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Teaching & Learning Visual Aids: PowerPoint and Visibility

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Abstract

Background: Visual aids play an imperative role in lecture delivery today. Visual aids enhance audience engagement and learning experience. The purpose of this study is to provide a better understanding of the illumination setting for Microsoft Office PowerPoint 2011 and its impact on learner's visibility at six-meter viewing distance during a lecture. Methods: The background illumination for Microsoft Office PowerPoint 2011 pre-set at one-quarter (25%), half (50%), three-quarters (75%), and full (100%) transparency levels in the visibility investigation. Visibility was inferred from the reading speed measurement to complete a text projected at six meters. Results: Visibility was affected significantly by different background illumination settings ($p<0.05$). The best visibility was found in a three-quarters transparency setting. Conclusions: Academicians should be more cautious about their PowerPoint text-background contrast in lecture preparation and delivery to enhance the learning environment.

Introduction

Essential components to effectively deliver a good presentation in teaching and learning are not only limited to appropriate content supported by facts, suitable designs, well-rehearsed lectures delivered with confidence, and minimum mistakes; visibility of the slides is also crucial. There are many types of digital screens used in teaching and learning, such as cathode ray tubes, liquid-crystal-displays, light-emitting diodes, high-definition televisions, and digital projectors. High text-background contrast is essential to enhance visual resolution (Buchner et al., 2009). Ambient lighting conditions have been reported to affect the text-background contrast (Boyce & Wilkins, 2018). When the luminance difference between text and background increases, the visibility becomes better (Legge et al., 1990). However, visual discomfort may occur in high contrast due to the glare factor (Jaiswal et al., 2019). The purpose of this study is to provide a better understanding of the illumination setting for Microsoft Office PowerPoint 2011 and its impact on learner's visibility at six-meter viewing distance during a lecture.

Method

Four texts were constructed by extracting sentences from local Standard Five school textbooks in Malay language. Each text contained the same word count of sixty-three words, employing four to twelve related words per sentence. The font, color, indent, spacing, and size of the four texts were kept consistent. The text color was black. Text alignment was justified. The font size was set at thirteen points. The text content was then transferred into PowerPoint slides. Each slide was constructed with a black circle on a different background (Table 1). Started with the right click on the background, then chose “format background” and adjusted the transparency levels at a quarter (25%), half (50%), three-quarters (75%), and full (100%) respectively. Transparency levels of each background proportionally correlated to text-background contrast levels. One-quarter yielded the lowest text-background luminance contrast; full transparency (100%) yielded the highest text-background luminance contrast. A digital projector was used to project the four slides at six meters from the learners. Calibration of the projector was carried out using an online calibrator (DisplayCal) that provided a rough estimation of the gamma value using a visual matching method.

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The sample size was calculated using the formula [n= (Z/Δ)²*P(1-P)]. Twenty-two learners were recruited using convenient sampling. Informed consent was obtained before participation. The study was approved by the Research Ethics Committee, Institutional Review Board. The visibility of each text-background luminance contrast was assessed by measuring the reading speed in words per minute (wpm). Four different texts were assigned randomly to minimise learning effect and memorisation.

Table 1
Summary of information in reading materials preparation

Transparency levels	Microsoft Office PowerPoint 2011 setting	Illustrations of reading materials
One-Quarter 25% transparency level		
Half 50% transparency level		
Three-Quarter 75% transparency level		
Full 100% transparency level		

Results

The visibility of PowerPoint as visual aids was inferred from measuring the speed of the learners reading from the text projected on the screen at 6-meter viewing distance. Visibility was affected by the level of transparency setting in Microsoft Office PowerPoint 2011 that was transpired through variation in reading performance at the viewing distance of six meters ($F=2.83$, $p<0.05$). The best visibility was at three-quarter transparency level.

