Understanding Cognitive Processes in Educational Hypermedia

Patricia M. Boechler
University of Alberta, Canada

INTRODUCTION

Cognitive load theory (CLT) is currently the most prominent cognitive theory pertaining to instructional design and is referred to in numerous empirical articles in the educational literature (for example, Brünken, Plass, & Leutner, 2003; Chandler & Sweller, 1991; Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Sweller, van Merriënboer, & Paas, 1998). CLT was developed to assist educators in designing optimal presentations of information to encourage learning. CLT has also been extended and applied to the design of educational hypermedia and multimedia (Mayer & Moreno, 2003). The theory is built around the idea that the human cognitive architecture has inherent limitations related to capacity, in particular, the limitations of human working memory. As Sweller et al. (pp. 252-253) state:

The implications of working memory limitations on instructional design cannot be overstated. All conscious cognitive activity learners engage in occurs in a structure whose limitations seem to preclude all but the most basic processes. Anything beyond the simplest cognitive activities appear to overwhelm working memory. Prima facie, any instructional design that flouts or merely ignores working memory limitations inevitably is deficient. It is this factor that provides a central claim to cognitive load theory.

In order to understand the full implications of cognitive load theory, an overview of the human memory system is necessary.

BACKGROUND

The Human Memory System: The Modal Model of Memory

It has long been accepted that the human memory system is made up of two storage units: long-term memory and working memory. There is an abundance of behavioral (for example, Deese & Kaufman, 1957; Postman & Phillips, 1965) and neurological evidence (Milner, Corkin, & Tueber, 1968; Warrington & Shallice, 1969) to support this theory. Long-term memory is a repository for information and knowledge that we have been exposed to repetitively or that has sufficient meaning to us. Long-term memory is a memory store that has an indefinable duration but is not conscious; that is, any information in long-term memory must first be retrieved into working memory for us to be aware of it. Hence, any conscious manipulation of information or intentional thinking can only occur when this information is available to working memory. The depth and duration of processing in working memory determines whether information is passed on to long-term memory. Once knowledge is stored in long-term memory, we can say that enduring learning has occurred.

Working Memory Limitations

Unfortunately, working memory has some very definite limitations. First, there is a limit of volume. Baddeley, Thomson, and Buchanan (1975) reported that the size of working memory is equal to the amount of information that can be verbally re-
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