

Chapter 2

Managing Cognitive Load in the Design of Assistive Technology for Those with Learning Disabilities

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ABSTRACT

This is the second of three chapters serving as the introduction to this handbook which addresses the relationship between human cognition and assistive technologies and its design for individuals with cognitive disabilities. In this chapter the authors present strategies to manage cognitive load in the design of instructional materials for those with learning disabilities. The authors introduce cognitive load theory, which proposes a set of instructional principles grounded in human information processing research that can be leveraged in the creation of efficient and effective learning environments. They attempt to separate conjecture and speculation from empirically-based study and consolidate more than twenty-five years of research to highlight the best ways in which to increase learning. Altogether, the authors affirm the approach discussed in the last chapter—that technology for learning should be created with an understanding of design principles empirically supported by how the human mind works, particularly when it comes to the design of assistive technologies for individuals with learning disabilities.

DOI: 10.4018/978-1-61520-817-3.ch002

INTRODUCTION

Cognitive Load, Assistive Technology, and Those with Learning Disabilities

In the last chapter, we learned that human information processing is constrained in both capacity and duration. We explained how working memory, a system that temporarily stores and manages information for performing complex cognitive tasks, is a contradiction in terms. Its limitations cause it to be a bottleneck, restricted to seven (plus or minus two) chunks of information at any given time (Miller, 1956); yet, it is also the conduit for learning. This is a problem because the acquisition of new knowledge relies so heavily on the processing and storage capabilities of working memory (Low & Sweller, 2005; Sweller & Chandler, 1994). New information may potentially overload working memory capacity and subsequently encumber learning (Kalyuga, Chandler, & Sweller, 1999; Sweller, van Merriënboer, & Paas, 1998).

While we are all confronted by these information processing roadblocks, individuals with cognitive disabilities are at particular risk. There has been considerable research focused on working memory and children with learning disabilities (LDs). Generally speaking, research on the matter suggests that children with LDs have difficulty with working memory in areas such as reading and mathematics (e.g., Bull, Johnston, & Roy, 1999; de Jong, 1998; Hitch & McLean, 1991; Keeler & Swanson, 2001; McLean & Hitch, 1999; Passolunghi & Siegel, 2004). For example, those with reading disabilities are not poor readers, but have less working memory capacity than more skilled readers (Swanson & Siegel, 2001).

Fortunately, there has been considerable research in the study of cognitive load with regard to working memory. Even though some researchers

have examined *cognitive load* under the premise of the *working memory overload hypothesis* (e.g., Niaz & Logie, 1993), the most predominant work on cognitive load can be attributed to *cognitive load theory* (CLT) (e.g., Chandler & Sweller, 1991; Kalyuga, Chandler, Tuovinen, & Sweller, 2001; Mousavi, Low, & Sweller, 1995; Sweller, 1999; Sweller et al., 1998)—a learning theory focused on the limitations of working memory during instruction.

This is the second of three chapters serving as the introduction to this handbook which addresses the relationship between human cognition and assistive technologies (ATs) and its design for individuals with cognitive disabilities. In this chapter we present strategies to manage cognitive load in the design of instructional materials for those with LDs. We introduce CLT, which proposes a set of instructional principles grounded in human information processing research that can be leveraged in the creation of efficient and effective instructional material. We attempt to separate conjecture and speculation from empirically-based study and consolidate more than twenty-five years of research to highlight the best ways in which to increase learning. This chapter also serves as scaffolding for the next chapter where we present the *cognitive theory of multimedia learning* (CTML), a learning theory which focuses on best practices in the use of visual and auditory information in multimedia-based instruction. Altogether, we affirm the approach discussed in the last chapter—that technology for learning should be created with an understanding of design principles empirically supported by how the human mind works, particularly when it comes to the design of ATs for individuals with LDs. Before we present these instructional principles, we begin this chapter with an in-depth discussion of CLT and its history.

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