

Recent Neuroscience and Cognitive Research Findings on Cyber Learning

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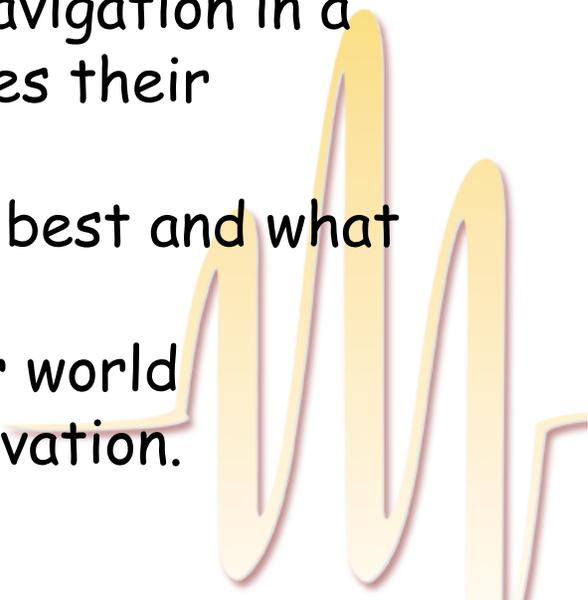


Topics

1. Why our cognitive architecture makes cyber learning difficult and what we can do about it.
2. Exciting neuroscience findings that may advance cyber learning in the future.
3. New and counter-intuitive information about cyber learning instructional design.



5 Assumptions about cyber learning

1. Cyber learning is more motivating and more effective than classroom learning.
 2. Cyber learning is under the conscious and willful control of the learner.
 3. Allowing students control over their navigation in a cyber course is motivating and enhances their learning.
 4. Students are aware of how they learn best and what they learned in a cyber environment.
 5. Immersive, interactive, realistic cyber world instruction enhances learning and motivation.
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Evidence about cyber learning

1. Cyber learning is NOT more motivating or effective than classroom learning.
2. Learning is NOT under the conscious and willful control of the learner
3. Allowing students control over their navigation and exploration in a cyber course is NOT motivating and DOES NOT enhance their learning
4. Students are NOT aware of how they learn best and DO NOT KNOW what or how they have learned
5. Immersive, realistic, interactive cyber worlds and multi-media presentations DO NOT enhance learning and motivation AND INSTEAD OFTEN DISTRACT AND DECREASE IT

Instructional Research Evidence

- In past quarter century, the best instruction resulted on only a 20% increase in learning - cyber learning has not increased that percentage.
- 50% of students are wrong when asked what and how much they learned from instruction.
- 30% of students like and choose instruction from which they learn the least when offered a choice between more or less guidance.

Instructional Research Evidence

- Adjusting instruction for different learning styles does NOT increase learning.
- For novice learners, many immersive simulations and serious games are significantly less effective and more expensive than other ways to teach.
 - Problem caused by game-based “discovery learning”.
- In task analysis, top experts only provide 30% of information about how they perform tasks.

■ Cognitive Architecture & Neuroscience

So what is the problem? Why have we not been more successful?

- Our cognitive architecture makes learning difficult to protect us
 - Can only think about 3 +/-1 things at a time
 - Stress takes up thinking space
- Much of our learning is automated and non-conscious to circumvent limits on our "working memory" (thinking space).

Here is some evidence:

❏ Ironical Impact of our Cognitive Architecture

Non-conscious cognitive learning evidence from neuroscience and cognitive science:

- Neuroscience evidence 27 years ago that many decisions are made non-consciously before we consciously decide (Libet et al, 1983).
- Most distressing is the evidence that when non-conscious cognition controls our learning, we believe that we have exercised our will and are in control (Bargh, 2002).
- Subconscious events influence values, self efficacy, mood, persistence, mental effort and behavior (Custers et al, 2008).
- Strong evidence that automated decisions, thinking and behavior is pleasurable (Helmuth, 2001) because they activate the same brain structures as drug addiction (Zjunc, 2001).

■ ■ Why Learning and Motivation are Difficult

We have evolved with dual knowledge systems to circumvent limits on working memory:

1. Declarative (what and why) - handles novelty (10% of total)
2. Procedural (when and how) - operates outside of our consciousness (90% of total).

Cyber learning focuses almost exclusively on conscious, declarative knowledge and ignores non-conscious procedures.

- Most students cannot construct (discover) ways to achieve learning objectives or motivate themselves and so they rely on non-conscious routines that are faulty and unsuccessful.

What instructional design framework will help us solve these problems?

From Learning to Instruction

We have not captured accurate "when and how" information because it is non conscious - so we can't teach anyone how to think or decide

Need to consider Cognitive Task Analysis (Clark et al, 2008):

Typically 25% to 50% learning gains with CTA + Guided Learning

- Neonatal Nurses changed diagnostic procedures for premature babies by 25% and increased survival rates.
- Patent examiners finish 75% faster (6 mo. Vs. 2 yrs.)
 - Production increase 200%+ mistakes down 65%
- Surgical residents finish 25% faster, learn 40% more
 - Important mistakes reduced 50%
- Lee (2004) - 34 studies averaged 47% performance increase

Interviewing 3 to 4 experts who have consistently successful performance increases knowledge to 70%

From Learning to Instruction

Anderson's Neuroscience-based ACT-R implies that lesson level Instruction requires:

1. **Goal and Reasons** (intentional module, goal buffer)
2. **Overview** (Declarative module)
3. **Connection to Prior Knowledge** (Declarative module)
4. **New Knowledge** (Declarative, visual/manual modules)
5. **Demonstrated Procedure** (Production system, declarative module)
6. **Practice** (Integration of new and old to achieve goal)
7. **Feedback** (Intentional module to correct and perfect)

These features mirror Merrill's (2006) principles from evidence-based instructional design systems

Guided Learning

The 8 Steps in a GL Lesson:

1. **Objective** (What trainees will learn to do)
2. **Reasons** (Benefit of learning and Risk of not)
3. **Overview** (Outline of this lesson)
4. **Connection to Prior Knowledge** (Analogy – this is like something you already know)
5. **Conceptual Knowledge** (processes, principles)
6. **When and How** (Step by Step Demonstration)
7. **Practice** (Students solve problems)
8. **Feedback** (what worked, what needs correction)

(Merrill, 2006; Clark, 2009)

Cyber Learning Principles

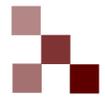
Evidence from instructional research:

1. Cyber students must first learn when and how to perform in an authentic, specific, disciplinary problem.
2. Providing analogies that relate the how and why to previous, experience in different knowledge domains increases adaptability.
3. "When and How to" knowledge must be applied in increasingly novel cyber-settings and tasks (varied practice).
4. All practice must be "hands on" with immediate, supportive and corrective feedback.
5. When students are asked to explain why the strategy they are using worked, or did not work, flexibility increases and learning becomes about 25% more efficient. (De Corte, 2003; Merrill, 2006; Clark, 2009). They can explain with drop down menu's.

■ Evidence for Guided Learning Effectiveness?

- Strategy sequence learned 25% more quickly
- Fewer and less important decision errors
- More accurate explanations of decisions
- Speed of automation increased
- Better assessment of developing expertise
- Coaching and feedback targets obvious
- Persistence and mental effort increased
- Learning increased +/- 40%

(Clark, 2009)



Questions?

Comments?



Evidence @:

http://www.cogtech.usc.edu/recent_publications.php

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