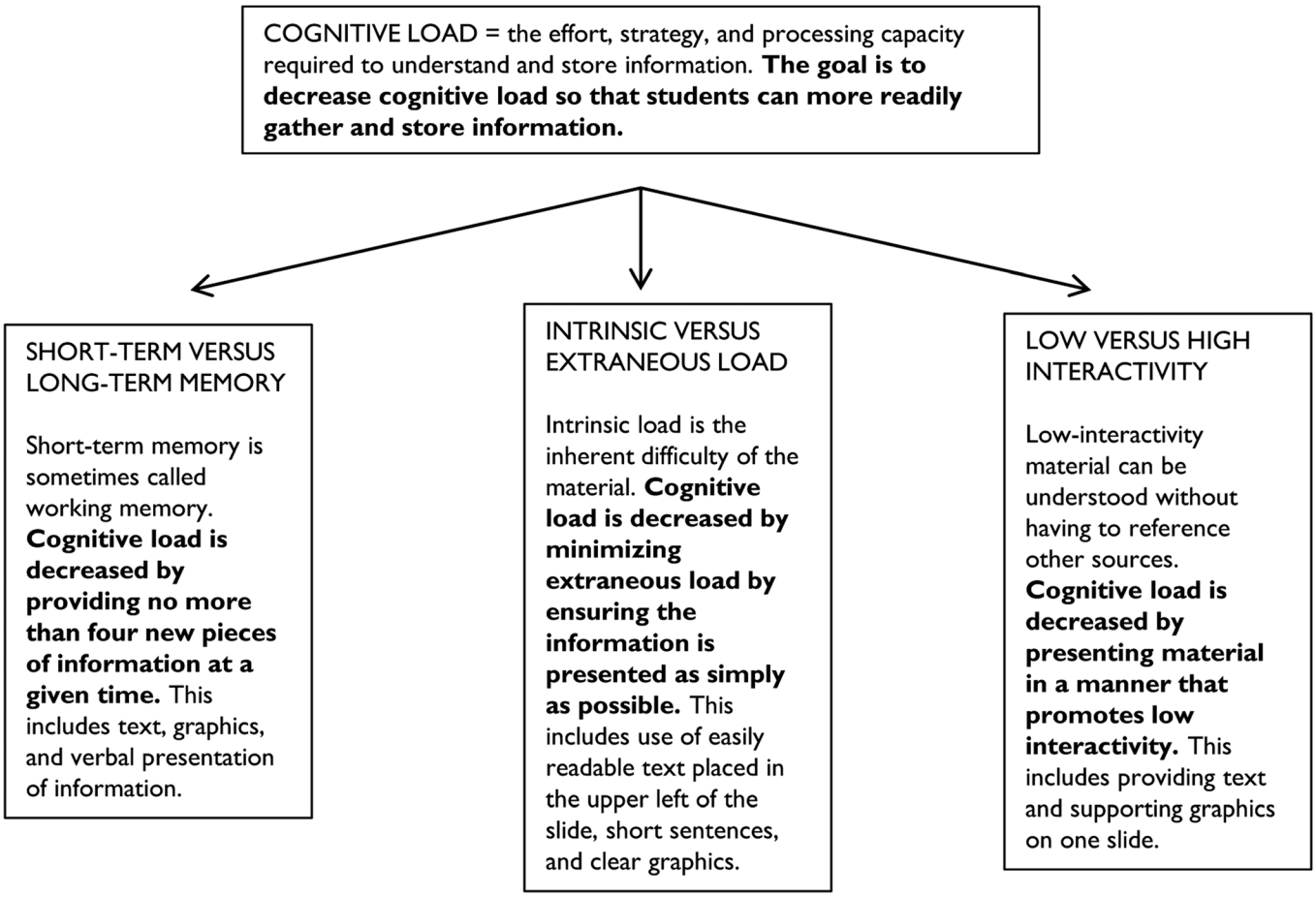

Figure 1: Factors affecting cognitive load

Cognitive load can be discussed through the lens of short-term (working) versus long-term memory, intrinsic or extraneous load, or high to low interactivity. Short-term memory is the amount of information a given person can manipulate mentally at one time. Most work suggests that no more than four items can be managed successfully by most people.[16] Intrinsic cognitive load is inherent in the material itself.[17] Complex material has a high intrinsic cognitive load. Extraneous cognitive load is created by how the information is presented.[17] If intrinsic cognitive load is high, presenters can enhance the ability of participants to learn by decreasing extraneous load by reducing the number of elements that must be held in memory at any one time.[18] Interactivity refers to how easily the material is understood. Low-interactivity information is easily understood without need to reference other pieces of knowledge.[19] High-interactivity elements can only be partially understood if those elements are not considered in relation to each other.[20]

