



Learn. Create. Innovate.
Virtual Open House

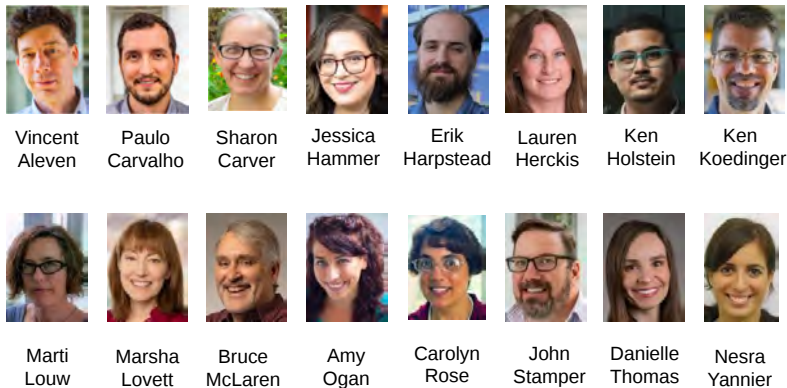
October 15 @ 9 AM EDT
Applications Due: December 10th
<http://metals.hcii.cmu.edu>

Welcome!

- Ken Koedinger,
Founding Director
- John Stamper,
Program Director
- Michael Bett,
Managing Director
- Lorraine Li-Hagerty,
Academic Program Manager



Extended Welcome from Our Learning Science Faculty



Overview

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

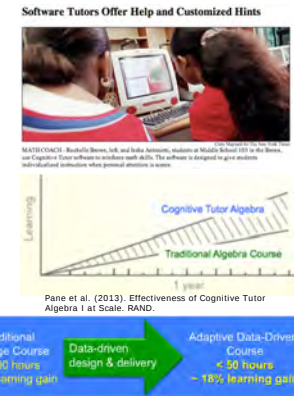
Why Carnegie Mellon

- Where Learning Science began
- Alan Newell and Herb Simon
 - Turing Prize Winners
 - Created Logic Theorist - first thinking machine
- Created the fields of
 - AI
 - Cognitive Psychology
 - Learning Science
 - EDM – Educational Data Mining

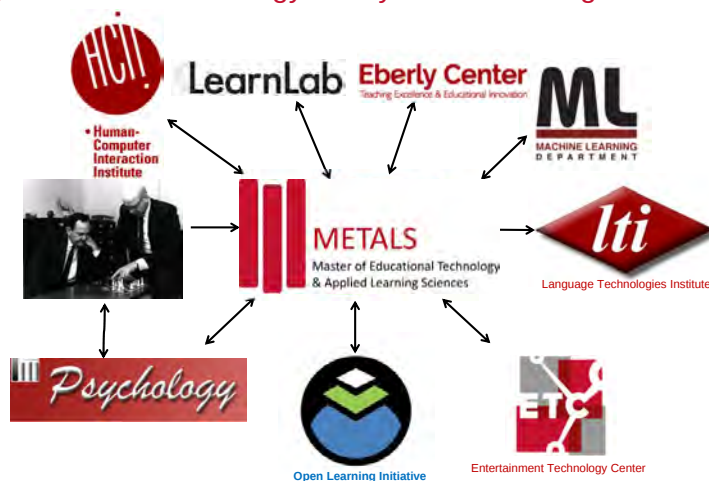


CMU Learning Science is Making a Difference

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



Learning Science & Technology Ecosystem at Carnegie Mellon University



Many Spinoffs and Local Startups



Many Corporate Partners



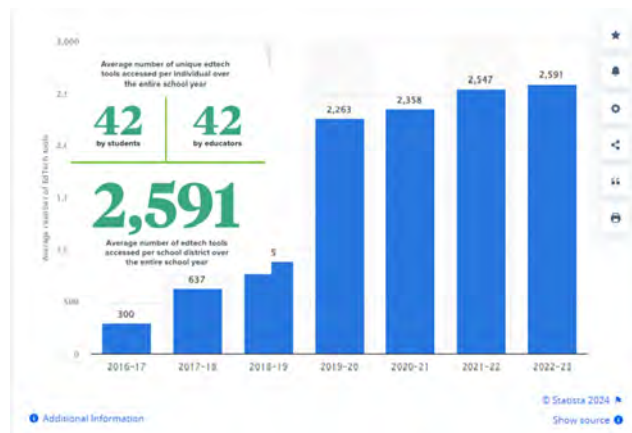
The Education Market is Huge!

