Industry Keynote

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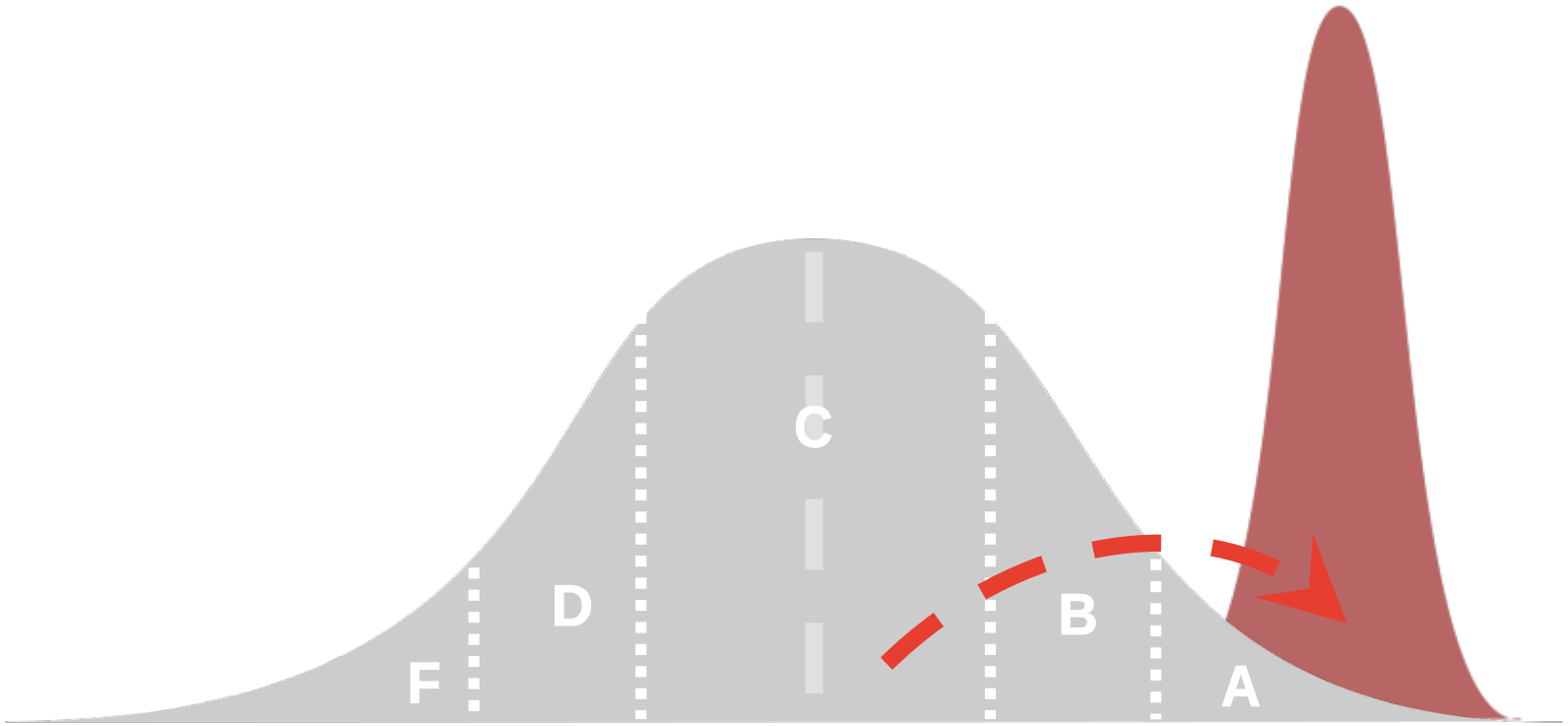
Learning Engineering: The Art of Applying Learning Science at Scale

Bror Saxberg
VP of Learning Science

August 27, 2018

The opportunity



How to do this?

- Start from how learning actually works
- Use technology to implement and enhance *good* solutions
- Use evidence to make progress

Learning Engineering

. . . linked in with the science of human development as a whole.

We must remain aware that ALL the characteristics act at once

Whole child Bror - time 1

- Academic - 1
- Identity - 1
- Social Emotional - 1
- Cognitive/EF/meta cog-1
- Mental health - 1
- Physical health - 1

Activities are designed to change these characteristics. . .

