DESIGNING SIMULATION BASED ON COGNITIVE LOAD THEORY

Designing with a Purpose

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OBJECTIVES FOR TODAY

• Overview of Cognitive Load Theory
• Simulation and Cognitive Load Theory
• How to use Cognitive Load Theory in Simulation Design
"Mr. Osborne, may I be excused? My brain is full."
What is Cognitive Load

**Miller 1957:**
the number of objects an average human can hold in working memory is $7 \pm 2$. This is frequently referred to as Miller's Law

**Sweller 1988:**
CLT Founded on the fact that working memory has a limited capacity when dealing with novel information and when requirements surpass this capacity, then learning is impaired
What is Cognitive Load

Working Memory

Long-term Memory
What is Cognitive Load
What is Cognitive Load

**Intrinsic Load**

Complexity of content and what the learners brings
What is Cognitive Load

Extraneous Load
What is Cognitive Load

**Germane Load**
YOU HAVE EXCEEDED YOUR WORKING MEMORY
YOU HAVE EXCEEDED YOUR WORKING MEMORY

OY - HAU - EVE - XCE - EDE - YDO - UR - WO - NIK - GME - OM - YR

OH, YOU THINK YOU KNOW COGNITIVE LOAD?

TELL ME, HOW MANY MEMORY ELEMENTS CAN THE MIND HOLD?
Cognitive Load Theory

Simulation
Have you ever seen this in your simulation?
Simulation has become an educational imperative for clinical training in health professions education (tremblay et al., 2016).

The goal of learning is the acquisition of knowledge, skills, and attitudes that results in changes to long term memory and that produces an observable knowledge, behavior or action.
Simulation and Cognitive Load Theory

Adult Learning Theory - Knowles

Kolb’s Experiential Learning Theory

As an imperative simulation based training techniques and the research agenda must change to how to best apply these techniques (Fraser et al., 2015)
NOVICE

Working Memory
- Vitals
- Stress
- Complexity of Sim
- Environment
- Classmates

Long-Term Memory
- Didactic Schemas

SCHEMAS

HPSN World 2017 Practice with a Purpose
When do they become experts?

Ebbinghaus Forgetting Curve
Simulation Intrinsic and Extraneous Load Contributors

LANGUAGE BARRIERS – SWELLER
Simulation Intrinsic and Extraneous Load Contributors

**SOUND** –
Moreno and Mayer (2011) correlated reduced performance with competing auditory stimulus.
Simulation Intrinsic and Extraneous Load Contributors

Roles
Simulation Intrinsic and Extraneous Load Contributors

DISTRACTORS

Reedy (2015) while real world clinical practice is full of surprising challenges and there is a philosophy that we should be reenacting these in simulation. However there is no evidence this promotes positive learning and has been shown to increase cognitive load.
Simulation Intrinsic and Extraneous Load Contributors

DISTRACTORS
EMOTIONAL STRESSORS

Evidence suggest emotions during simulation directly relate to cognitive load (Tremblay et al, 2016)
Simulation can cause learners to be overwhelmed limiting learning process, (Reedy, 2005)
Fraser et al (2012) increased emotional stress showed a 30% reduction in performance one hour post simulation.
Simulation Intrinsic and Extraneous Load Contributors

COMPLEXITY OF SIMULATION - MY STORY
This gives me cognitive overload
SIMULATION GERMANE LOAD ENHANCERS

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SAY GERMANE LOAD

ONE MORE TIME!
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Three Dimensions of Simulation
1. Task Fidelity
2. Task Complexity
3. Instructor Support
SIMULATION GERMANE LOAD ENHANCERS

Know your learners relative schemas
Minimize goals and objectives
Design / Program Simulation to learner level
Bringing relevance to basic science
SIMULATION GERMANE LOAD ENHANCERS

Give them rehearsals
SIMULATION GERMANE LOAD ENHANCERS

Remove extraneous factors

I'M ON COGNITIVE OVERLOAD!
I NEED TO DECREASE MY EXTRANEOUS LOAD...
PT and the ICU
Avoid over compensating

EXPERTISE REVERSAL EFFECT

Plass et al., (2007) Simulations that are effective for novice learners may hamper learning for expert learners.
SIMULATION GERMANE LOAD ENHANCERS

Work with faculty
Assess outcomes

THINGS GOT REALLY INTERESTING WHEN THE STATISTICIAN STARTED DOING WARD ROUNDS

DOES IT WORK?

THAT DEPENDS ON WHAT YOU MEAN BY "DOES," "IT" AND "WORK"
A new psychometric instrument for the measurement of intrinsic cognitive load (i.e. questions 1–4) and extraneous cognitive load (i.e. questions 5–8)
All of the following eight questions refer to the activity that just finished. Please take your time to read each of the questions carefully and respond to each of the questions on the presented scale from 0 to 10, in which ‘0’ indicates not at all the case and ‘10’ indicates completely the case:

0 1 2 3 4 5 6 7 8 9 10
[1] The content of this activity was very complex.
[2] The problem/s covered in this activity was/were very complex.
[3] In this activity, very complex terms were mentioned.
[4] I invested a very high mental effort in the complexity of this activity.
[5] The explanations and instructions in this activity were very unclear.
[6] The explanations and instructions in this activity were full of unclear language.
[7] The explanations and instructions in this activity were, in terms of learning, very ineffective.
[8] I invested a very high mental effort in unclear and ineffective explanations and instructions in this activity.
By incorporating a multi-dimensional rating procedure, NASA TLX derives an overall workload score based on a weighted average of ratings on six subscales:

- Mental Demand
- Physical Demand
- Temporal Demand
- Performance
- Effort
- Frustration

NASA TLX has been successfully used around the world to assess workload in various environments such as aircraft cockpits; command, control, and communication (C3) workstations; supervisory and process control; and simulations and laboratory tests.
References


NOW YOU DO IT.
Thank You For the Privilege To Speak To You

Design and Train Your Simulations with a PURPOSE

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