

**Student Characteristics and CBT Performance:
An Overview of the Literature
by MARCES**

One big change in the field of education and assessment under the influence of modern technology is the transition from paper-based to computer-based assessment. Computer-based testing (CBT) is gaining popularity over the traditional paper-and-pencil test (PPT) due to many advantages that computer-based assessment provides. Meanwhile, more and more educators and researchers have shown interest in investigating the factors that influence students' CBT performance. Factors related to student characteristics, such as student demographic attributes, learning style, computer familiarity and test anxiety, were examined in terms of their relationship with CBT compared with PPT.

Demographic attributes

The results of the effect of demographic attributes on students' CBT performance are not always consistent. For example, some studies indicate that gender was not related to performance differences between CBT and PPT (e.g., Clariana & Wallance, 2002; Alexander, Bartlett, Truell, & Ouwenga, 2001), while other studies suggest that gender is associated with the test mode (Leeson, 2006; Gallagher, Bridgeman, & Cahalan, 2000), with male examinees benefiting from the CBT format more than female examinees who showed slightly poorer performance on CBTs. Though age was found to be associated with the test mode effect (Parshall, & Kromrey, 1993), the study by Alexander, et al. (2001) suggests no difference in the administration mode for age and class level. Consistent results were found in examinees' race associated with the test mode (Gallagher, et al., 2000; Parshall, & Kromrey, 1993). It was found that although the differences were quite small, some patterns were consistently found for some racial/ethnic groups, with African American examinees and Hispanic examinees benefiting from the CBT format (Gallagher, et al., 2000). To explore whether family income was related to test mode effect, Pomplun and Custer (2005) examined the differences between format score means at grade level from K-3 for students eligible for free/reduced lunch and students not eligible for free/reduced lunch. Results showed that at every grade, the free/reduced lunch eligible students had larger score differences in favor of the PPT than for students not eligible for free/reduced lunch. In addition, these differences generally decreased as grade level increased, suggesting that family income, and possibly computer familiarity may be related to PPT/CBT score differences and that the longer students are in school and exposed to computers, the smaller the score differences become.

Learning styles

Researchers also examined the relationship between student learning styles and online learning and testing. It should be mentioned that scholars define learning styles differently, and there is currently no widely accepted definition of what a learning style is. In a study by Johnson (2007) about learning style under two web-based study conditions, four learning styles (active-reflective, visual-verbal, sequential-global, and sensing-intuitive) were considered and it was found that students who were more active than reflective expressed a preference for face-to-face study groups rather than online study groups and for online quizzes. Ames's study (2003) used Gregorc's definition of four distinct learning styles (Abstract Sequential (AS), Abstract Random (AR), Concrete Sequential (CS), and Concrete Random (CR)). The findings indicate that computer-based or computer-assisted instruction may not be optimal for all students. In their study to investigate the effects of formative assessment and learning style on student achievement in a Web-based learning environment, Wang, Wang, Wang, & Huang (2006) used another four learning modes (concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE)). Results showed that both learning style and formative assessment strategy are significant factors affecting student achievement in a Web-based learning environment.

Computer familiarity

Computer familiarity was examined as another important factor that may have an impact on students CBT performance, but the results were not consistent. Some studies suggest that computer familiarity was not related to performance difference between CBT and PPT groups (Clariana & Wallance, 2002; Bennett, Braswell, Oranje, Sandene, Kaplan, & Yan, 2008). Little or no performance difference was shown associated with students' computer familiarity, suggesting that computer experience does not affect students' CBT scores (Leeson, 2006; Edit, 2005; Taylor, Kirsch, Eignor, & Jamieson, 1999). On the other hand, other studies reported the opposite findings. For example, Goldberg and Pedulla (2002) found that students' computer familiarity was significantly associated with test performance in CBTs. Students with lower computer familiarity scored lower on CBTs than students with moderate and higher computer familiarity.

Anxiety

A few studies have examined the relationship between CBTs and student test anxiety. Results from these studies seem consistent, providing no support that CBTs will induce additional anxiety or impact performance levels (Cassady & Cridley, 2005; Stowell & Bennett, 2010). Shermis and Lombard (1998) also found for a written English exam, computer anxiety was not statistically significant for performance on the written English essay.

Other interesting findings

Other interesting findings include the effect of higher-attaining students, students with learning disabilities, and the time factor that impact students' CBT performance. For example, Clariana and Wallance (2002) found higher-attaining students benefited most from CBTs relative to higher-attaining students under PPTs. Similarly, Leeson (2006) found that high-ability students' performance appeared to be advantaged by CBT. In a study by Schmidtd, Ralph, and Buskirk (2009), it was indicated that the online exams provided an opportunity for students to complete the exam at a time that was best for them. In terms of the relationship between test mode and students with learning disabilities, Dolan, Hall, Banerjee, Chun, and Strangman (2005) found a significant increase in scores on the CBTs versus PPTs administration for high school students with learning disabilities. Further, in a study by Calhoun, Fuchs, and Hamlett (2000) to compare the effects of CBT accommodations to a noncomputer-based test accommodation and to no accommodation on mathematics performance assessment (PA) scores for secondary students with learning disabilities, over four weeks, each student was tested on four parallel PAs, each time under a different condition: (a) standard administration (SA), (b) teacher-read (TR), (c) computer-read (CR), and (d) CR with video (CRV). Results indicated that providing a reader, either human or computer, increases scores, but no significant difference was seen among TR, CR, and CRV.

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