Designing PowerPoint for the Online

Environment

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Center for Innovation in Teaching and Learning (CITL)

Memorial University

One of the most common barriers that prevents the successful integration of technology is a lack of familiarity regarding best practice knowledge on its appropriate use. This review is intended to help inform and guide PowerPoint use in the *online* learning environment.

PowerPoint software originated in the mid to late 1980's as a business package designed for presentation of information to audiences to sell a product (Burke & Apperley, 2003/2004). Today, presentation software has evolved into an extensively pervasive communication medium. In a study by Hill, Artford, Lobitow, & Smollin (2012), 67% of college students identified that their instructors used PowerPoint and that 95% of these instructors used this software all or most of the time. In 2004, Mahin conservatively estimated that PowerPoint was installed on over 250 million computers worldwide, with over 30 million PowerPoint presentations taking place every day. By 2012, the number of PowerPoint installations had exceeded one billion (Jordan & Papp, 2014, as cited in Parks, 2012).

Although numerous software programs and digital devices are becoming quite prevalent in today's university classrooms, PowerPoint continues to "stand alone as the iconic staple of the late 20 - early 21st century lecture hall" (Adams, 2008, p. 63). Since its inception, PowerPoint has created considerable debate over its pedagogical value in the educational world. However, regardless of one's opinion, PowerPoint appears to have integrated itself as a taken for granted entity into the current daily learning experiences of students (Adams 2008; Hill et al., 2012).

PowerPoint Pedagogy Debate

Much of the information surrounding the PowerPoint debate has been anecdotal in nature. Compounding this issue is a lack of sound empirical research and compiled findings on the pedagogy and effective use of PowerPoint, especially in the online environment (Levasseur & Sawyer, 2006). Although today's current research is able to inform us, it is unable to resolve the pedagogical debate as there remain too many understudied, inconsistent, and controversial findings (Baker, Goodboy, Bowman, & Wright, 2018; Burke & James, 2008; Hill et al., 2012; Levasseur & Sawyer, 2006). Criticisms of PowerPoint have been widespread, having escalated with its' ubiquitous use (Amare, 2004; Mahin, 2004).Various authors contend that PowerPoint cannot be used in a sound pedagogical manner (Adams, 2006; Burke & Apperley 2003/2004; Tufte, 2003). It has been accused of being more often abused than used correctly.

Criticisms and Advantages of PowerPoint

C*riticisms* of PowerPoint accuse it of:

- having an architecture that encourages the passive presentation of predetermined content that is often sequential, linear, and lacking spontaneity (Adams, 2008);
- supporting a "cognitive and pedagogical style that is inconsistent with both the development of higher analytical thinking skills and the acquisition of rich narrative and interpretive understanding" (Adams, 2006, para1);

- having an ability to cognitively overload the learner (Mayer & Moreno, 1998; Paas, Renkl, & Sweller, 2003; Sweller 1994; Sweller, van Merrienboer, & Paas, 2019);
- condensing and reshaping ideas into a preconceived format, constraining ways of thinking, knowing, and looking at content; subsequently affecting how knowledge is presented (Adams, 2006; Mahin, 2004; Turkle, 2004);
- encouraging a presentation style with use of predefined default settings and templates, thus minimizing content, resulting in complex issues being reduced to bulleted phrases and headings (Adams, 2008; Burke & Apperley, 2003/2004);
- affecting and shaping habits of mind in a negative way, through easy access and minimal effort (Adams, 2006; Turkle, 2004);
- obscuring complexity and blocking creativity and individual preferences (Adams, 2006);
- communicating details poorly; simplifying content for ease of presentation, thereby degrading the quality and credibility of communication (Tufte, 2003); and
- giving more attention to the look of the presentation, often at the expense of the content or pedagogy (Tufte, 2003).

Conversely, supporters claim *benefits* of PowerPoint, in that it:

- improves attitudes and helps to increase understanding (Apperson, Laws, & Scepansky, 2006; Szabo & Hastings, 2000);
- invokes audience interest, motivation, self-efficacy, and helps capture and maintain attention (Lari, 2014; Susskind, 2008; Szabo & Hastings, 2000);
- helps students study for exams and take notes on important key points (Szabo & Hastings, 2000; Susskind, 2008);
- helps to organize and structure content, aided by a positive student view of accessible slides and course handouts (Susskind, 2008; Worthington & Levasseur, 2015);
- is preferred to lectures, as learners perceive content to be more interesting and engaging (Susskind, 2008);
- can aid explanation of complex illustrations (Apperson et al., 2006; Alley and Robertshaw, 2004);
- can help improve retention (Savoy, Proctor, & Salvendy, 2009; Alley & Neeley, 2005);
- can increases student control over their own learning (Lari, 2014); and
- can promote authentic learning (Ögeyik, 2017; Pillay, Bozalek, & Wood, 2015).