Whole child Bror - time 1

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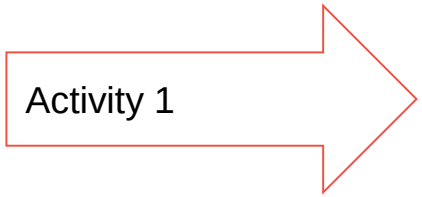
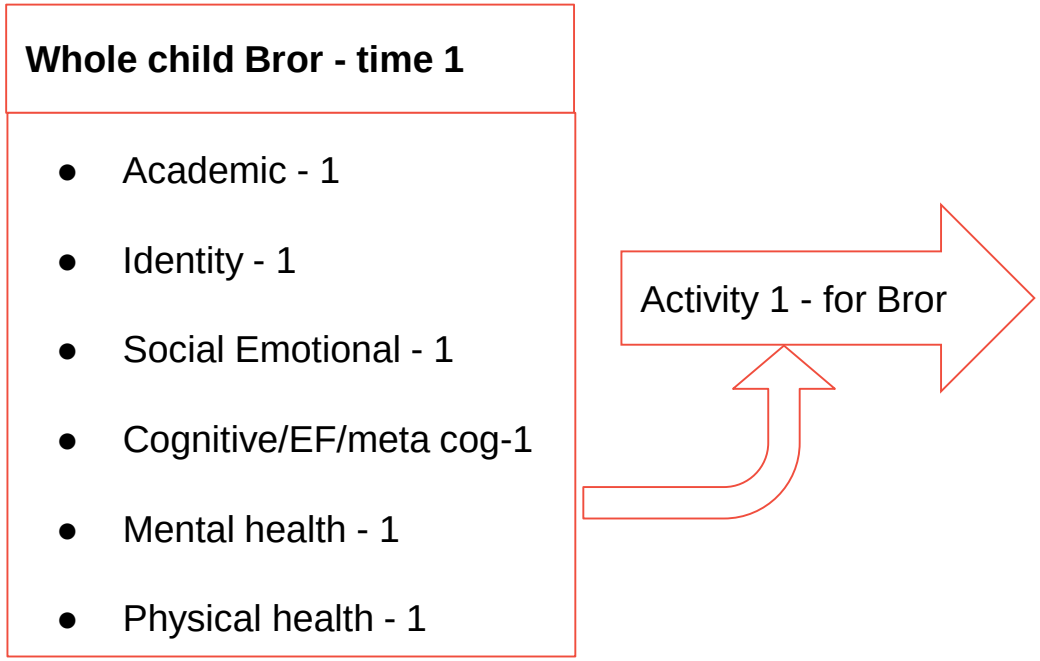
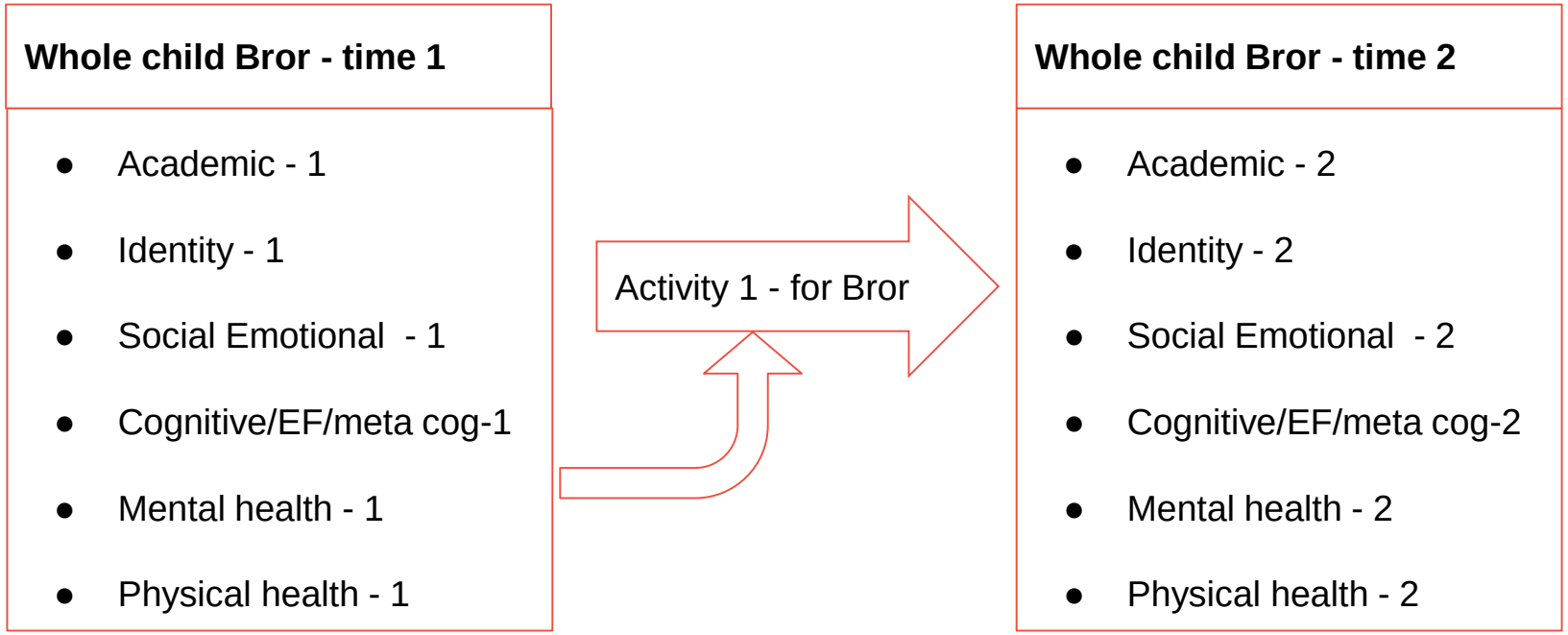
- Physical health - 1



