

Cognitive Load Theory and Mathematics Learning: A Systematic Review

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Abstract. Cognitive load theory (CLT) is an instructional design theory which is based on an information processing view of human cognition. Recently, proponents of this theory have claimed that all forms of “minimally-guided instruction” lead to poorer learning compared to direct instruction because they impose irrelevant cognitive load. This article critically examines this claim by reviewing the empirical evidence that it is based on. This review focuses on studies of mathematics learning. This review concludes that there is little evidence to support the strong claim made by cognitive load theory. Theoretical and practical implications of this finding are discussed.

Keywords: cognitive load theory, mathematics, learning, direct instruction

Abstrak. Teori beban kognitif adalah teori perancangan pembelajaran yang didasarkan pada teori pemrosesan informasi tentang kognisi. Belum lama berselang, beberapa ahli teori beban kognitif menyatakan bahwa semua metode pembelajaran yang mengharuskan siswa untuk memecahkan masalah secara mandiri (minimally-guided instruction) akan membawa hasil belajar yang lebih buruk bila dibandingkan metode-metode pengajaran langsung seperti ceramah atau belajar dari contoh soal. Klaim inilah yang diulas secara kritis dalam artikel ini. Untuk mempersempit permasalahan, ulasan ini hanya akan membahas pembelajaran di bidang matematika. Ulasan ini menemukan sedikit bukti yang mendukung klaim yang dikemukakan para ahli teori beban kognitif. Implikasi teoretis dan praktis dari temuan akan dibahas.

Kata kunci: teori beban kognitif, matematika, belajar, instruksi langsung

This article presents a systematic review of studies of mathematics learning and instruction based on cognitive load theory (Sweller, van Merriënboer, & Paas, 1998; van Merriënboer & Sweller, 2003). This review is set against the background of a recent claim from proponents of CLT that forms of minimally-guided instruction (which the authors take to include “constructivist, discovery, problem-based, experiential, and inquiry-based teaching”) lead to poorer learning compared to direct instruction because they impose irrelevant cognitive load (Kirschner, Sweller, & Clark, 2006).

By extension, Kirschner et al. (2006) are claiming that mathematics instruction should solely consist of direct instruction (e.g. worked examples) and be

stripped of any problem solving and inquiry activities. Clearly, this strong claim bears significant practical implications and hence needs to be carefully assessed. I have chosen to do this with respect to mathematics instruction because, firstly, this is an area which has been central to the development of CLT and as such, it serves as a test bed for Kirschner et al.’s claim. Secondly, mathematics learning has been extensively theorised other theoretical perspectives, including constructivism and socio-cultural theories, which can provide fruitful contrasts to CLT’s own conceptualisation. Before presenting results of this review, this article will outline the main tenets and development of CLT.

Basic Tenets of Cognitive Load Theory

According to Sweller’s (2006) account, CLT originated from research on problem solving during the 1970s. Back then Sweller and his group stumbled upon an intriguing observation: their research par-

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