Literature Review

Such conflicting claims make it crucial to review the literature in terms of PowerPoint's effectiveness in relation to how it is perceived and its ability to achieve learning outcomes (Savoy, et al., 2009).

Student and Faculty Perceptions

Although students identify issues with PowerPoint, many studies have demonstrated that students, in general, prefer PowerPoint, find it beneficial to their learning and respond favorably to classes when it is used (Baker et al., 2018; Levasseur & Sawyer, 2006). In a study by Apperson et al., (2006), students using PowerPoint believed that their classes were more organized, clear, and interesting. In addition, faculty who used PowerPoint were seen as more credible and generally rated higher by their students than those who did not use it (Apperson et al.; Hill et al., 2012; Susskind, 2008). Both faculty and students perceived PowerPoint to be superior to the traditional lecture (Atkins-Sayre, Hopkins, & Mohundro, 1998; James, Burke, & Hutchins, 2006). Apperson et al. (2006) indicates that faculty members have significantly more positive evaluations of PowerPoint than their students in terms of note taking, emphasizing key points, information recall, ease of learning, and attention holding. James et al. (2006) identify that faculty may overestimate the value of PPT because it may be the only software presentation tool that their colleges or universities support. Findings by Burke and James (2008) indicate that the student's perception of the *novelty* of PowerPoint significantly affected their perceptions of PowerPoint's ability to impact their learning.

Academic Achievement: Attaining Learning Outcomes

To date, comparison exam scores reveal conflicting results in the literature (Baker et al., 2018). A study performed by Susskind (2008) reveals that although PowerPoint was found to be preferred and enhances student's self-efficacy and attitude, it was *not found* to have any significant impact on academic achievement. There is an apparent disconnect between student preferences and their related performance. This has been a consistent finding with much of the existing research (Appersons et. al, 2006; Baker et al., 2018; Bartsch & Cober, 2003; Levasseur & Sawyer, 2006; Savoy et al., 2009; Szabo & Hastings, 2000; Worthington & Levasseur, 2015). Although traditional PowerPoint may be able to structure lecture content, it appears to be less able to affect how students interact with it (Alley & Neeley, 2005; Creed, 1997; Jordan & Papp, 2014). These inconsistent findings and inability to produce improved learning outcomes raise concerns with its pervasive use.

Designing PowerPoint Presentations

Multimedia and Layout

Multimedia design theory informs us that well designed multimedia effects, with a specific educational purpose, can be extremely beneficial for learning. Effective design helps learners "attend to relevant information, organize it into a coherent mental representation and integrate it with prior knowledge" (Isa, Mayer, Schuller, Wang, Shapira & DaRosa, 2013, p.389).

Multimedia

Research on how students assimilate information from multimedia from words, pictures, animations and sound informs us that learners have a very limited working memory (short term memory) for processing novel information, being split between two main processing channels, the visual and auditory (Mayer & Moreno, 2003). Meaningful learning through slide presentations, involving the integration of multimedia components, requires that learners engage in substantial cognitive processes that have the potential to overwhelm either one or both of these channels, resulting in cognitive overload and decreased student learning (Mayer & Moreno; Sweller, 1994; Sweller et al., 2019).

Although multimedia effects have the capacity to arouse, irrelevant effects and extraneous information are distracting (Lang et al., 1999; Mayer, 2008; Mayer & Moreno, 2003; Paas et al., 2003). Findings by Bartsch and Cobern (2003) indicate that students did significantly better in a basic PPT condition (text only) on recall and scored 10% worse with expanded PP conditions, with graphics and sounds, indicating a detrimental effect when instructors use unnecessary embellishments in their presentation. Irrelevant sound effects, redundant information, unnecessary animations such as fancy slide transitions, poor visuals, generic clip art and decorations do not support learning, may actually be detrimental, and are not desired by students (Alley & Neeley, 2005; Blokzijl & Naeff, 2004, Burke & Apperly, 2003-2004; Gaskins, 2007; Moreno, 2008; Voss, 2004). Also, intricate PowerPoint builds, where points are revealed line by line, can affect a learner's control over the pace of the learning environment and result in decreased learner satisfaction (Katt, Murdock, Butler, & Pryor, 2008; Orvis, Fisher, & Wasserman, 2009).