- From preschool to corporate training
 - Global market: \$6T in 2022 → \$8T in 2030*
 - 1.5 Billion K12 Students**
 - 151 Million Post-Secondary Students**
- Edtech is the fastest-growing segment.*
 - \$250B in 2022 to \$620B by 2030.*

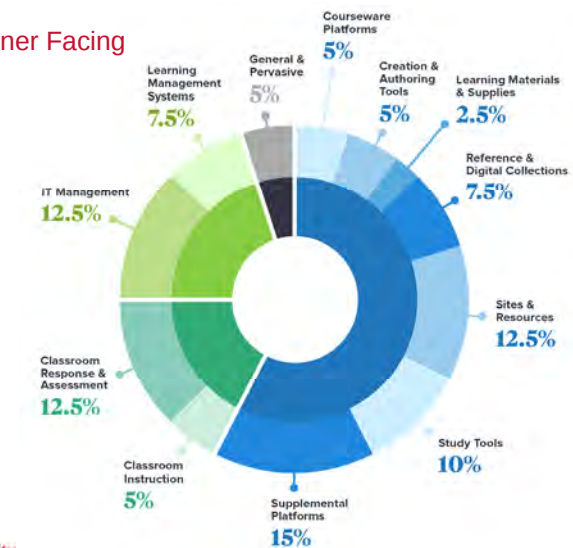
*<https://www.morganstanley.com/ideas/education-system-technology-reboot>

**<http://data.uis.unesco.org/> (2015 data)

#EdTech Tools Used in US School Districts



>75% Tools Learner Facing



Carnegie Mellon is Unique

Our Values ... Innovative Interdisciplinary
Inspiring Business
Influential Relevant
Quality 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 & integrate METALS skills on a two semester-long project
- Be a member of an interdisciplinary teams (4-6 people)
- For an external client
- Learn to interview (CTA), research, write reports & give presentations
- Use Agile methods to iteratively produce minimally viable product (MVP)

Learn to Create Evidence-Based Innovations in Learning

Gather Field Data



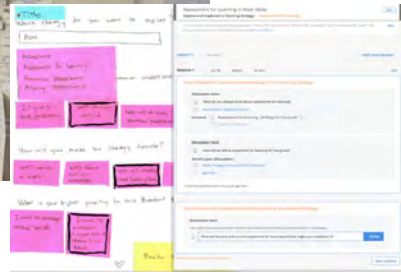
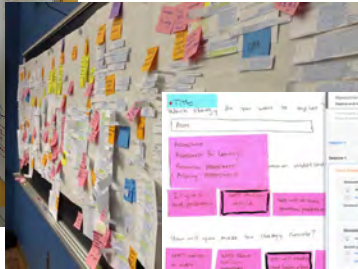
Review Literature





Understand Needs

Understand Research



Create Effective Designs

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



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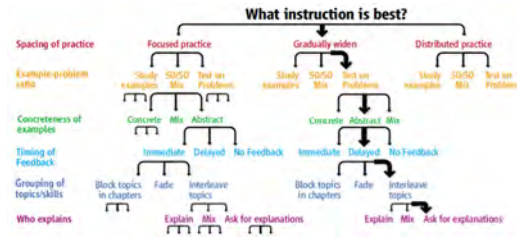
METALS Core Courses

- E-Learning Design Principles & Methods
- Evidence-Based Educational Design (EdDesign)
- Interaction Design Fundamentals
- Tools for Online Learning
- Capstone Project

E-Learning Design Principles & Methods

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

Paulo Carvalho

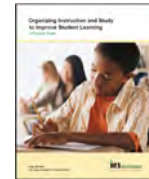
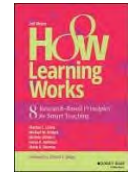


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Understand the best form of instruction

- 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)
 - ...

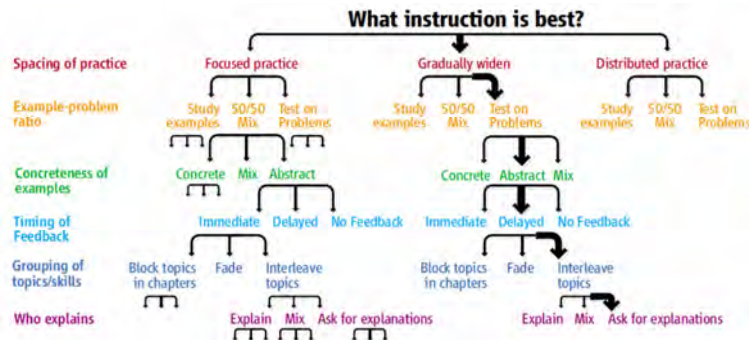
Koedinger, K. R., & Aleven, V. (2007). Exploring the assistance dilemma in experiments with cognitive tutors. *Educational Psychology Review*, 19(3), 239-264.



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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, ...

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

$> 3^{15 \times 2} = 205$ trillion options!

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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?