So how can we use this information about cognitive load to help us design the best slides possible for presentation of scientific material? Studies have evaluated many components of slides design, and general principles exist for background and text colors, use of bulleted lists, use of images representative of information in the study, use of decorative images including backgrounds and logos, and the amount and placement of text on the slide.

In general, there are no specific rules for background and text colors other than to make sure that they contrast with each other. Yellow letters on a tan background are not easily read, while black letters on a yellow background are easily read but may be aesthetically jarring.

Bulleted lists fragment information and do not provide the audience with obvious connections between the material. Information in bulleted lists could be replaced by timelines, flowcharts, text with varying size to show incidence or otherwise highlight specific connections between textual elements, or other relational graphics.[2]

Graphics, including photos, drawings, diagrams, graphs, videos, equations, and short tables, are a valuable component on presentation slides.[21] It is recommended to not use clip-art images if photographs or other sorts of graphics are available because use of clip art may undercut the seriousness of the presentation and decrease the credibility of the speaker.[22] Presentation of data both verbally and with a representative image leads to better integration of that information and increased retention compared with presentation of either alone.[23,24] The graphics used must be relevant; when decorative or irrelevant images are included on slides, students find this objec-

tionable and it decreases learning as evidenced by poor recall of information.[25] One study suggested that use of irrelevant images actually decreased learning in some students.[26] These distracting graphics include irrelevant pictures on the slide, decorative backgrounds, and excessively large or prominent logos.

Audiences accustomed to reading English orient themselves to written information by first accessing the upper left corner of an area of text.[21] A presenter can decrease extraneous load for the audience by left justifying text. To minimize difficulty in reading the text, other things that can be done are to use 28-point font and fonts that are easily readable when projected.[27–29] This usually means using a sans-serif font, which does not have extra decorative strokes. It is wise to limit the number of words per slide and to arrange those words on one or two lines if possible. It has been well demonstrated that students learn better when unnecessary words are removed from slides and that it is best to present students with no more than 20 projected words per minute.[21,24,30,31] This again pulls presenters away from the use of bulleted lists, which tend to make slides dense with wording, the consequence of which may be decreased comprehension of the subject matter by the audience.[3–6,22] Finally, keep blocks of text to one or two lines if possible; in one study, over half of the participants would not read text blocks that were three or more lines long.[32]

Assertion-evidence slide design uses principles of cognitive load theory to decrease extraneous load and ensure that members of the audience are clearly provided with the most important information in that presentation. This slide design was originated at Lawrence Livermore National Laboratory.[33] Assertion-evidence structure consists of a headline sentence stating the main assertion of the slide and a relevant graphic in the body of the slide.[21] These slides are designed to serve as a visual aid during the talk, rather than as a handout after the talk, and to help the audience understand the content, not to provide speaking notes for the presenter.[21] Specific stylistic guidelines are delineated in Table 1.

In a good presentation, there is balance between what the speaker shows and what the speaker says. These slides will not serve as a set of presentation notes for speakers, and speakers will be required to know their material well and to practice with these slides before giving a presentation. Because there is no bulleted list, the speaker must explain the visual evidence, which requires practice but gives a more natural delivery.[21] If speakers show a graph, they should slow down and give some "soak time" so that the audience knows they can concentrate on the graph instead of listening to the speaker.[21] Speakers should never read what is on the slide; if everything a speaker says is on the slides, many people will read the slides instead of listening to the speaker.[21] This issue is compounded if the speaker provides the slides as a handout.[9] The last slide should not be a question mark or other type of prompt to ask questions but instead should be a summary slide, as this likely will be the slide projected the longest as the speaker answers questions and engages the audience.[34]

Creation of assertion-evidence slides is challenging because it requires the speaker to define an important message, or assertion, for every slide and to explain or provide evidence for that assertion visually. This effort is only valuable if use of this slide design can be demonstrated to increase student learning.