This potential for overload must be minimized by keeping things "simple" in relation to design principles. Complex information should be broken down into smaller components and information should be presented uncluttered with the provision of ample white space, allowing for learners to quickly separate items and find logical order (Alley & Robertshaw, 2004; Mayer & Moreno, 2003). One can use the annotation features of PowerPoint, such as the laser pointer, pen, or highlighter to annotate PowerPoint slides to help cue and hold students' attention or to emphasize key points and important details. Learning with digital inking can be greatly enhanced with the integration of new pen and touch tablet technologies (Ipad, Wacom tablet, Microsoft Surface Pro) with PowerPoint slides that allow for more complex content creation (Hammond, Valentine & Alder, 2016; Johnson, 2008). Blokzijl and Naeff (2004) indicate that students prefer slide unity and a consistent layout. Collins (2004) indicates that a horizontal (landscape) layout is preferable to a vertical (portrait) layout.

Diagrams, graphs, tables, images, and, animations that introduce advanced concepts, or demonstrate a logical succession of related concepts unfamiliar to the learner, which are difficult to explain by words alone, are desired (Farkas, 2005). Mayor and Moreno (2003) indicate that students comprehend more information when it is expressed through well-designed graphics and words, linked together with media, than they do by words alone. Note, however, that it is exceedingly difficult to listen and read at the same time.

Graphs have been found to be more preferable to reading long passages of text on the screen. When used appropriately, simple 2D graphs have been found to enhance communication and from a design perspective are desired over more complex 3D graphs that may be felt by many to be more attractive, resulting in advisement to avoid the 3D default in PowerPoint (Doumont, 2005; Mackiewicz, 2007).

Attention Span

In 1977, Mills identified that a typical learners' full attention starts to wane after the first 5-7 minutes of a presentation and then decreases more rapidly after about the first 10 minutes.
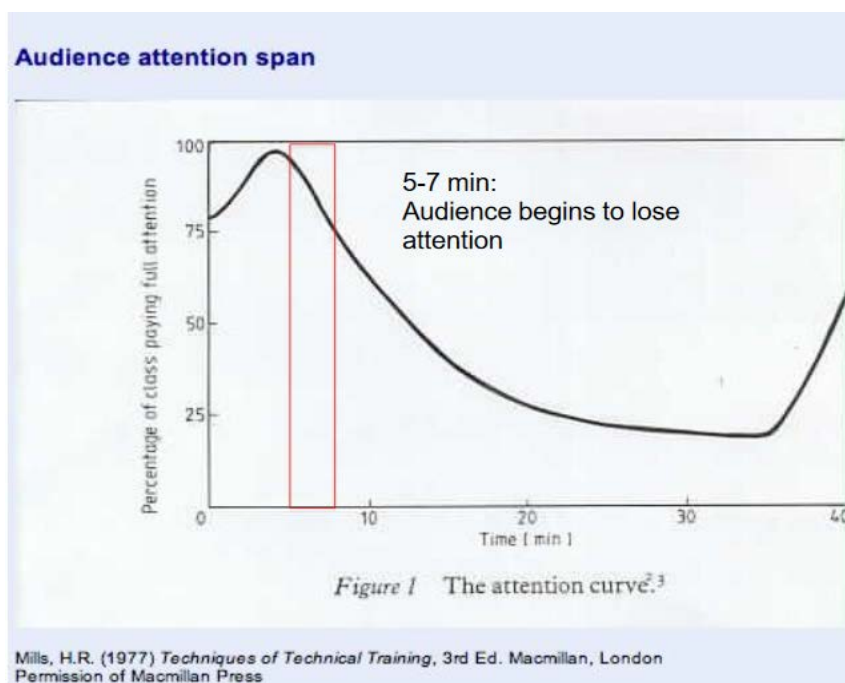

Audience attention span

5-7 min:
Audience begins to lose attention

Figure 1 The attention curve.[2,3]

Mills, H.R. (1977) *Techniques of Technical Training*, 3rd Ed. Macmillan, London
Permission of Macmillan Press

Figure 1. Audience attention span 1977.

Source: Mills, H. R. (1977). Techniques of Technical Training, 3rd ed. Macmillon, London: Macmillion Press.

