



Virtual Open House

October 14 @ 11 AM EDT

Applications Due December 15th

<http://metals.hcii.cmu.edu>



Human-Computer Interaction Institute

Welcome!

- Ken Koedinger, Director



- Michael Bett, Managing Director



Human-Computer Interaction Institute

Extended Welcome from Our Learning Science Faculty



Vincent Alevan

Justine Cassell

Sharon Carver

Ken Koedinger

Jessica Hammer

Chinmay Kulkarni

Bruce McLaren

Amy Ogan

Carolyn Rose

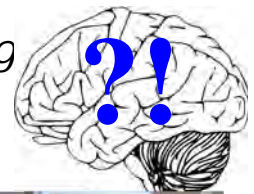
John Stamper



+ many others outside of Human-Computer Interaction Institute

Science & technology of learning: important, interesting, challenging!!

- Education is *important*
- Unlocking the mysteries of human learning is *interesting*
- Tech innovation is *challenging, fun, powerful*



Intelligent tutors helping city kids catch up in math

Learning games on mobiles in Africa

Virtual labs & MOOCs scaling education

Intelligent exhibits make doing science fun!

A bit about me, Ken Koedinger



- Modest educational background
 - Tech skills, want to make a difference
- Math undergrad, computer science masters, cognitive psychology phd => HCI
- Intelligent tutors for math
 - In city schools
 - Spin-off reaches millions
 - Doubles algebra achievement
- Direct LearnLab, formed METALS



Overview

- CMU & METALS are unique
- Curriculum
 - Capstone
 - Courses
- Finances



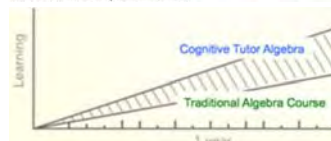
CMU Learning Science is Making a Difference

- Real-world impact of Cognitive Tutors
 - 600K students/year
 - *Doubles achievement!*
 - 2011 sale for ~\$95M
- OLI college courses
 - 25 open online courses
 - *2x faster & better*

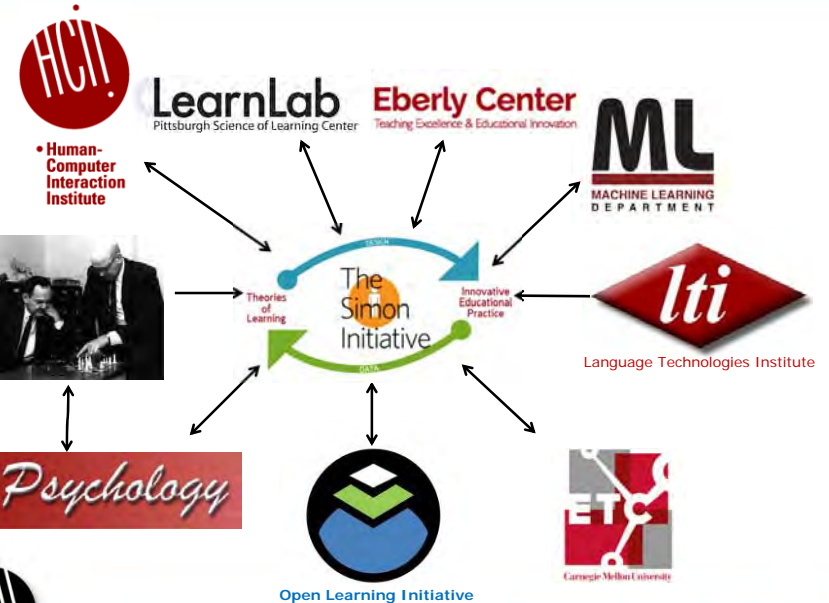
Software Tutors Offer Help and Customized Hints