Table 1: Principles of assertion-evidence design

Slide element	Specifics
Assertion	The heading is a succinct headline sentence that states the main assertion or message. This sentence should be left justified in an easily readable 28-point font, with normal capitalization and punctuation, and should be no more than two lines long.
Evidence	A relevant graphic should be included. Avoid clip art and unnecessary animations. Ensure adequate white space between slide elements.

The goal of this study was to compare use of traditional slides with assertion-evidence slides in a cohort of third-year veterinary students in a theriogenology diagnostics course.

MATERIALS AND METHODS

This study was evaluated by an institutional review board. Students in a required third-year theriogenology diagnostics course were offered the opportunity to attend the 2-hour lecture on small-animal theriogenology diagnostics either in the evening (5–7 p.m.) or at the regularly scheduled time the next morning (8–10 a.m.). Students self-selected which lecture they attended and completed and signed a pre-test so the instructor knew that all students attended one of the sessions and that no student attended both sessions. All students had the same course schedule throughout the time of the study.

In both sessions, a hard-copy pre-test was administered, which consisted of 10 multiple-choice questions. The same lecturer spoke at both sessions, and the same course notes were available to the students; these printed notes were not PowerPoint handouts.[a] Students attending the evening session were presented with slides that followed a traditional phrase and bullet-point design (Figure 2a). Students in the morning session were presented with slides that used assertion-evidence design principles (Figure 2b). The pre-test was not returned to students in either group, nor were they given information about their performance on the pre-test.

Students in both sessions completed a take-home, open-resource assignment that was due 2 weeks following the first lecture date. Students were permitted to work in groups, but each student had to submit a completed assignment written in their own words. A post-test, which was identical to the pre-test, was available online for 1 week after the submission deadline for the homework assignment. Corrected assignments were not returned to the students until they had all completed this post-test. One month later, a slightly different set of multiple-choice questions was available for 1 week online to test retention.

Figure 2a: Example of traditional PowerPoint slides used within a lecture describing use of vaginography in bitches

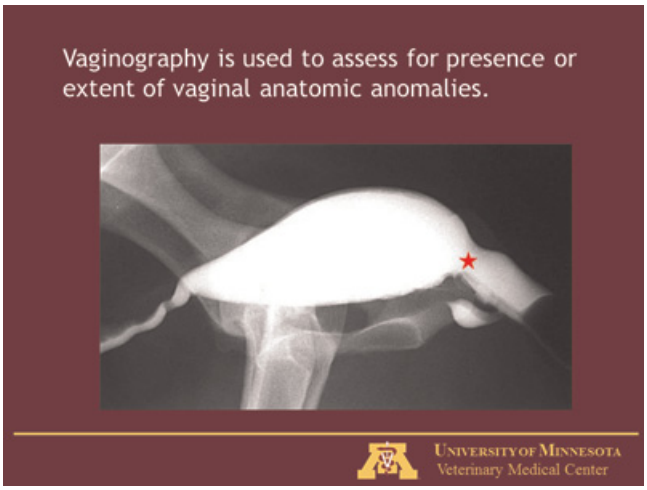

Figure 2b: Example of an assertion-evidence PowerPoint slide used within a lecture describing use of vaginography in bitches

Students were not given direction regarding whether or not they should access notes to complete the pre-test, post-test, and retention tests. Students were informed that to pass this section of the course they needed to get 15 out of 25 possible points on the take-home assignment and needed to complete the pre-test, post-test, and retention test.

Students had previously completed an online learning styles evaluation.[35] Pre-test, post-test, and retention-test scores and learning styles were compared within and between groups using the unpaired Student's *t*-test. A difference in gender distribution between groups was compared using the Chi-square test. Significance was set at $p < .0500$.

