Measuring cognitive load during procedural skills training with colonoscopy as an exemplar

Reference:
Sewell JL1, Boscardin CK1, Young JQ2, ten Cate O1,3, O'Sullivan P1. Measuring cognitive load during procedural skills training with colonoscopy as an exemplar. Medical Education. 2016 Jun;[ePub ahead of print]

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Tags
Clinical domain
Medical Expert

Educational domain
Teaching and learning
Education research
(Post)graduate
(Residency training)

Background

This review is in partnership with the Wiley journal, Medical Education. The KeyLIME podcast receives an advance copy of several manuscripts accepted by Medical Education and selects one to review. (Editorial note: The KeyLIME hosts have complete editorial license to review and critique the paper. There is no conflict of interest to declare from any of the hosts.)

Thankfully, from my perspective, cognitive psychology and theory is making a comeback in medicine and medical education (although the terms and origins are often hidden). Consider the patient safety movement. Systems engineering recognizes that task interruption and rapid task switching, required when an individual is attempting to manage an excessive number of issues simultaneously, leads to error. Cognitive load theory, proposed by John Sweller in the 1980’s describes this phenomenon. Looking to the 1960’s Atkinson and Shiffrin present a modal model of memory that describes the central executive (+ visuospatial sketch pad and phonological loop) of working memory. Looking back even further to the 1950’s, we see Miller describing the functional capacity of working memory (and the apocryphal story of 7 +/- 2 as an explanation for the length of a phone number).
So, what does this have to do with being a Clinician Educator? Can you teach “too much” while teaching a procedure, and overwhelm your learner? That’s the topic of this paper.

**Purpose**

“We used cognitive load theory to develop a self-report instrument to measure three types of cognitive load (intrinsic, extraneous, and germane load), and to provide evidence for instrument validity.”

**Type of paper**

Research

**Key Points on the Methods**

Using colonoscopy as an exemplar, a SELF-REPORT instrument was designed to measure the 3 elements of cognitive load theory (CLT) activated while learning a procedural skill:

1. Intrinsic load is a function of the complexity of the essential steps to learn a task; it is influenced by previous knowledge and experience.
2. Extraneous load is a function of factors not related to learning a task; it is essentially distraction.
3. Germane load is the cognitive processes activated for learning; it is maximized if the learning task has adequate complexity, time and instruction. (Think of it as the metacognition required for learning.)

The instrument was developed using a rigorous process that included:

- A review of the literature
- Identification of general concepts to inform the items essential to learn the skill
- Pilot testing the instrument
- Expert consensus on the final questions and scales

The final instrument had 19 items + 3 global rating scales rated on a 10-point agreement scale (strongly disagree to strongly agree).

Gastroenterology fellows during the 2014-15 academic year were recruited by email using a Dillman methodology. The instrument was completed ONCE, soon after completing a colonoscopy. Part A was an exploratory study; part B was a confirmatory study to determine the appropriate model.

Validity evidence included content evidence (e.g. how the instrument was constructed), internal structure evidence (e.g. reliability and discrimination of the instrument), and relations to other variables (e.g. association of the instrument score and a theoretically linked other variable, in this case scoring differences between year in fellowship).
Key Outcomes

N = 477 (45%; 166 exploratory, 361 confirmatory), representing 154 (95%) of programs.

The three-factor model demonstrated the best fit (i.e. best explanation for variance) with a modified three factor model (removing 3 items) demonstrating better fit. All items demonstrated factor loading > 0.69 with statistical significance.

Cronbach’s alpha was > 0.87 for all three factor subscales.

Cognitive load decreased on all factors from first to third/fourth year fellows.

Key Conclusions

The authors conclude...“we developed an instrument that separately measures the three types of CL during an exemplar procedural skills training setting in medical education, among a nationally representative sample of learners...Our data illustrate the potential impact of systematic instrument development and consideration of factors affecting validity when studying medical education. Teaching trainees to perform medical procedures is a challenging task, considering issues of patient safety, healthcare quality, and time. We believe that CLT provides tools to address these challenges in research and teaching settings.”

Spare Keys – other take home points for clinician educators

Congrats to the authors on providing a great “meta” on linking theory (CLT and contemporary validity arguments) to front line teaching.