



Training Program Goals

The goal of the pre-doctoral training Program in Interdisciplinary Education Research (PIER) at Carnegie Mellon University is to produce scientists who are qualified to do rigorous research needed for evidence-based educational practice and policy.

PIER aims to produce a new generation of researchers who will be
(a) grounded in cutting-edge theories and methodologies in cognitive and developmental psychology, statistics, human-computer interaction and instructional technology;
(b) familiar with many of the fundamental problems facing education in America, and
(c) committed to applying their skills and knowledge to solving those problems.

PIER students deal with the bi-directional flow of ideas and challenges between laboratory studies and instructional applications. In addition to achieving expertise in a chosen discipline such as Psychology, Statistics, Human Computer Interaction, or Philosophy, PIER students from these fields form interdisciplinary teams to assess learners' knowledge at vastly different temporal and cognitive grain sizes. They develop skills necessary to utilize cognitive science, educational technology and advanced statistical methods to further our understanding of learning in a variety of real-world contexts and settings.

Interdepartmental Admissions & Evaluation

All PIER students are first admitted to an existing Carnegie Mellon Ph.D. program and secondarily admitted to PIER. PIER offers U.S. citizens or permanent residents up to 5 years of support, including a stipend and partial tuition grant.

Cohort 1 (Beginning Fall 2004) 7 Students - 3 Psych, 3 HCII, 1 Philosophy, 1 HCI Student Affiliate)

Cohort 2 (Beginning Fall 2005) 4 Students - 1 Psych, 1 HCII, 1 Robotics, 1 Machine Learning & 1 Psych Affiliate

Cohort 3 (In Process for Fall 2006) 2 Students - 1 Psych, 1 Statistics & 3 Students Pending

Students meet all of the requirements for the Ph.D. in their home departments, plus participate in the PIER Community, complete a series of three PIER Core Courses (years 1 & 2), and develop an Interdisciplinary Research Project (year 3), in addition to pursuing a dissertation that is guided by an interdisciplinary committee and involves educational research. Students are evaluated annually via their home department process. In addition, each student completes an annual PIER self-evaluation for review by the Steering Committee. Based on the committee's discussion of each student's performance, the program director provides feedback in writing to supplement the verbal feedback provided by the student's advisor(s)

Local Community Building

The PIER community includes faculty, research associates, graduate and undergraduate students at Carnegie Mellon, together with colleagues at other institutions in Pittsburgh. An ongoing series of activities is open to broad participation. Our current distribution list includes 270 individuals.

Biweekly EdBag Discussions are coordinated by IES Post-Doc Mari Cary. The diverse sessions include research presentations, funding and policy discussions, updates on local research in practice, etc. Since launching the EdBag in January of 2005, we have sponsored 28 sessions. EdBag participation ranges from approximately 10 to 30, with an average attendance of roughly 15. The total number of distinct participants during the first year and a half of discussions is estimated by the coordinator to be close to 70.

We have covered a broad range of topics in a variety of formats, including:

- 1) Faculty and students affiliated with the PIER program discussing current research, giving practice talks, presenting and discussing articles on a topic of common interest, soliciting feedback on research at the conceptualization and design stage, etc.
- 2) Faculty from other departments (e.g., Physics, Engineering, etc.) and colleagues from other institutions (primarily the University of Pittsburgh) sharing research to build collaborative relationships
- 3) RAND researchers providing an overview of their educational research projects
- 4) Speakers from the colloquium series prompting discussion of hot topics

For a complete list of topics and associated readings, see <http://www.psv.cmu.edu/edbag/>

PIER Community members may also participate in events sponsored by the Pittsburgh Science of Learning Center (PSLC) and the Learning Research and Development Center (LRDC), and vice versa.

Interaction with Prominent Education Researchers

PIER sponsors a colloquium series to provide opportunities for trainees to benefit from in-depth interactions with diverse role models in the learning sciences field. Each guest has at least one faculty and one graduate student host. Schedules for each visit are oriented to graduate student interests re: topics, methods, and career paths, with the majority of each visitor's time being spent with graduate students.

Dan Schwartz, Stanford University 10/05 (Hosts: Ido Roll and Sharon Carver)
Colloquium: *How can Physical Action Support Abstract Learning?*

Alan Schoenfeld, UC Berkeley 3/06 (Hosts: Norma Chang and David Klahr)
Colloquium: *Toward a Theory of Problem Solving*

John Bruer, James S. McDonnell Foundation 4/06 (Hosts: Yvonne Kao and Marsha Lovett)
Colloquium: *A Skeptical Theme and Variations: The Primacy of Psychology in the Science of Learning*

Sara Rimm-Kaufman, University of Virginia 5/06 (Hosts: David Klahr and Jamie Jirout)
Colloquium: *Classroom social processes and children's development of social and academic skills: The Contribution of the RC Approach*

Jim Stigler, UCLA 10/06 (Hosts: Brian MacWhinney and Matthew Easterday)
Colloquium: *Improving Mathematics Teaching: A Journey Beyond TIMSS Video*

Core Curriculum Foundations

Scientific Research in Education

(Taught by Training Director David Klahr, Spring 2004, 2005, 2006)

Overview: Discussion-oriented overview of the national policy and funding landscape related to rigorous scientific research in education, yielding group project proposals responsive to a federal RFP

Key Questions:

What does "scientifically based education research" mean?