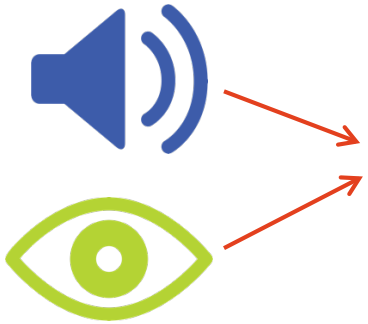
. . . and should be customized based on learner's characteristics



. . . to get the activity to give maximum multi-dimensional benefit



We know a lot about how minds work



Audio & Visuals aid memory

Working Memory	Long-Term Memory
Short retention	Long retention
Audio + video = benefits	Auto-connect to WM
Verbal/conscious	Non-verbal/Non-conscious
3-5 things at once	Highly parallel
Slow processing	Rapid processing
Error-prone	Error-free (with proper training)
Highly flexible	Rigid – decisions and tasks must “fit”
Can generate new insights/knowledge	

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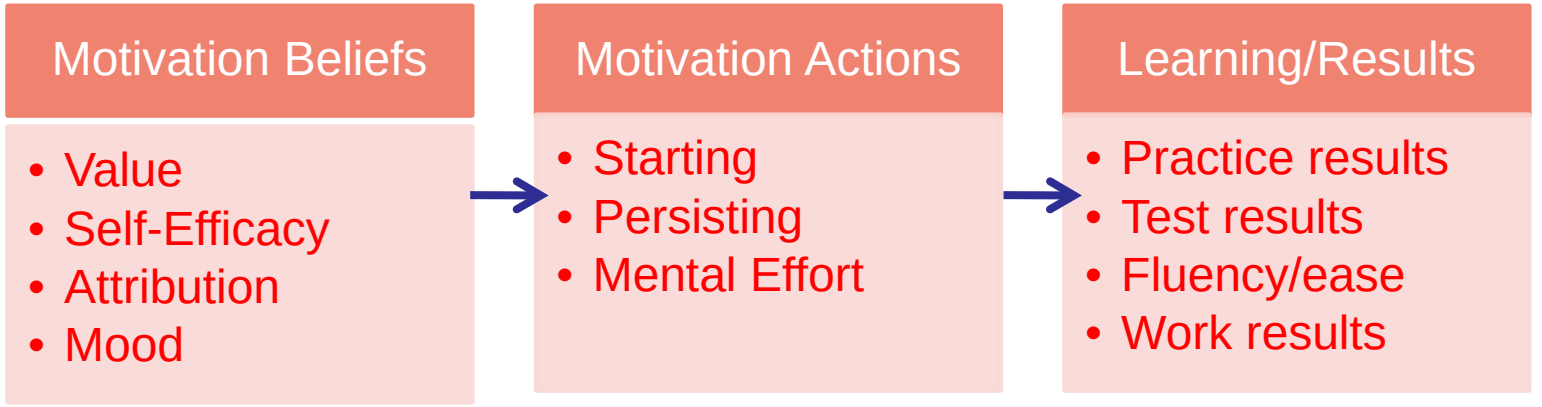
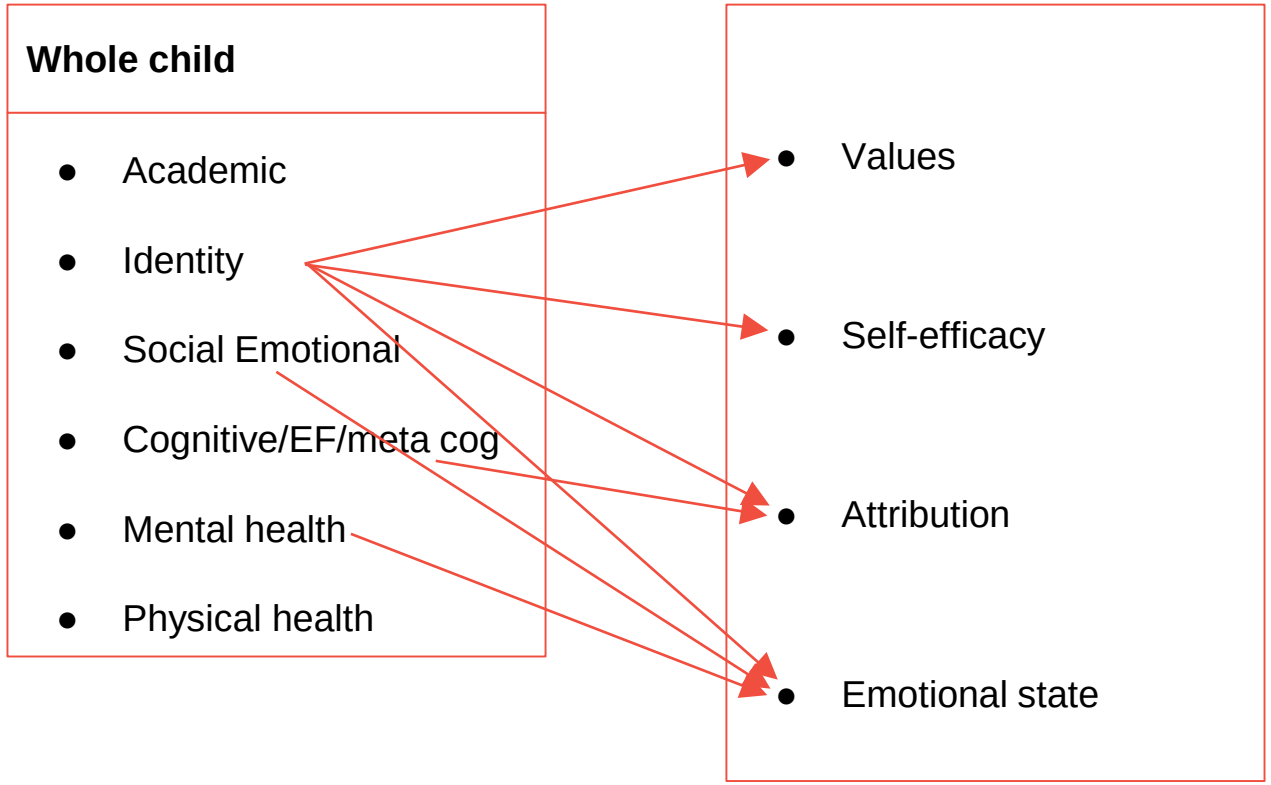
We also know quite a lot about motivation. . .



