Improving Handoffs Curricula: Instructional Techniques From Cognitive Load Theory

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Handoffs and Cognitive Load Theory (CLT)

Handoffs are a common source of medical errors and patient harm. The task demands can easily exceed the working memory capacity of trainees. The resulting cognitive overload impairs learning and performance.1 Implementation of more effective handoffs curricula is a public health imperative.2 CLT can help the medical education community meet this imperative. With its appreciation for working memory limitations, CLT offers instructional design principles that optimize cognitive load.

Bottleneck for Learning

CLT builds upon established models of human memory such as the Atkinson–Shiffrin model. In the interaction between the subsystems of sensory, working, and long-term memory, working memory can retain and process only a limited number of information elements at a time.3 This creates a “bottleneck” for learning, as shown in the figure. CLT specifies the types of load that affect working memory, and offers instructional techniques to optimize load for learning not only handoffs but any complex clinical procedure.

Mediators of Cognitive Load in a Handoff

CLT identifies three types of cognitive load that affect working memory. Some argue for a two-load model in which germane load is subsumed under intrinsic load. Either way, the strategies associated with germane load are relevant.

### Extraneous Load

- **Not Task-Essential**
  - **Interference from nonessential aspects of a task**
  - Induced by the design of the task (e.g., instructions with detailed narrative that does not visually chunk the information by steps), internal sources (e.g., anxiety), or the physical environment (e.g., pager ringing)

### Intrinsic Load

- **Task-Essential**
  - **Performing essential aspects of a task**
  - Determined by number of information elements (e.g., number of patients assigned tasks), information interactivity (e.g., diagnostic uncertainties or disease/therapy interactions), time, and knowledge of the learner

### Germane Load

- **Learning Essential**
  - **Actions that facilitate learning**
  - Generated by the deliberate use of cognitive strategies that facilitate learning (e.g., activating prior knowledge, compare/contrast, monitoring understanding)

### Instructional Strategies

To facilitate learning, CLT researchers focus on instructional techniques that optimize cognitive load via three strategies.4

#### Strategy 1: Decrease extraneous load

- **Avoid split attention**
  - Place all related and needed information in a single space/time. For example, the EMR should populate all relevant written information into a single document, or the sender should provide information to the receiver when needed (just-in-time). The split-attention effect occurs when two or more sources of information that cannot be understood in isolation (e.g., the explanatory text for a graphical illustration) are separated in space and/or time.

- **Use dual modalities**
  - Distribute information between auditory and visual modalities. Working memory has partially independent processes for each type. For example, present the laboratory data and trends in a graphical format while presenting the overall assessment verbally.

- **Write complex information**
  - Put complex information in written rather than auditory form. Auditory information is transient. Written information is permanent and can be repeatedly reconsidered.

- **Reduce redundancy**
  - Minimize redundant information: avoid repeating the same clinical information several times (e.g., during the patient summary and the problem/action list).

#### Strategy 2: Match intrinsic load to developmental stage of the learner

- **Isolate Elements**
  - Use part-task practice such as having an early learner practice either the written or verbal sign-out, but not both, before doing the whole task.

- **Use worked example**
  - Assign the learner to observe an attending physician perform a handoff. The attending should stop to explain each step, or students can be repeatedly reconsidered.

- **Transition from low to high fidelity**
  - Transition, as the learner progresses, from role-playing the handoff of paper-based cases in a classroom setting to simulating handoffs in a laboratory with standardized patients to performing handoffs in actual clinical practice with direct supervision.

- **Titrate guidance**
  - Provide guidance initially and then withdraw as learner expertise increases. The observing senior clinician should step in less.

#### Strategy 3: Ensure that unused working memory capacity is dedicated to germane load

- **Increase task variability**
  - Increase the variability of the task/problem to enhance learning. Change blocked practice from AAA (same presentation of given illness) to AAA-BBB-CCC-DDD (different presentations of the same illness—typical vs. atypical, emergent vs. urgent, and/or with or without comorbidity).

- **Introduce contextual interference**
  - As learners progress, practice different versions of a task (A, B, C) in a random (ACBABCAB) rather than blocked order (AAA-BBB-CCC) so knowledge becomes generalizable. For example, simulation for early learners should practice the same system-specific protocol and/or clinical scenario repeatedly to acquire initial capability. Simulation for more advanced learners should randomly vary the clinical scenario and/or system-specific protocol.

- **Practice self-explanation**
  - Ask learners to self-explain the concept (i.e., describe the rationale for each of the handoff’s recommended tasks).

- **Emploype self-regulation strategies**
  - Train learners to monitor their understanding during a patient handoff and to make adjustments in their approach (e.g., ask a clarifying question) when necessary.

References:


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First published online March 14, 2017

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