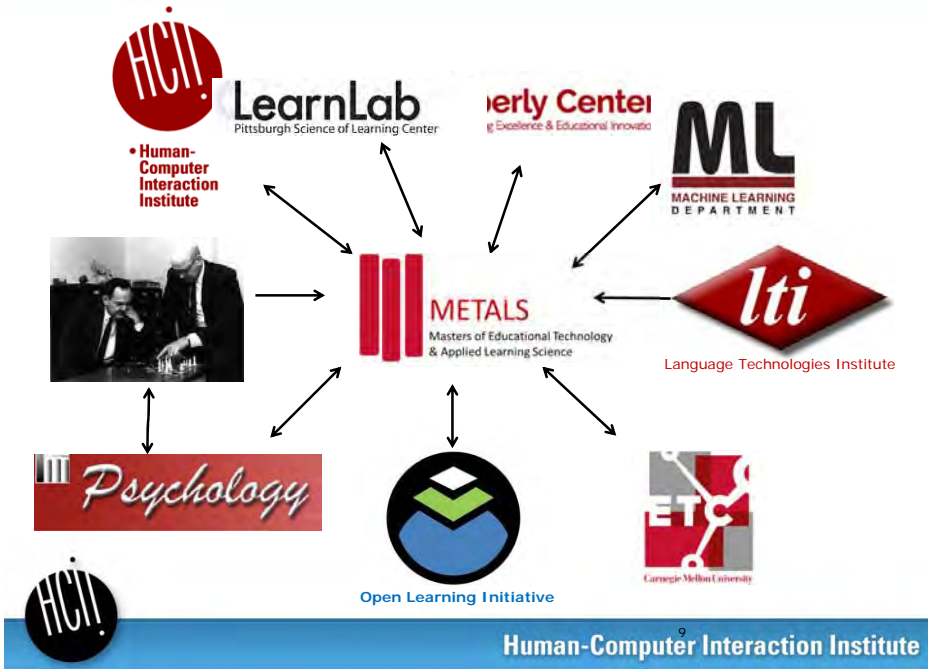


MATHCOACH - Rachelle Brown, left, and India Anagnostis, students at Middle School 153 in the Bronx, use Cognitive Tutor software to reinforce math skills. The software is designed to give students individualized instruction when personal attention is scarce.



Pane et al. (2013). Effectiveness of Cognitive Tutor Algebra I at Scale. RAND.

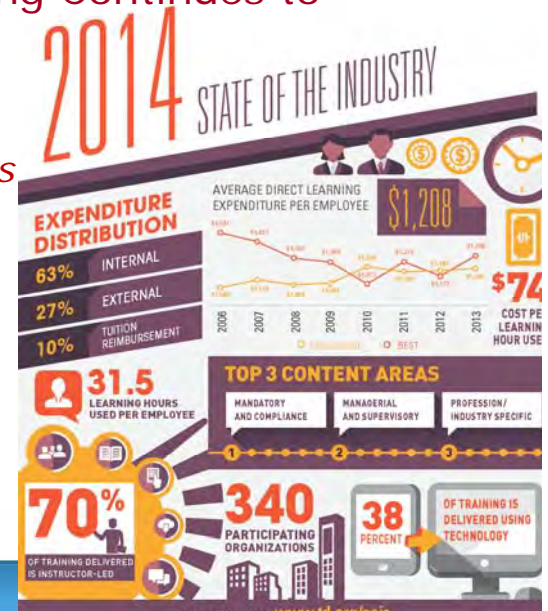




Learning & Training Continues to Boom!!

- *New ideas*
- *New technologies*
- *New companies*
- *New careers*

Report on industry trends
<https://www.td.org/Professional-Resources/State-Of-The-Industry-Report>



The Ed Tech Market is Huge!

World market: \$1.3 Trillion*
 740M Students*
 US K12 Market: \$8.38B**

*<https://prezi.com/xguky7u7aur6/ed-tech-market-map/>

**<https://www.siaa.net/Press/SIAA-Estimates-838-Billion-Dollars-US-Market-for-PreK-12-Educational-Software-and-Digital-Content>



Many Spinoffs and Local Startups



Many Corporate Partners



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Carnegie Mellon is Unique

Our Values... Innovative
Inspiring
Influential
Quality

Interdisciplinary
Business
Relevant
Impactful

Our Methods... cutting edge,
grounded in theory,
drawn from industry

Our Research...collaborative

Our Projects... practical and experiential



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Major Focus: Capstone Project

- Apply METALS skills on a two semester-long project
- Work in interdisciplinary teams (4-6 people)
- Work with clients
- Integrate skills gathered over the curriculum
- Learn to write reports & give presentations

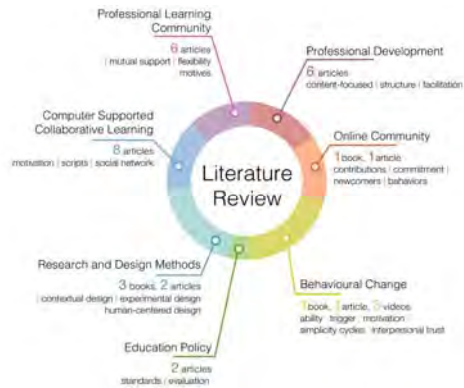


Learn to Create Evidence-Based Innovations in Learning

Gather Field Data



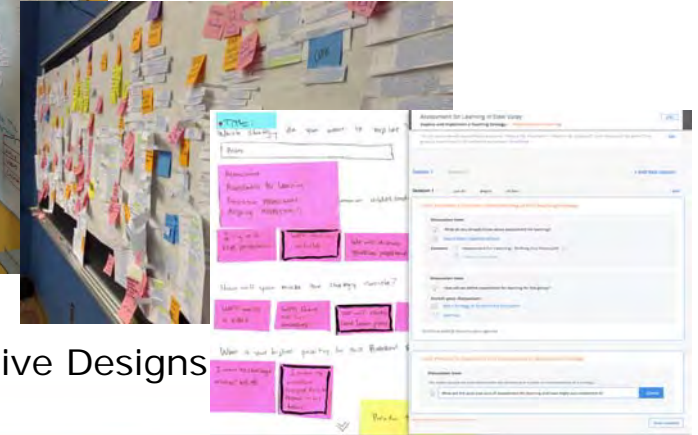
Review Literature



Understand Needs



Understand Research



Create Effective Designs



...And design some more. Then do it all over again, but better!