RESULTS

Ninety-nine students participated in this study. There were 31 students in the traditional slide group (T group) and 68 students in the assertion-evidence slide group (A–E group). The T group consisted of 83% female and 17% male students, and the A–E group consisted of 74% female and 26% male students; difference in gender distribution between groups was not significant. Scores for the homework assignment did not differ between groups, at 23.7 ± 1.6 (mean $\pm$ *SD*) for the T group and 23.6 ± 1.5 for the A-E group.

The mean pre-test score for the T group was 3.6 ± 1.6 and for the A–E group was 3.7 ± 1.3; this difference was not significant. The mean post-test score for the T group was 6.2 ± 1.9 and for the A–E group was 6.6 ± 2.0; this difference was not significant. Both groups showed significant gains in knowledge from pre-test to post-test ($p < .0001$).

The mean retention score for the T group was 5.3 ± 1.8 and for the A–E group was 6.0 ± 1.9. This difference was significantly different ($p = .0300$). The A–E group did not show a significant decline from post-test to retention test ($p = .0500$), while the T group did show a significant decline from post-test to retention test ($p = .0300$).

Learning styles did not vary between the two groups on any of the four scales of active learning versus reflective learning, sensing versus intuitive learning, visual learning versus verbal learning, and sequential learning versus global learning. In general, students were evenly distributed between active and reflective learning and were more inclined toward the sensing, visual, and sequential ends of the other scales.

DISCUSSION

This study demonstrated value in the use of slides designed following specific principles that have been demonstrated to enhance student learning. The sample size could have been increased by offering the slide designs to classes in two successive years instead of splitting one class, but that would have led to increasing variability between classes in regards to other information presented before and during the course. The lack of significant differences between groups on pre-test, post-test, and assignment scores suggests that the groups were well balanced intellectually.

JVME 41(3) © 2014 AAVMC doi: 10.3138/jvme.0114-004R

The group size was uneven. The schedule did not permit scheduling of two sessions at successive times within the school day, and the author wished to present both sessions, preventing them from being offered concurrently. The author wanted to ensure that the two groups had as similar educational experiences around these presentations as possible. School policy does not permit requiring students to attend an evening session without prior scheduling of such within that course, so participation in the evening session had to be voluntary. While it would have been desirable to have closer to 50 students in each group, that would not have been possible without assigning students to those groups.

Learning style, as assessed using this instrument, did not play a role in how students perceived these varying slide designs. Students did, in general, have a more visual than verbal slant to their learning styles, and although the A-E group was slightly more visual than the T group, the difference was not significant and any apparent synergy between learning style and test scores was not identified.

Veterinary educators may view themselves using various metaphors. Is knowledge a commodity that is transferred from you to the students? Are you shaping their minds? Are you leading them on a journey to discover information? Are you nurturing them to discover things for themselves?[36–39] With all of these metaphors, a common thread is that the instructor is the expert who has knowledge or knows where to find it. Assertion-evidence slides make that knowledge overt, decreasing intrinsic cognitive load by organization and emphasis and decreasing extraneous cognitive load by streamlining the presentation.

Numerous studies have evaluated slide design. In one such study, the average student score on an examination after a lecture with traditional slides was 69%, while that for an examination after a lecture with assertion-evidence slides was 79% ($p = .0010$).[40] Students in a similar study in an undergraduate course showed similar gains and preferred the assertion-evidence slides at a ratio of 7 to 1.[41] Medical students were presented with presentations associated with either traditional slides or assertion-evidence slides. Both groups showed increased knowledge from pre-test to post-test, but the assertion-evidence group had a higher average post-score ($p = .0081$) and retention ($p = .0016$).[42] One investigator proved increased gains with assertion-evidence slides and demonstrated that assertion-evidence slides and the introduction of an active learning component led to greater attendance in class.[43] Finally, a study was performed comparing narrated slides that were viewed online; the narration was the same, but some of the students viewed traditional slides while others viewed assertion-evidence slides. Again, the group that viewed the assertion-evidence slides showed higher test scores, both on essay questions immediately following viewing of the slide set and on a multiple-choice examination administered about one week later.[44]

This group of students did not show any difference between groups in post-test scores. The post-test followed completion of an assignment that required students to review the material, and this is perhaps the difference between this study and the others described. The ability of any slide design to help students encode information is altered by the learning that follows it, and working through an assignment and reviewing the material through discussion with peers most likely diluted the impact of the slide design used in the initial lecture presentation. However, retention of information was superior in the A–E group, suggesting that long-term encoding of important concepts was enhanced using the assertion-evidence slide design.

