Science of learning to ed-tech

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MIT
Why care?
Ed-Tech

Science of learning (SoL)

Cognitive science
Ed-Tech

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Cognitive science
Ed-Tech

Science of learning (SoL)

Cognitive science
Learning is ubiquitous...
# List of websites

<table>
<thead>
<tr>
<th>Site</th>
<th>Domain</th>
<th>Alexa top 100 global websites (As of April 3, 2017)[3]</th>
<th>SimilarWeb top 100 websites (As of May 2017)[4]</th>
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Imagine someone not looking for traditional education...
…should’ve learned some investment basics first?
Ed-Tech

Science of learning (SoL)

Cognitive science

Non traditional learning
4 challenges
(and an appeal)
Challenge areas 1 & 2
Model of memory, and cognitive load
Model of memory

Sensory register

Working memory

Long-term memory

Model of memory

sensory input

Sensory register

Working memory

Long-term memory

Model of memory

Model of memory

Model of memory

Model of memory

- Sensory register
- Working memory
- Long-term memory

Limited

Bigger

Cognitive load (on working memory)

Cognitive load (on working memory)

Cognitive load (on working memory)

Cognitive load (on working memory)

Task difficulty load + Ineffective load + Effective load

Cognitive load (on working memory)

Task difficulty load + Ineffective load + Effective load

Reducing ineffective load
Reducing ineffective load

Beginner

Expert
Reducing ineffective load

Beginner

Expert

Worked examples
Reducing ineffective load

Beginner

Worked examples

Worked examples + self-explanation

Expert
Reducing ineffective load

Beginner → Worked examples

Beginner → Worked examples + self-explanation

Beginner → Worked examples + self-explanation + fading

Expert
Reducing ineffective load

Beginner

- Worked examples
- Worked examples + self-explanation
- Worked examples + self-explanation + fading

Expert

- Problem solving
Challenge area 1

Making “worked examples” more widely available

— With fading, self-explanation

— Intelligent tutoring system?
Model of memory

- Sensory register
  - Sensory input
  - Attention

- Working memory
  - Encoding

- Long-term memory
  - Retrieval

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Model of memory

Retrieval

Practice helps us learn better
Retrieval

Practice helps us learn better

Frequency of practice matters
Retrieval

Practice helps us learn better

Frequency of practice matters

Mix-n-match as you retrieve
Retrieval — examples

Quizlet

duolingo
Challenge area 2

Tech-assist to retrieve more complex topics
Challenge area 2

Tech-assist to retrieve more complex topics

— Flashcards 2.0?
Challenge areas 3 & 4
Remember when you learned something well
Remember when you learned something well

— you were motivated
Remember when you learned something well

— you were motivated

Intrinsic factors

Extrinsic factors
...but learning is difficult!
Sisyphus! You are cursed to push a stone up a hill, only to see it fall down over and over again!
Okay, okay, *Addendum*: each time the rock rolls back down, a meaningless counter will say you've increased one level.

*Woohoo!*
Motivation $\leftrightarrow$ Gamification

Okay, Okay, Addendum: Each time the rock rolls back down, a meaningless counter will say you've increased one level.

Woohoo!
Challenge area 3

How do we tap into intrinsic motivation?

Also, improve extrinsic motivation beyond badges and points?
Avoiding biases
THIS IS YOUR MACHINE LEARNING SYSTEM?

YEP! YOU POUR THE DATA INTO THIS BIG PILE OF LINEAR ALGEBRA, THEN COLLECT THE ANSWERS ON THE OTHER SIDE.

WHAT IF THE ANSWERS ARE WRONG?

JUST STIR THE PILE UNTIL THEY START LOOKING RIGHT.
@teenybiscuit
Challenge area 4

Avoiding biases is hard

— Look for them carefully
— Fix them promptly
Summarizing,
Challenge areas — Tech-assist for:

- Better worked examples
- Better retrieval system (flashcard 2.0)
- Better gamification
- More bias-resistant systems
Finally, an appeal

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openlearning.mit.edu/campus/resources-and-references

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Comment: https://goo.gl/fxqRFo