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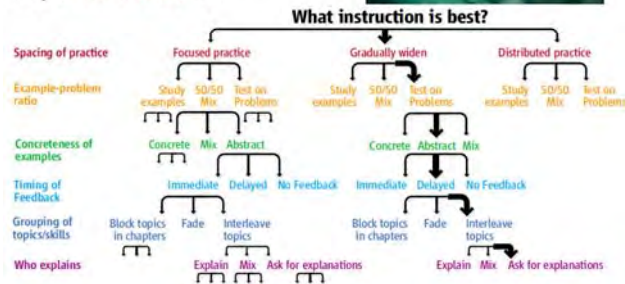


E-Learning Design Principles & Methods

- Gain a *broad understanding* of the field and literature.
- Know when to apply *evidence & theory*
- Learn how to adapt *methods* to specific needs

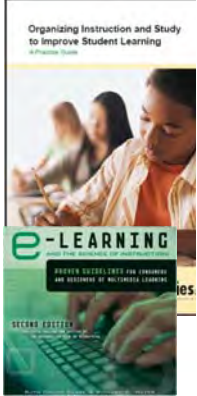
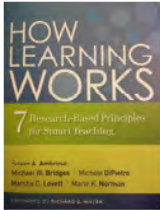


Ken Koedinger
TA: Mimi McLaughlin



Understand the best form of instruction

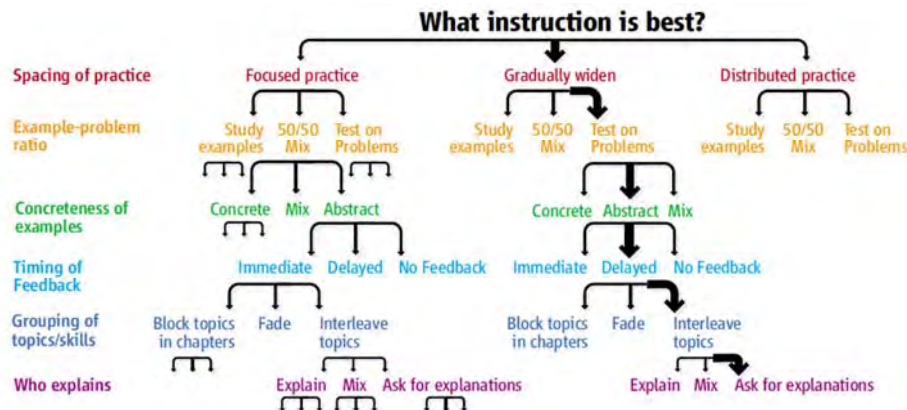
- More assistance vs. more challenge
 - Basics vs. understanding
 - Education wars in reading, math, science...
- Researchers like binary oppositions too. We just produce a lot more of them!
 - Massed vs. **distributed** (Pashler)
 - Study vs. **test** (Roediger)
 - **Examples** vs. problem solving (Sweller ...)
 - **Direct instruction** vs. discovery learning (Klahr)
 - Re-explain vs. **ask for explanation** (Chi, Renkl)
 - **Immediate** vs. **delayed** (Anderson vs. Bjork)
 - **Concrete** vs. **abstract** (Pavio vs. Kaminski)
 - ...



Koedinger, K. R., & Alevan, V. (2007). Exploring the assistance dilemma in experiments with cognitive tutors. *Educational Psychology Review*, 19(3), 239-264.

Instructional Complexity
How many instructional options are there?

More help, *passive* ← → More challenge, *active*



Many other dimensions of choice: animations vs. diagrams vs. not, audio vs. text vs. both, ...

> 3¹⁵*2 = 205 trillion options!



Koedinger, Booth, Klahr (2013). Instructional Complexity and the Science to Constrain It. *Science*.

What instructional choices are best for a particular course?

- Choices depend on a deep understanding of the content
 - A “cognitive model”
- But, do course designers know what they know?



Creating Cognitive Models is not Obvious

Which is hardest for algebra students?

Story Problem

As a waiter, Ted gets \$6 per hour. One night he made \$66 in tips and earned a total of \$81.90. How many hours did Ted work?