Creation of assertion-evidence slides is challenging. The instructor must define what the audience needs to know and make their point clearly.[45] Educators may not wish to create assertion-evidence slides because of a lack of time and energy to learn a new approach and recreate slides for established courses, a lack of confidence for giving presentations with so little visual display to prompt recall for the speaker, and requirements for specific templates in some organizations.[46] For assertion-evidence slide design to be useful to the learner, the speaker must have a mastery of the material that permits the identification of assertions of greatest import and the creation or identification of supportive graphics, good speaking skills and practice with the slides, and the support from higher authority and the time needed to create new slide sets.[46] This effort is of value only if it enhances learning. In this study, the value of this effort was shown by increased retention as demonstrated on a multiple-choice examination.

CONCLUSION

Assertion-evidence slide design uses principles from graphic design and the educational research to create slides that should enhance student learning. It has been well demonstrated that assertion-evidence slides provide fewer words per slide and fewer words projected per minute.[47] Students retained the most information from slides with fewer words, showing the immense value of choosing select words and associated graphics for greatest effect.

NOTES

a Handouts available at http://www.tc.umn.edu/~rootk001/Class_notes_second_year.htm.

REFERENCES

1 Simons T. Does PowerPoint make you stupid? [Internet]. Presentations Magazine; 2004 Mar [cited 2013 Nov 7]. Available from: http://academic.evergreen.edu/curricular/ATPSMPA/power%20point%20make%20you%20stupid.pdf.

2 Shaw G, Brown R, Bromiley P. Strategic stories: how 3M is rewriting business planning. Harv Bus Rev. 1998;76(3):41–50. Medline:10179653

3 Tufte ER. The cognitive style of PowerPoint. Cheshire, CT: Graphics Press; 2003.

4 Tufte ER. Engineering by viewgraphs. In: Columbia Accident Investigation Board. Vol. 1, The report. Arlington, VA: Columbia Accident Investigation Board; 2003 Aug. p. 191.