A whole learner perspective gives insight into motivation issues

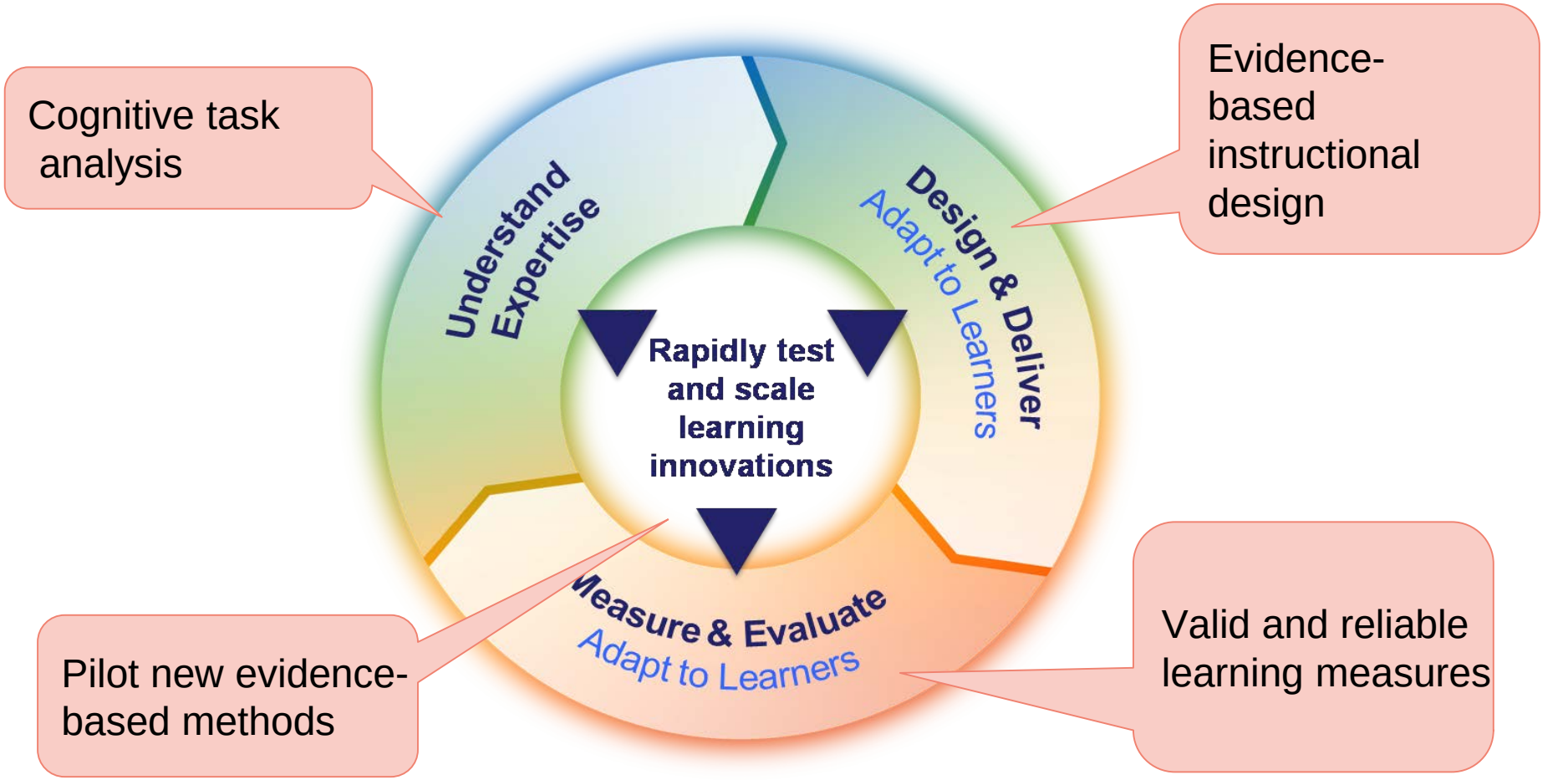


And diagnosing and treating those issues is part of activity design

Problems with:	**E.g.:**	**Approaches to resolve:**
Value	“I don’t see the point”	Help learner find value Let learner use their existing expertise Make the activity itself be enjoyable
Self-efficacy	“I can’t do this”	Show they have done things like this before Show stories from others like them who’ve mastered this before
Attribution	“<Something> is in my way”	Problem-solve around the issue (Space? Time? Materials not working? Etc.) Show stories from others like them with this issue who’ve found a solution
Emotional state	“I’m <angry/depressed/ scared>”	Wide array of possible solutions, from structured conversation techniques through more professional help

From: Clark, R. E., Saxberg, B., “Engineering Motivation Using the Belief-Expectancy-Control Framework,” **Interdisciplinary Education and Psychology**, 2(1), 4-32, 2018

