Editorial Comment on the Expertise Reversal Effect

Kayluga has done an excellent job in both describing and considering the implications of “Cognitive Load Theory”. Given its increasing currency in TICL, I would like to add some additional thoughts on future directions. Specifically, I’d like to call attention to a potentially deeper explanation of the so-called “Expertise Reversal Effect”. Namely, discovery environments impose a heavier memory load on novice as opposed to expert learners. To quote Kayluga:

“As learner experience in a domain increases, solving relatively new problems or exploring new tasks become less cognitively demanding due to acquired domain-specific knowledge.”

As Kayluga notes, the origins of cognitive load research go back to George Miller’s seminal Psychological Review paper in 1956. My initial work on processing capacity in the SLT goes back to Scandura (1971), more fully elaborated in Scandura, 1973 (esp. Chapter 10 on memory load in SLT) and Voorhies & Scandura (1977). This work, which I discussed at some length with Miller at the time, takes the issue of cognitive load a step further. Our essential conclusion goes beyond showing as Miller did that Ss short term memory falls in the range of 7 plus or minus 2 – on average over a variety of tasks. In addition to “7 plus or minus 2”, Miller showed that apparent capacity increases as a result of training and experience. Presumably, this is due to increasing “chunk size”. This fact also is cited by Kaluga, and has significant implications for the design of instruction.

What cognitive load research does not take into account is the following: Each individual appears to have a fixed capacity for processing information, a capacity that remains invariant over tasks. When Ss are given detailed highly precise training on the procedures to be used in solving given tasks (ranging from recalling simple lists to simple addition), some may be able to process up to 7 chunks of information at one time, whereas others may only be able to process 5, and a few may go up to 8 or 9.
In effect, while the apparent capacity to process information generally increases with practice over time, our early research shows that each individual appears to have a fixed capacity. Even if shown not to be permanent as proposed in the SLT (cf. Scandura, 1971, 973, 1977, 2001, 2007), the evidence suggests that each individual’s inherent capacity to process information remains essentially constant over indefinitely long periods of time. What this means is that individuals may differ systematically in the amount of information they can process during instruction – some being able to assume a higher cognitive load than others. This leads to the theoretical possibility of adjusting memory requirements during instruction based on each individual student’s processing capacity.

On occasion, I brought this early research to the attention of Jeroen Merrienboer who along with Sweller has played a significant role in developing instructional implications of cognitive load. With the above in mind, I just checked and was somewhat surprised, but pleased to see that someone has added the following quote to Wikipedia’s segment on “Cognitive Load Theory” under the heading “Cognitive Load”.

**Individual differences in processing capacity:** Evidence has been found that individuals systematically differ in their processing capacity (e.g., Scandura, 1971; Voorhies & Scandura, 1977). A series of experiments support the assumption that each individual has a fixed capacity for processing information, irrespective of the task in question, or more accurately, irrespective of the processes an individual uses in solving any given task. Tasks ranged from remembering simple lists, lists supplemented with a fixed constant and simple arithmetic.

Identifying the processing capacity of individuals could be extremely useful in further adapting instruction (or predicting the behavior) of individuals. Accordingly, further research would clearly be desirable. First, it is essential to compute the memory load imposed by detailed analysis of the processes to be used. Second, it is essential to ensure that individual subjects are actually using those processes. The latter requires intensive pre-training.

Based on the above, I believe the main heading “Cognitive Load” might be a better title than “Cognitive Load Theory”. The implications of Cognitive Load during instruction may be derived from more fundamental theory. I point this out in some detail to make a point – namely, deeper understanding of instruction related phenomena may have far reaching practical implications. As noted in my introduction to this issue, presciently written before reading Kayluga, even long established principles in SLT, such as the way knowledge
is represented, have only very recently been shown to have far reaching implications for developing automated tutoring systems.

Perhaps it will take several more decades for the implications of individual processing capacity to be realized in advanced instructional systems. A major issue will be how to adapt instruction for students with different processing capacities. It would seem that automated tutoring systems should be up to the task. Nonetheless, it remains to be determined how much of a difference it will make and under what circumstances.

On the one hand, George Miller (1956) showed early on that chunk size gradually increases with practice. Accordingly, there is every reason to believe that effective processing capacity for any given individual will similarly increase (with practice). Orthogonal to this truism, it is widely believed that students differ in their preference for different kinds of instruction. Some learn better when information is presented verbally, for example, while others prefer spatial representation. Given the old adage “one picture is worth 1000 words”, one might wonder whether, how and/or to what extent such preferences may have their roots in core processing capacity? How much in right-left brain hemispheric differences? Or, some combination of the two? IMHO more attention in designing instructional systems should be given to fundamental issues of this sort.

REFERENCES


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