5 Tufte ER. PowerPoint is evil [Internet]. Wired. 2003 Sep [cited 2013 Aug 20];(11.09). Available from: http://www.wired.com/wired/archive/11.09/ppt2.html.
6 Tufte ER. NASA seeks to curb PowerPoint engineering [Internet]. Cheshire, CT: Graphics Press LLC; [cited 2013 Aug 20]. Available from: http://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0001OB&topic_id=1&topic=.
7 Wald ML, Schwartz J. Shuttle inquiry uncovers flaws in communication. The New York Times. 2003 Aug 14.
8 Hartnett N, Römcke J, Yap C. Recognizing the importance of instruction style to students' performance: some observations from laboratory research—a research note. Account Educ. 2003;12(3):313–31. http://dx.doi.org/10.1080/0963928032000095446.
9 Parker I. Absolute PowerPoint. The New Yorker. 2001 May 28; Business. p. 76–87.
10 Craig RJ, Amernic JH. PowerPoint presentation technology and the dynamics of teaching. Innovative High Educ. 2006;31(3):147–60. http://dx.doi.org/10.1007/s10755-006-9017-5.
11 Angus I. The materiality of expression: Harold Innis' communication theory and the discursive turn in the human sciences. Can J Comm. 1998;23:9–29.
12 Jones AM. The use and abuse of PowerPoint in teaching and learning in the life sciences: a personal view [Internet]. BEE-j. 2003 Nov [cited 2013 Nov 7];2:1–3. Available from: http://www.csun.edu/science/ref/presentation/powerpoint/powerpoint_use_abuse.pdf.
13 Nouri H, Shahid A. The effects of PowerPoint lecture notes on student performance and attitudes. Accounting Educ J. 2008;18:103–17.
14 Warnick B. Analogues to argument: new media and literacy in a posthuman era. Argumentation Advocacy. 2002;38:262–70.
15 Garner JK, Alley M, Gaudelli AF, et al. Common use of PowerPoint versus the assertion-evidence structure: a cognitive psychology perspective. Tech Comm. 2009;56:331–45.
16 Cowan N. The magical number 4 in short-term memory: a reconsideration of mental storage capacity. Behav Brain Sci. 2001;24(1):87–114, discussion 114–85. http://dx.doi.org/10.1017/S0140525X01003922. Medline:11515286
17 Sweller J. Implications of cognitive load theory for multimedia learning. In: Mayer RE, editor. The Cambridge handbook of multimedia learning. New York: Cambridge University Press; 2005. p. 19–30. http://dx.doi.org/10.1017/CBO9780511816819.003.
18 Ayres P, van Gog T. State of the art research into Cognitive Load Theory. Comput Human Behav. 2009;25(2):253–7. http://dx.doi.org/10.1016/j.chb.2008.12.007.
19 Paas F, Renkl A, Sweller J. Cognitive load theory and instructional design: recent developments. Educ Psychol. 2003;38(1):1–4. http://dx.doi.org/10.1207/S15326985EP3801_1.
20 Chandler P, Sweller J. Cognitive load theory and the format of instruction. Cogn Instr. 1991;8(4):293–332. http://dx.doi.org/10.1207/s1532690xci0804_2.
21 Alley M. Critical error 7: following the defaults of PowerPoint. In: The craft of scientific presentations: critical steps to succeed and critical errors to avoid [Internet]. New York: Springer; 2013 [cited 2013 Aug 16]. p. 127–70. Available from: http://link.springer.com/content/pdf/10.1007%2F978-1-4419-8279-7.pdf.
22 University of Minnesota. Minnesota mining and manufacturing. In: Macnamara J, editor. The modern presenter's handbook. Chippendale, Australia. Archipelago Press; 2000.
23 Paivio A. Mental representations. New York: Oxford University Press; 1986.
24 Clark JM, Paivio A. Dual coding theory and education. Educ Psychol Rev. 1991;3(3):149–210. http://dx.doi.org/10.1007/BF01320076.
25 Bartsch RA, Cobern KM. Effectiveness of PowerPoint presentations in lectures. Comput Educ. 2003;41(1):77–86. http://dx.doi.org/10.1016/S0360-1315(03)00027-7.
26 Carney RN, Levin JR. Pictorial illustrations still improve students' learning from text. Educ Psychol Rev. 2002;14(1):5–26. http://dx.doi.org/10.1023/A:1013176309260.
27 Atkinson C. Beyond bullet points: using Microsoft PowerPoint to create presentations that inform, motivate, and inspire. Redmond, CA: Microsoft Press; 2005.
28 Doumont JI. Trees, maps, and theorems: effective communication for rational minds. Kraainem, Belgium: Principiae; 2009.
29 Alley M, Neeley KA. Rethinking the design of presentation slides: a case for sentence headlines and visual evidence. Tech Comm. 2005;52:417–26.
30 Mayer RE. Multimedia learning. New York: Cambridge University Press; 2001. http://dx.doi.org/10.1017/CBO9781139164603.
31 Sadoski M, Paivio A. Imagery and text. Mahwah, NJ: Lawrence Erlbaum Associates; 2001.
32 Alley M, Robertshaw H. Rethinking the design of presentation slides: creating slides that are readily comprehended [Internet]. In: Proceedings of the 2004 ASME International Mechanical Engineering Congress; 2004 Nov 13–19; Anaheim, CA. New York: American Society of Mechanical Engineers; 2004 [cited 2013 Nov 7]. Available from: http://www.writing.engr.psu.edu/speaking/imece2004-61889.pdf.
33 Gottlieb L. Well organized ideas fight audience confusion. Proceedings of the 49th Annual Conference for the Society for Technical Communication; 2002 May 5–8; Nashville, TN. Fairfax, VA: Society for Technical Communication; 2002.
34 Alley M. Critical error 8: following the common practices of PowerPoint talks. In: The craft of scientific presentations: critical steps to succeed and critical errors to avoid [Internet]. New York: Springer; 2013 [cited 2013 Aug 16]. p. 171–201. Available from: http://link.springer.com/content/pdf/10.1007%2F978-1-4419-8279-7.pdf.
35 Soloman BA, Felder RM. Index of learning styles questionnaire [Internet]. Raleigh, NC: North Carolina State University; [cited 2013 Nov 4]. Available from: http://www.engr.ncsu.edu/learningstyles/ilsweb.html.