This allows for a “learning engineering” process



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Research gives us clearer guides to help with hard outcomes

Knowledge Component		Practice/Assessment
Supportive Knowledge		

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Supportive Knowledge	Fact	Recall fact in task context; spaced repetition
	Concept	Classify, identify or generate examples and non-examples
	Process	Identify causes of faults in a process; predict events in a process
	Principle	Decide if principle applies; predict an effect; apply principle to solve a problem, explain a phenomenon or make a decision

* Based on Koedinger, K.R., Corbett, A.T., Perfetti, C, "The Knowledge-Learning-Instruction framework: Bridging the science-practice chasm to enhance robust student learning." *Cognitive science* 36.5 (2012): 757-798.

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There's specific guidance to make screens/lessons work better

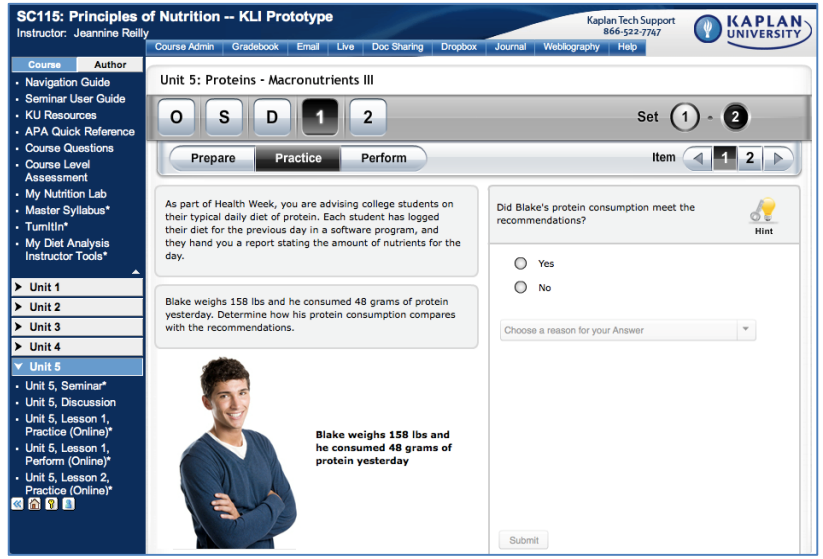
Principle	Description	Effect size (s.d. units)
Multimedia	Use relevant graphics and text to communicate content	1.4
Contiguity	Integrate the text nearby the graphics on the screen – avoid covering or separating integrated information	1.1
Coherence	Avoid irrelevant graphics, stories, videos, media, and lengthy text	0.9
Modality	Include audio narration where possible to explain graphic presentation	0.8
Redundancy	Do not present words as both on-screen text and narration when graphics are present	0.9
Personalization	Script audio in a conversational style using first and second person	0.8
Segmenting	Break content down into small topic chunks that can be accessed at the learner's preferred rate	0.8
Pre-training	Teach important concepts and facts prior to procedures or processes	0.8
Etc.	Worked examples, self-explanation questions, varied-context examples and comparisons, etc.	??

Source: E-learning and the Science of Instruction, Clark and Mayer, 4th ed., 2016

More use of learning science principles does help

Existing courses

Redesigned courses



Read, Write, Discuss

- Outcomes and content not precisely aligned
- Limited demonstrations, worked examples, and practice
- General assessment rubrics
- High reliance on discussion boards

Prepare, Practice, Perform

- Outcomes and content aligned
- One lesson per objective
- Demonstrations and worked examples
- Practice, feedback before assessment
- Detailed scoring guides
- Less discussion/more practice
- Standard instructor materials
- Monitoring and support for motivation