Here, characteristics and technology skills of "digital natives" must also be taken into consideration. As the "Net-Gens" (1996/2000-present day) and Millennials (born after 1984-1995) have grown up immersed in a digital world, it should come as no great surprise that they are often more tech savvy, more easily distracted, often multitask, and that their tolerance for boring, static content is less pronounced than in older generations (Kirshner & Bruyckere, 2017). Many contend that these generations think, communicate, and process information in a fundamentally different way and have shorter attention spans than their predecessors, thus creating significant educational challenges for educators (Presky, 2001). Many such issues are currently contested in the literature (Bennett, Maton, & Kervin, 2008; Kirshner & Bruyckere).

PowerPoints should be designed with such considerations in mind. If considerable information needs to be conveyed, creating more than one, or several shorter PowerPoints should be considered. Teaching methods and strategies should be adapted to support the idiosyncratic needs of student from all generations to successful attain 21st century skills (Alphonso; 2013; Bennett, Maton, & Kervin, 2008). The promotion of more interactive, engaging and relevant content, however, is a recommendation for all.

Color

The use of proper color(s) is an important design element of PowerPoint, as different colors can evoke different human psychological and physiological responses, affecting perceptions of the attractiveness of the slides (Mackiewicz, 2006). People's perceptions and preferences for different colors are often discussed in terms of temperature, particularly warm and cool. Cool colors - blue, green, and purple and are perceived to be peaceful and calming. In contrast, warm colors - red, orange, and yellow and are perceived to be arousing or anxiety provoking. As a general rule, cool colors are used to display regular text and warm colors are used to emphasize and draw attention to main points, as cool colors generally recede and warm colors project forward (Mackiewicz, 2006). Significant color contrast is necessary between the background color and the foreground text to enhance readability (Alley & Robertshaw, 2004). Contrasting colors (or color complements) are located opposite to each other on the color wheel. The Art Studio Chaulkboard Website, Color Wheel and Color Compliments and the VISME Website, Color Theory for Presentations should provide you with an understanding of these color concepts.

Blokzijl & Naeff (2004) indicate that students prefer a solid and quiet background, avoidance of busy colors, and use of legitimate color combinations. Doumont (2005) emphasizes that colors should be used sparingly. In a color comparison study by Mackiewicz (2006), the colored slides that were rated the highest were those that presented cool colors on white backgrounds and cool colors on black backgrounds. These were found to be the most attractive, and interestingly contained the most contrast between background and foreground colors. Darker backgrounds are preferred in dark lighting situations, but they appear "washed out" in better lighting conditions (Mackiewicz). It is advisable to avoid red and green color combinations, if possible, as these are the two most affected colors in people with color blindness (Alley & Robertshaw, 2004).

Typography of Presentation Slides
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One significant decision to be made when beginning PowerPoint slides is which font to use. The two most commonly used fonts currently found on the Web are the serif Times New Roman (NTR) and the sans serif Arial (Bernard, 2000). The literature indicates that particular fonts have the ability to affect such factors as: reading comfort, reading time, accuracy, perceived legibility, and can determine personality, mood, or atmosphere

(Bernard & Mills, 2001; Mackiewiez, 2006). Research by Bernard (2000) indicates an advantage of Arial over New Times Roman (NTR) while reading on the Web.

In a comparison study of the ten most popular and commonly used Web fonts, Bernard & Mills (2001) identified general font preferences on the Web to be: Arial, Verdana, Georgia, Tahoma, Courier, and Comic Sans (specifically designed for children). Although low on the overall preferences, NTR was identified in this study as ranking high with regard to legibility and professionalism.

Table 1. Serif Versus San Serif Fonts

Serif Versus San Serif Fonts			
Serif Fonts		**Sans Serif**	
New Times Roman **H**	Fonts with projecting ornamental strokes (little feet) at the tip and base of each letter	Arial H	Plain fonts with no ornamental strokes (no feet) at the tip and base of each letter

Traditional guidelines inform us that serif typeface fonts have been used for printed documents, as they have been considered to be more readable across text; encouraging readers to read along an invisible textual baseline. However, this finding has not been supported by research (Mackiewicz, 2007). In contrast, San Serif typefaces have been traditionally suggested as the preference for computer screen readability. Research does support that readers prefer sans serif typeface for online reading, due to clarity and that uncommon and obscure fonts be avoided (Alley & Robertshaw, 2004; Mackiewicz).

