Learn. Create. Innovate.

Virtual Open House

October 15 @ 11 AM EDT
Applications Due December 12th
http://metals.hcii.cmu.edu

Welcome!

- Ken Koedinger, Director
- Michael Bett, Managing Director

Extended Welcome from Our Learning Science Faculty

Vincent Aleven Justine Cassell Sharon Carver Jessica Hammer Erik Harpstead Lauren Herckis Ken Koedinger Chinmay Kulkarni Marti Louw Marsha Lovett Bruce McLaren Amy Ogan Carolyn Rose John Stamper

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

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

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

**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
  - 30+ open online courses
  - 2x faster & better

**Learning Science & Technology Ecosystem at Carnegie Mellon University**

- LearnLab
- Eberly Center
- ML
- ETC
- Psychology
- METALS
- Language Technologies Institute
- Open Learning Initiative
- Entertainment Technology Center

**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 Market is Huge!

- 1.5 Billion K12 Students**
- 151 Million Post-Secondary Students**
- Education World market: $6 Trillion*
- EdTech World Market $152 Billion*
- Venture Captial: $8.2 Billion*

*https://www.holoniq.com/edtech/10-charts-that-explain-the-global-education-technology-market/
**http://data.uis.unesco.org/

Many Spinoffs and Local Companies

Many Corporate Partners

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
- Integrate skills gathered over the curriculum
- Be a member of an interdisciplinary teams (4-6 people)
- For an external client
- Learn to interview (CTA), research, write reports & give presentations
- Produce a high fidelity prototype

Learn to Create Evidence-Based Innovations in Learning

Gather Field Data

Review Literature

Create Effective Designs

Understand Needs

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

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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

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)
  - ...


Instructional Complexity

How many instructional options are there?

More help, passive
- More challenge, active

What instruction is best?

Spacing of practice
- Focused practice
  - Study examples
  - 50/50 Mix
  - Test on Problems
- Gradually widen
  - Study examples
  - 50/50 Mix
  - Test on Problems
- Distributed practice
  - Study examples
  - 50/50 Mix
  - Test on Problems

Concreteness of examples
- Concrete
- Mix
- Abstract

Timing of Feedback
- Immediate
- Delayed
- No Feedback

Grouping of topics/skills
- Block topics in chapters
- Interleave topics

Who explains
- Explain
- Mix
- Ask for explanations
- Explore
- Mix
- Ask for explanations

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

>3^{15/2} = 205 trillion options!


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
- \( x \times 6 + 66 = 81.90 \)

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
Educational Goals, Instruction, and Assessment

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

Actually 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

Career Exploration
EGDA Fall 2016

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
- 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

**Psychology**
- 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

**UX 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
  - any educational content domain

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

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

- 2019-2020
  - 3 Semesters (4 semester option available)
  - $23,175 per semester
  - ~$27,000 for living expenses
  - $96,525 commitment (for 3 semester option)
- 2019-2020 Tuition Not Set
- Currently offering small merit-based tuition assistance ($1000-$4000/semester)
  - Not guaranteed
  - If you are skilled & passionate, let us know!

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Application Guidelines

- Apply Online
- Applications Due December 12th
- Applications Must Demonstrate
  - Your interest in EdTech and/or Learning Science
  - 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 speaking

Questions?

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