Word Problem

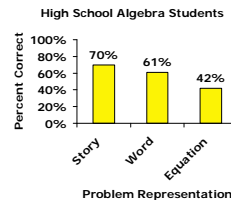
Starting with some number, if I multiply it by 6 and then add 66, I get 81.90. What number did I start with?

Equation

$x * 6 + 66 = 81.90$

Math educators say:
story or word is hardest

Equations are
hardest for
students...



Expert blind spot!

Experts do not know what they know: They are incorrectly think equations are easy for students



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Learning Objectives

What to do

- Design Principles
 - Multimedia instruction
 - Learning by doing
 - Supporting metacognitive, motivation & dispositions

When & how to do it

- Design Methods
 - Cognitive Task Analysis
 - Assessment design
 - User experience
 - A/B testing

What tools/technology to use

How to analyze and improve instruction



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METALS Core Courses

- E-Learning Design Principles & Methods
- Educational Goals, Instruction and Assessment
- Interaction Design Overview
- Tools for Online Learning
- Capstone Project



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Example Elective Courses

Technology

Cognitive Modeling and Intelligent Tutoring Systems
Design of Educational Games
Computer-Supported Collaborative Learning
Applied Machine Learning
Mobile Service Innovation
Software Engineering for Information Systems
Comp. Models of Discourse
Role of Tech in Learning in the 21st Century
Ubiquitous Computing
Big Data Pipeline
Computer-Assisted Language Learning

Psychology

Human Expertise
Applications of Cognitive Science
Scientific Research in Education
Learning and Motivation
Cognitive Development
Stats: Experimental Design for Behavioral and Social Sciences
Research Methods for the Learning Sciences
Human Factors
Analysis of Social Media
Evidence-Based Management

UX Design

User Centered Research and Evaluation
Game Design Studio
Design of Educational Games
Adaptive Service Design
Human Factors
Social Perspectives in HCI
Computer Science Perspectives In HCI
Research Methods in Human Centered Design
Computer Mediated Communication
Social Web
Inventing the Future of Services
Sensemaking: Cognitive, Social, and Technical Perspectives



General Electives Continued

- Crowd Programming
- Entrepreneurship
- Designing for Service
- Web Accessibility
- Gadgets, Sensors and Activity Recognition in HCI
- Machine Learning Text Mining
- Advanced Web Design
- Designing Human Centered Software
- Social Perspectives in HCI
- Language and Statistics
- Decision Making Under Uncertainty

- > 100 others in other part of the university, if approved
 - Business, CFA, H&SS, CS, Robotics, Entertainment Technologies



We want students who are:

- Passionate about using technology to develop better learning outcomes
- With backgrounds especially in
 - computer science
 - design
 - psychology
 - education
 - business
 - any educational content domains



On the Philosophy...

- METALS education provides students
 - Skills to engineer & implement innovative & effective educational solutions
 - Real-world project-based experience
 - Team management
- You will learn about all of software development, psychology, & design
 - You will not become an expert in all in 1 year
 - You will learn to communicate with specialists in other areas



What You Will Be Able to Do After METALS? Part 1

- Design, develop, & implement *innovative, effective, & desirable* educational solutions
- *Innovative*
 - Use state-of-the-art technologies
AI, machine learning, language technologies, intelligent tutoring systems, mixed reality, ...
- *Effective*
 - Apply cognitive & social psychology principles to instructional design, analysis, & redesign
 - Design & evaluate using cognitive task analysis, data mining, statistics, experimentation



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What You Will Be Able to Do After METALS? Part 2

- *Desirable*
 - Design skills to enhance learning *and* enjoyment
- *Innovative*: Analytic, psychometric & educational data mining skills
- *Putting it together*: Develop continual improvement programs that employ experiments & analytics to reliably identify best practices & opportunities for change



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Gain Breadth & Expertise

- You may already possess expertise in some of these areas, but not in all.
- METALS will
 - Deepen your prior expertise
 - Broaden your knowledge in new areas



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Finances

- 2015-2016
 - 3 Semesters
 - \$20,500 per semester
 - \$20,000 for living expenses
 - \$80,000 commitment
- 2016-2017 Tuition Not Set
- Currently exploring offering merit-based tuition assistance
 - If you are skilled & passionate,
 - let us know!



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Application Guidelines

- Apply Online
 - <https://applygrad.cs.cmu.edu/apply/index.php?domain=1>
- Applications Due December 15th
- Applications Must Demonstrate
 - Your interest in EdTech
 - Past relevant experience/training
 - Plans after you graduate
- GREs
 - Expected 165 Quantitative, 160 Verbal
 - But we look at the entire application...
- TOEFL
 - 25 or better in 3 out of 4 sections and
 - 23 or better in forth section



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Questions?

<http://metals.hcii.cmu.edu>

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