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Chapter I

Multimedia Impact on Human Cognition

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ABSTRACT

Organizations are faced with increasing costs needed to train employees in today's high technology environment. Educators are also striving to develop new training and teaching methods that will yield optimal learning transfer and complex skill acquisition. This study suggests that trainee/learner cognitive processing capacity, information presentation format and complexity, and multimedia technology should be leveraged in order to minimize training duration and costs and maximize knowledge transfer. It presents a causal model of how multimedia and information complexity interact to influence sustained attention, mental effort, and information processing quality, all of which subsequently impact comprehension and learner confidence and satisfaction outcomes. Subjects read a text script, viewed an acetate overhead slide presentation containing text-with-graphics, or viewed a multimedia presentation depicting the greenhouse effect (low complexity) or photocopier operation (high complexity). Causal

path analysis results indicated that presentation media (or format) had a direct impact on sustained attention, mental effort, information processing quality, comprehension, and learner confidence and satisfaction. Information complexity had direct effects on sustained attention, mental effort, and information processing quality. Finally, comprehension and learner confidence and satisfaction were both influenced through an intervening sequence of sustained attention, mental effort, and information processing quality.

INTRODUCTION

During information presentation, the target audience must construct a mental representation of situations or scenarios conveyed by the verbal content and images contained in the presentation. Cognitive psychologists refer to these representations as situation models (Friedman & Miyake, 2000; Kaup & Zwaan, 2003). During situation model construction, increases in the number of alternative order of events, number of interconnections among objects and events, and factors that give rise to specific events will lead to a decline in the accuracy and capacity in cognitive processing utilized to construct a situation model (Zwaan & Madden, 2004; Zwaan, Magliano & Graesser, 1995).

During multimedia presentation, subjects are presented with information in verbal and pictorial form, and both the verbal and visual processing channels of memory are used to translate the information into the appropriate situation model (Hegarty, Narayanan, & Freitas, 2002; Mayer & Moreno, 2002). In instructional settings, animation and other types of graphics that depict the behavior of various phenomena such as meteorology, physics, or chemistry have been used to reduce information complexity, augment cognitive processing, and facilitate comprehension (Moreno & Mayer, 2002; Moreno & Mayer, 2004; Rieber, 1991). Multimedia can also reduce the perceived equivocality of a low-analyzable decision-making task (Lim & Benbasat, 2000) and promote computer self-efficacy that leads to increased performance in computer-based training situations (Christoph, Schoenfeld & Tansky, 1998).

The goal of this study is to investigate the impact of multimedia information representation on cognitive processing activities (e.g., information encoding, situation model construction, and comprehension) typical to problem solving, training, and decision-making contexts. A capacity theory of comprehension (Just & Carpenter, 1992), dual processing theory of working memory (Mayer & Moreno, 2002, 2004; Paivio, 1986), theory of attentional inertia (Burns & Anderson, 1993; Lavie et al., 2004), and the PASS (Planning, Attention, Simultaneous, and Successive) cognitive processing theory (Naglieri & Das, 1997; Naglieri & Rojhan, 2004) are used to provide a framework for this investigation.