36 Amernic J, Craig R. The internet in undergraduate management education: a concern for neophytes among metaphors. Prometheus. 1999;17(4):437–50. http://dx.doi.org/10.1080/08109029908632121.
37 Fox D. Personal theories of teaching. Stud High Educ. 1983;8(2):151–63. http://dx.doi.org/10.1080/0307507831233137901 4.
38 Lucas U. Contradictions and uncertainties: lecturers' conceptions of teaching introductory accounting. Br Account Rev. 2002;34(3):183–203. http://dx.doi.org/10.1006/bare.2002.0197.
39 Reddy MJ. The conduit metaphor: a case of frame conflict in our language about language. In: Ortony A, editor. Metaphor and thought. 2nd ed. New York: Cambridge University Press; 1993. p. 164–201. http://dx.doi.org/10.1017/CBO9781139173865.012.
40 Alley M, Schreiber M, Ramsdell K, et al. How the design of headlines in presentation slides affects audience retention. Technical Comm. 2006;53:225–34.
41 Alley M, Schreiber M, Muffo J. Pilot testing of a new design for presentation slides to teach science and engineering. In: Proceedings of the 35th Annual Frontiers in Education Conference; 2005 Oct 19–22; Indianapolis, IN. New York: IEEE; 2005. http://dx.doi.org/10.1109/FIE.2005.1612283.
42 Issa N, Schuller M, Santacaterina S, et al. Applying multimedia design principles enhances learning in medical education. Med Educ. 2011;45(8):818–26. http://dx.doi.org/10.1111/j.1365-2923.2011.03988.x. Medline:21752078
43 Diesel E, Alley M, Schreiber M, et al. Improving student learning in large classes by incorporating active learning with a new design of teaching slides. In: Proceedings of the 36th Annual Frontiers in Education Conference; 2006 Oct 27–31; San Diego, CA. New York: IEEE; 2006. http://dx.doi.org/10.1109/FIE.2006.322395.
44 Garner JK, Alley M, Sawarynski LE, et al. Assertion-evidence slides appear to lead to better comprehension and recall of more complex concepts [Internet]. In: Proceedings of the 118th ASEE Annual Conference and Exposition; 2011 Jun 26–29; Vancouver. Washington: American Society for Engineering Education; 2011 [cited 2013 Nov 7]. Available from: www.asee.org/public/conferences/1/papers/900/download.
45 Shwom BL, Keller KP. The great man has spoken. Now what do I do? A response to Edward R. Tufte's "The cognitive style of PowerPoint." Comm Insight. 2003;1:1–15.
46 Neeley KA, Alley M, Nicometo CG, et al. Challenging the common practice of PowerPoint at an institution: lessons from instructors. Tech Comm. 2009;56:346–60.
47 Alley M, Garner J, Zappe S. Projected words per minute: a window into the potential effectiveness of presentation slides [Internet]. In: Proceedings of the 117th ASEE Annual Conference and Exposition; 2010 Jun 20–23; Louisville, KY. Washington: American Society for Engineering Education; 2010 [cited 2013 Nov 7]. Available from: http://search.asee.org/search/fetch;jsessionid=bmo2eh67ric9?url=file%3A%2F%2Flocalhost%2FE%3A%2Fsearch%2Fconference%2F32%2FAC%25202010Full670.pdf&index=conference_papers&space=129746797203605791716676178&type=application%2Fpdf&charset=.

AUTHOR INFORMATION

Margaret V. Root Kustritz, DVM, PhD, DACT, is Assistant Dean of Education and Professor, Department of Veterinary Clinical Sciences, University of Minnesota College of Veterinary Medicine, St. Paul, MN 55108 USA. E-mail: rootk001@umn.edu.