Font variations within a presentation should be minimized. Doumont (2005) informs us that the use of a single font, at a few different sizes throughout a presentation, is favorable. Vetter et al., (1995) indicate a preference for a maximum use of two font types. The smallest font size that should be used when developing a presentation for multimedia related online learning is *24 Points* (Gregory, 2008; Multimedia Department CITL, 2020). With regard to letter case, capital letters are identified as the most difficult to read, as they are rectangular in shape. Shape recognition is easier with lowercase lettering, as the top half of the letter is more visible against the opposing background. Therefore, it is recommended that one use predominantly lower case letters (Collins, 2004). Alley & Robertshaw (2004) inform us that some graphic designers recommend bolding typestyles to make them more readable. However, other options such as use of italics, underline, and outline are not recommended, as they slow reading time.

The Traditional PowerPoint Slide

The traditional PowerPoint slide default encourages a centered single word or shortly phrased heading, which is generally supported by a bulleted list; it can also be accompanied by charts, graphs, images. As bullets are often the focal point, Farkas

(2005) suggests using the five following criteria for writing more effective bullet points. Bullet should be 1) structural; 2) meaningful on their own right; 3) brief; 4) noncontraversial; and 5) keyworded - bullet points should contain at least one, and preferably several keywords. A common recommendation for the maximum amount of text per traditional slide, uses the general "rule of sixes," a maximum of six lines per slide and six words per line (Collins, 2004).

Audience confusion and intimidation quickly occurs when too much information is presented on a slide, bulleted lists are too long, font type is illegible, or the order of information is unclear or illogical (Alley & Robertshaw, 2004). Farkas (2005) identifies that a common cause of excess slide text, irrespective of lack of knowledge in slide design, includes designing for "stand alone mode." An important consideration when designing for online presentations is to optimally use the PowerPoint notes section for the details, called gloss, and to take advantage of a voiceover feature, which allows for audio to explicate the bulleted slides. The literature clearly indicates that audiences *do not* want slides read to them (Gregory, 2008). Presentation software in education should be used for the benefit of the audience and not for the simplification of the oral portion of a presentation (Alley & Neeley, 2005; Farkas, 2005). The purpose of the bulleted text is to emphasize a main point or key words that will be expanded upon during the presentation itself (Collins, 2004).

Curiously, in a study competed by Burke & Apperley (2003/2004) when students were asked what information they believed would be best represented on slides, they included charts, images, quotes, and references. Bullets and textual information were not included in their choices. When surveyed, students identified a preference for between 5-30 slides, with an average of 20 slides per presentation (Burke & Apperley).

Rethinking Traditional Design

Publications originating from Virginia Tech, by Michael Alley and associates have focused on the rethinking of the design of traditional presentation slides, especially for the presentation of technical information, in light of the criticisms of default driven traditional PowerPoint slides. With regards to traditional formatting, they acknowledge that "a communications strategy can be both ubiquitous and standardized but not be effective" (Alley & Neeley, 2005, p.418).

Their presentation slides have been redesigned with the intentions of 1) better emphasizing key points; 2) displaying images that are too complex to explain in words; and 3) quickly orienting, revealing organization, and fostering comprehension of information. Main recommendations for change:

1) Each slide except for the title slide should use a left justified sentence headline, to a maximum of two lines. The headings should begin in the upper left slide, as that it is the initial area that leaners track, when examining a slide/screen. Usability studies by Cooke, 2005; Slykhuis, Wiebe, & Annetta (2005) on Z eye-tracking movements during PowerPoint presentations and on Websites support left justification.

2) The headline should *explicitly* state the slide's purpose.
3) The title slide should be largely supported by images, with minimal text to ensure that information on the slide can be quickly discerned.
4) Restrict lists to two, three, or four items.

The main changes incorporated have been shown to reduce split-attention issues, be more memorable, persuasive, and to significantly increase audience retention (Alley & Neeley, 2005; Alley, & Robertshaw, 2004; Wolfe, Alley, & Sheridan, 2006). In a study by Alley, Schreiber, Diesel, Ramsdell, &Borrego (2007), students preferred these new slides 12:1 over traditional ones. Alley & Neeley (2005) provide the following example slides to portray their recommended changes. However, the challenge has been in convincing people to implement such slides, as they require more understanding of content, work, and thought in their development.

