Chapter 19
A Cognitive Load Perspective to Instructional Design for Online Learning

Onur Dönmez
https://orcid.org/0000-0001-5200-1468
Ege University, Turkey

ABSTRACT

Learners struggle to keep up with the cognitive demands of online learning. Terms referring to the drain of learners' cognitive resources such as "Zoom fatigue" have been around for a while. The instructional design of online courses must consider cognitive factors more than ever. The cognitive load theory (CLT) has major underpinnings for designing online courses. The CLT seeks to optimize the learning process by considering the demands of the learning tasks (intrinsic cognitive load), design of the learning material (extrinsic cognitive load), and activation of learners' cognitive resources (germane cognitive load). Several principles have been proposed to manage each cognitive load type. This chapter will begin by outlining the CLT. Then, well-defined cognitive load effects will be introduced, along with evidence from the field. Next, new frontiers of the theory will be presented. Finally, implications of the cognitive load effects for online learning practices will be discussed.

INTRODUCTION

Online learning refers to instruction intended to facilitate learning, generally delivered over the Internet through a wide range of digital devices such as computers and any kind of mobile device (Clark & Mayer, 2016). This broad definition covers an extensive array of technologies and instructional systems, including but not limited to multimedia, hypermedia, synchronous and asynchronous classes, learning objects, intelligent tutors, and augmented/virtual reality (Mayer, 2019). Fueled by the immense research and development efforts and institutional/governmental investments, online learning is transforming into the dominant education exercise (Panigrahi et al., 2018). Higher education institutions sought to incorporate the affordances of online education into their systems to promote learner success and engage-

DOI: 10.4018/978-1-7998-8701-0.ch019

ment (Gillett-Swan, 2017). Moreover, the recent pandemic lockdown forced national education systems to utilize online platforms to ensure education continuity (OECD, 2020). Despite those voluntary and obligatory endeavors, it is naive to expect a swift online learning revolution. A relatively short history of educational technology proved that techno-centric efforts overlooking the science of learning are destined to be ineffective if not useless, where online learning is no exception (Cuban, 1986).

Several factors such as learner isolation, learner distraction (i.e., procrastination or multitasking), lack of learner engagement, and need for critical technological competencies trouble online learning (Gillett-Swan, 2017; Michinov et al., 2011; Peper et al., 2021; Solis, 2019). Furthermore, the recent boom of digital media use due to the COVID pandemic has brought new issues such as "Zoom Fatigue" into the research agenda (Bailenson, 2021; Fosslein & Duffy, 2020). The Zoom Fatigue is induced by media-rich activities such as prolonged excessive close-up eye contact, seeing the real-time image of oneself, and lack of mobility. These demands swiftly deplete learners' cognitive resources (Ramachandran, 2021). Furthermore, the verbatim transfer of classroom teaching exercises to online learning exacerbated the problems for online learners (Mayer, 2019; Peper et al., 2021). Eventually, online learning providers must scrutinize their practices and consult the science of learning more than ever. Instructional design must consider learners' cognitive processes for any chances of successful online learning. The Cognitive Load Theory (CLT) by Sweller (1994) has significant underpinnings for designing high-quality online courses.

BACKGROUND

Introduced in the late 1980s, the CLT is one of the leading theories in instructional design (Sweller, 1988, 1994). The theory seeks to manage the information processing load per se, the Cognitive Load (CL) generated by learning tasks (Sweller, 2010). The CLT focuses on the human cognitive architecture and cognitive mechanisms to deliver design implications (Kalyuga, 2011a). These implications have been studied in various research addressing complex learning environments such as classroom settings, industry settings, and online learning (Kirschner et al., 2011).

The CLT has a few characterizations of human cognitive architecture. The first characteristic is the permanent and hypothetically unlimited information reserve called Long-Term Memory (LTM). The LTM stores information in organized information networks called schema. The cognitive system can effortlessly use automated schemata in complex learning and problem-solving tasks. Hence, the LTM and the schemata reserve is the key to learning and domain expertise. Schemata vary in their degree of complexity and automation (van Merriënboer & Aryres, 2005). The instructional design aims to facilitate schema construction and automation (Sweller, 2011).

The second characteristic of the human cognitive architecture is the Working Memory (WM), the temporary information processor with limited capacity (Miller, 1956; Sweller, 2010). Novel information must consciously be processed through a random generate and test procedure in the WM before assimilating into a schema. However, the amount of information that WM can handle within a timeframe is severely limited (Cowan, 2010; Shiffrin & Schneider, 1977). Thus, schema creation or manipulation capacity is narrowed down by this limitation. The cognitive architecture overcomes the limited capacity constraint by schema utilization. A highly complex schema including a network of several facts is manipulated as one element within the WM. Besides, automated schemata demand less cognitive resources once brought into the WM (Roxana Moreno & Park, 2010). These schemata can be reorganized by assimilating new information where schema complexity, hence the learner expertise, is escalated (Sweller et al., 2019).