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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

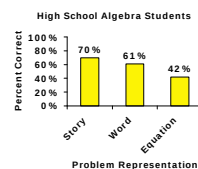
Starting with some number, if I multiply it by 6 and then add 66, I get 81.90. What number did I start with?

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 thinking equations are easy
for students

Evidence Based Educational Design

Students will learn to use scientifically-based principles & practical strategies for:

- developing learner models & educational goals based on analysis of the knowledge, skills, and dispositions required for understanding and mastery
- aligning the instructional program and its valid assessment with learners and goals
- considering additional aspects of learning environments that may impact implementation and evaluation

Reading, and Seminar Discussion



Figuring Out How this All Works ...



Course Project

Apply
Course
Big Ideas

1. Context & Initial Resources
2. Anticipated Learner Profile
3. Learning Goal Specification
4. Assessment Design
5. Instructional Design
6. Research Design

Final Presentation & Poster

EGIA Fall 2016

Career Exploration
Yiran Buckley, Napol Rachatasumrit, Shayan Doroudi, Yali Chen

Goal Framework & Learner Context	Goals	Assessment	Instruction	Research
Project Focus Exploring the relationship between career exploration and learning goals. Exploring the relationship between career exploration and learning goals. Exploring the relationship between career exploration and learning goals.	Understanding Yourself How do you know what you want to do? Evaluating Yourself How do you know what you want to do? Building Yourself How do you know what you want to do?	Assessment How do you know what you want to do? Assessment How do you know what you want to do? Assessment How do you know what you want to do?	Instruction How do you know what you want to do? Instruction How do you know what you want to do? Instruction How do you know what you want to do?	Research How do you know what you want to do? Research How do you know what you want to do? Research How do you know what you want to do?

Longitudinal Research Design

How do you know what you want to do?



Poster Session



Tools For Online Learning

- This course is expected to give you
 - an overview of current educational technology.
 - hands on experience with educational technology used in online learning
- Hands-on projects every couple of weeks
- Final project build out a complete course module

Topics Include

- Overview of Educational Technology
- Learning Management Systems
- GenAI
- Accessibility
- Adaptive Learning
- Conversational Agents
- Data-Driven Design and Development
- Online Courseware

Example Elective Courses

Technology

Personalized Online Learning
Design of Educational Games
Applied Machine Learning
Computational Models of Discourse Analysis
Design & Engineering of Intelligent Information Systems
Role of Technology in Learning in the 21st Century
The Big Data Pipeline
Mobile Service Innovation

Learning Science

Cognitive Development
Human Expertise
Applications of Cognitive Science
Research Methods for the Learning Sciences
Role of Technology in Learning in the 21st Century
Scientific Research in Education
Learning Analytics and Educational Data Science

Methods & Design

Human Factors
Stats: Experimental Design for Behavioral and Social Sciences
Design of Educational Games
Service Design Social Perspectives in HCI
Computer Science Perspectives In HCI
Research Methods in Human Centered Design
Learning Media Design
Learner Experience Design

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 a wide variety of backgrounds including:
 - computer science
 - design
 - psychology
 - education
 - business

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 one year
 - You will learn to communicate with specialists in other areas

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

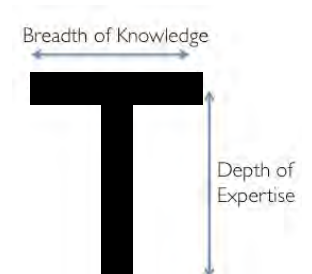
- Design, develop & implement *innovative, effective & desirable* educational solutions
- *Innovative*
 - Use state-of-the-art technologies
AI, machine learning, language technologies, intelligent tutoring systems, mixed reality, ...
- *Effective*
 - Apply cognitive & social psychology principles to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

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

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

- 2025–2026
 - 3 Semesters (4 semester option available)
 - \$26,250 per semester
 - ~\$36,365 for fees, health insurance, books & living expenses
 - ~\$115,115 commitment (for 3 semester option)
- 2026–2027 Tuition Not Set
- Currently offering small merit-based tuition assistance (\$1000–\$5000/semester)
 - Not guaranteed
 - If you are skilled & passionate, let us know!
- Scholarships – see METALS FAQ page
 - GEM Fellowship
 - Rales Fellowship

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Application Guidelines

- Apply Online
 - <https://www.cs.cmu.edu/academics/graduate-admissions>
- Applications Due: December 10 at 3PM EST
- Applications Must Demonstrate
 - Your interest in EdTech and/or Learning Science
 - Past relevant experience and/or training
 - Plans after you graduate
- GRE required
 - Expected scores 165 Quantitative, 160 Verbal
 - But we look at the entire application...
- English Proficiency is required!
 - **TOEFL**
 - 25 or better in 3 out of 4 sections and
 - 24 or better in speaking
 - DuoLingo and IELTS are options

Questions?

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

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