Pedagogy

The complexity of teaching and learning in higher education has been heightened with increased technology use. This has been driven by an increasingly competitive global market to produce higher educational quality (Wanner, 2015). However, instructors and faculty vary significantly in their knowledge of learning theories and ability to use technologies. As such, the efficacy of an instructional tool can have less to do with its innate functionality and more to do with how it is used (Baker et al., 2018; James, Burke, & Hutchins, 2006). The evidence from surveyed university students using PowerPoint suggests that when it is used as a presentation tool in university lectures, it is only pedagogically effective when it provides variety and stimulates active engagement in the learning environment (Clarke, 2008). Clarke indicates that its benefits of use can be increased if PowerPoint is used to bridge direct and constructivist teaching models.

For the teacher who is in the instructivist camp, representative of teacher-centered instruction, the questions is, "How can I best use technology to efficiently *transmit* predetermined information to my learners"? In contrast, when a teacher views knowledge from a constructivist perspective, representative of a more learner-centered instruction, the question then becomes, "How can the use of this technology be effectively integrated into the lesson plan to help facilitate the active construction of meaningful knowledge"? The constructivist learning model aims to encourage students to not just remember information, but to engage with it, work it, take ownership of it, and understand it by relating it to previous knowledge and actively building on new knowledge through the exploration of alternate possibilities (Clarke, 2008; Tucker & Batchelder, 2000). Better learning outcomes can be achieved by stimulating interest in a topic and promoting high-order thinking by encouraging active and engaged learning participants (Wanner, 2015). As such, a conceptual paradigm shift must occur.

How can presentation software impact pedagogy in a more positive way? Adams (2006), Clarke (2008), Denbeste (2009), and Wanner (2015) provide possibilities for more innovative strategies, which include using an online PowerPoint presentation:

- as a basis for introducing a topic for further investigation;
- to present a visual representation of one or more perspectives on a topic, encouraging students to discover other perspectives or to defend one or more perspectives, such as in an online debate;
- to display appealing and provocative images/animation(s) aimed at invoking interest and further discussion;
- to encourage analysis of database and graphical information;
- to support an interactive activity throughout the viewing of the presentation, to help maintain attention;
- to set up a realistic scenario or problem-based activity as a basis for a collaborative group project that enhances online community building;
- to try to increase student interactivity by asking reflective and stimulating questions on the slides, during the presentation;
- to incorporate more diagrams, graphs, images, etc., to motivate students to respond to presented materials imaginatively, analytically, and aesthetically so they can think more critically, question, and explore;
- to project written text to allow for extended analysis; and
- to encourage active student engagement using just-in-time teaching.

So, instead of using PowerPoint for the presentation of information alone, it can be used as a catalyst to trigger active engagement and exploration. Of particular note, PowerPoint can be hyperlinked to the Internet and become a gateway for a wealth of resources. However, due to the facts that hyperlinks are often removed by synchronous presentation software tools, hyperlinks are automatically broken when being in-putted into multimedia software programs when being voiced over and that links often change, we strongly encourage you to establish your links elsewhere in your online course, not in your presentation. Also, the option of using synchronous conferencing within your online course encourages a constructivist approach for students to present their own ideas and demonstrate their creativity and expertise, using PowerPoint.

Conclusion

PowerPoint is often seen as being *simple*. However, it is in fact very complex, as it encompasses theories of learning, communication, and instructional design. Ultimately, PowerPoint is a strategic *cognitive tool* that is to be wielded by its user (Alley & Neeley, 2005; Jonassen, 1995). The more knowledgeable and informed its user, the more effective it will be. With informed decision making on the knowledge of both the dangers of PowerPoint and its best practices, we may "raise the bar" for PowerPoint's future use. Presenting summarized information is PowerPoint's most limiting feature, yet to date it is the one that is most commonly used. We need to break away from the constraining predefined default parameters of PowerPoint and learn to use it more effectively to engage the learner and help students learn (Baker et al., 2018).

It should be realized that no tool, no matter how exemplary, will miraculously turn a poor presenter into an exceptional one or make poorly designed pedagogical content engaging (Lanius, 2004). A tool is only as effective as the Technolgical Pedagogical and Content

knowledge (TPACK) of the instructor behind its use (Mishra & Koehler, 2006). Upon reflection, we must recognize that the persistent use of any one particular medium alone is disadvantageous for the learner. We need to use a variety of alternate theories, strategies, and technologies, not just *one tool*, to help students attain their highest potential.

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