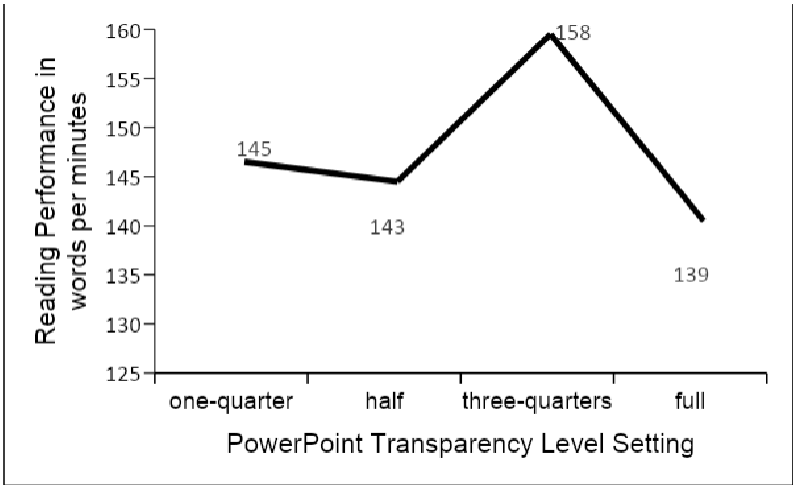

Fig. 1 Reading performance in four different PowerPoint transparency level settings. The number indicates the mean reading speed in words per minute.

Discussion

Reading is a complex task involving various visual and non-visual factors (Akutsu et al., 1991; Laubrock et al., 2006; Lott et al., 2001; Owsley, 2011). Factors that affect reading performance include font size, font type, field size, contrast, eye movement, temporal summation and transient mechanism, central-field loss and cloudiness of the ocular media, visual span, reading distance, and age. Contrast plays a central role in the illumination and visibility effects on reading performance (Legge et al., 1987). At the

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maximum contrast, subjects have the fastest reading rates and it declines as the contrast reduces (Legge et al., 1987). The high sensitivity for neural integrity of the temporal contrast sensitivity among maculopathy patients is evident by a stronger association between temporal contrast sensitivity and reading speed (Brussee et al., 2018). Faster readers are less susceptible to environmental factors in comparison to slow readers (Rubin, 2013). The reading rate in normal vision is hardly affected by any large change in photopic luminance (Legge & Rubin, 1986). Transparency setting affects visibility through its link to contrast and illumination.

The elements of the reading process involve the physical, physiological, and psychological of the readers, the reading materials, surroundings, and environment. Reading performance can be evaluated in many ways such as acuity, speed, accuracy, comprehension, endurance, and eye movement during reading (National Research Council, 2002). Reading accuracy is determined by the number of errors (Kiely et al., 2001). Reading comprehension is the interaction of text-based and knowledge-based processes (Shihab, 2011) and can be assessed by asking questions about the content of the text (Burton et al., 2014). Endurance is assessed using longer passages and the test usually takes a longer time (Rubin, 2013). Eye movement assessment for reading can analyse the fixation duration, saccade, regression, and return sweep (Rayner, 1998). Despite having many parameters of reading, our study focuses on the speed of reading as it practically defines the functional vision. Our finding is in agreement with the previous study that reported a reduction of reading speed under low luminance, less number of saccades velocity, and more eye blinks compared to high luminance (Benedetto et al., 2014). Although the reading speed reduces at lower transparency levels in our study, the best reading performance does not occur at the highest transparency level. The reduction of reading speed at the highest transparency level might be due to the glare effect (Yoshimoto et al., 2020). The glare from the background might interfere with the clarity of the text (Wilkins, 2016). The effect of the luminous veil might reduce the contrast perceived in the retinal image (Flynn & Badano, 1999). The average reading speed at distance in this study is slightly less than the reading speed at near (164wpm) reported in the Malaysian population for contextual sentences (Chen et al., 2019).

Conclusion

Best visibility has been revealed in the three-quarter transparency setting of PowerPoint. Appropriate contrast between background and text is vital for visibility and ease of reading during PowerPoint presentations. Contrast differences should not be excessive between text and background that might elicit visual discomfort. Academicians are recommended not to set their PowerPoint text-background transparency levels to the maximum during lecture delivery to minimise the glare effect that can affect visibility and ability to read the projected slides efficiently. Adequate text-background illuminance difference with minimum glare should be incorporated in lecture slides for better ergonomic presentation.

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