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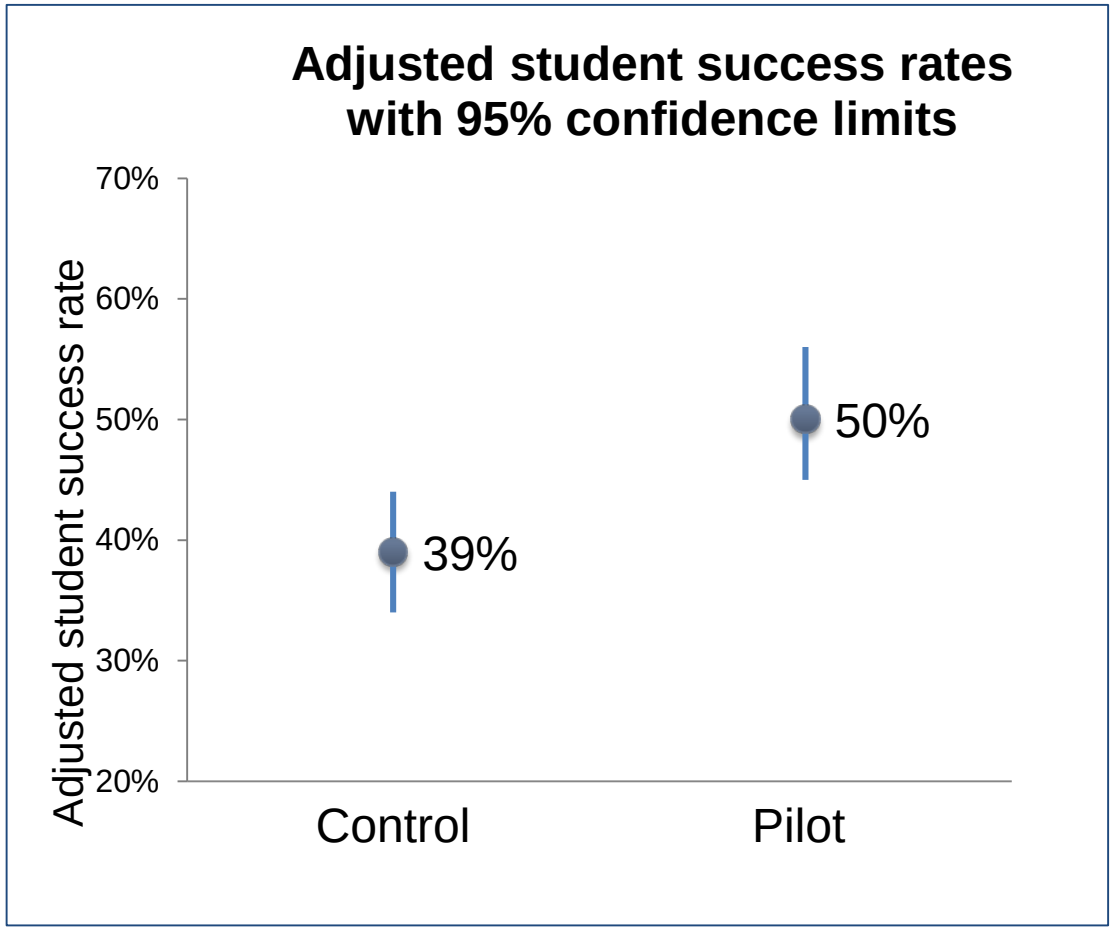
Result: much greater student success



- **11%** higher success rate
- **28%** increase
- Students in redesigned courses were **1.6** times more likely to be successful

Wald Chi-Square: 10.42, df=1, n=895, Sig<.001.

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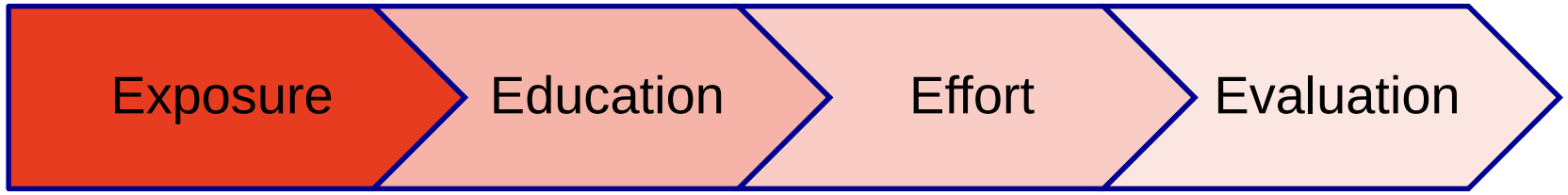
Getting this in place at scale is a serious process



- Show the science
- Show a process
- Make examples

- Refine process
- Train IDs
- Market exposure

- Wider use
- Community
- Set GM goals

- Initial tools/rubric
- Evidence review
- Detailed measures