What constitutes a treatment or an independent variable: the content of a lesson, the instructional approach, the qualifications of the teacher, the attributes of the students, the philosophical and educational "approach"?

What is the appropriate grain size of the measurements and analyses: individual students, classrooms, teachers, schools, or school districts?

How can traditional academic research in cognitive science contribute to improving the science of education? Can such research inform policy and practice in ways that have substantial impact?

What happens when other stakeholders, such as practitioners, academics from other disciplines (historians, philosophers, "hard" scientists), professional groups, advocacy groups, policymakers, and the media begin to assess and comment on what the research enterprise is producing?

Key Learning Activities: We will explore these questions by (a) Looking briefly at the history of education research, (b) reading and discussing some of the broad policy statements, as well as a few of the highly contentious debates in the literature about the nature of educational research; and (c) reading and discussing several of the more "conventional" studies -- i.e., articles that appear in the scholarly journals in psychology, cognitive science, and education bearing about how children learn math and science.

Central Readings:

An Elusive Science: The Troubling History of Educational Research (Lagemann, 2000)

Scientific Research in Education (Shavelson & Towne, 2002)

Course Project: Individual or Group development of project proposals in response to an IES or NSF request for proposals, including discussion of the project's significance and a research plan.

Educational Goals, Instruction, and Assessment

(Taught by Associate Training Director Sharon Carver, Fall 2005)

Overview: Project-based course involving development of learner models and educational goals targeting knowledge, skills, and dispositions required for mastery, followed by matching the instructional program and its valid assessment to learners and goals

Goals: Students will learn to use scientifically-based principles for 1) developing learner models and educational goals based on detailed task analysis of the knowledge, skills, and dispositions required for mastery, 2) matching the instructional program and its valid assessment to learners and goals, and 3) considering additional aspects of learning environments that may impact implementation and evaluation.

Central Readings:

Bain, K. (2004). *What the best college teachers do*. Cambridge, MA: Harvard University Press.

Bransford, J.D., Brown, A.L. & Cocking, R.R. (2000.) *How people learn: Brain, Mind, Experience, and School*. Washington, D.C.: National Academy Press.

National Research Council (2001). *Knowing what students know: The science and design of educational assessment*. National Academy Press: Washington: DC.

Project: This project involves the choice of a specific unit to teach at a particular age level, followed by progressive development of a learner model, task analysis of the learning goals, and design of instruction and assessment. This design will be supplemented by briefly outlining a research program to test key components, and then culminated by class and public presentations of the project.

Additional Features:

* Summer reading response re: the Bain Book (see above) to provide a common foundation for initial discussions

* 3 Field Trips related to Educational Research (lab school, charter school, and children's museum all with strong research base and active research programs)

* Mid-course student evaluation and choice of topics for subsequent 5 weeks

Research Methods in the Learning Sciences

(Co-Taught by Steering Committee Members & Colleagues, Spring 2006)

Overview: Modular course on data collection, design, and analysis methodologies, including cognitive task analysis, video & protocol analysis, ethnography & design experiments, surveys & interviews, psychometrics, and data mining

Goals: To learn data collection, design, and analysis methodologies that are particularly useful for scientific research in education and to help students consider and learn how to apply these methods to their own research programs.

Central Text: Research Methods: The Concise Knowledge Base (Trochim, 2002)

Modules:

Experimental Methods (Ken Koedinger)
Cognitive Task Analysis – Rational (Ken Koedinger)
Video & Verbal Protocol Analysis (Marsha Lovett and Carolyn Rose)
Ethnography & Design Experiments (Ken Koedinger)
Surveys, Questionnaires & Interviews (Sara Kiesler)
Psychometrics, Reliability, Validity & IRT (Brian Junker)
Log Analysis & Data Mining (Richard Scheines and Joe Beck)
Cognitive Task Analysis – Empirical (Ken Koedinger)

Additional Features:

Each module involved specific readings and faculty led discussions, together with student presentations related to applications in their own research and brief experiences with each of the techniques.

Integrative, Interdisciplinary Field-Based Projects

Project Goals:

- 1) to participate in an interdisciplinary research team for a real-world educational research project prior to the dissertation phase of graduate studies
- 2) to experience and appreciate the real-world constraints encountered in educational research
- 3) to develop project management, organizational, and research skills necessary to conduct research in field settings to stretch by learning new methodologies and theoretical frameworks

Project Topics for Cohort 1

Evaluation of On-Line Mathematics Games

Matt Easterday, Elida Laski, and Amy Ogan (PIER Coach: Marsha Lovett)

Collaborators from the Pittsburgh Public Schools – Elem Math

How effective are the computer math games used by elementary school students in the Pittsburgh Public Schools at teaching the intended skills?

Planning in Tutoring Systems

Yvonne Kao and Ido Roll (PIER Coach: Ken Koedinger)

Collaborators from the PSLC LearnLab - Geometry

In what ways is high school students' learning affected by giving them more control of their solution paths during geometry tutor lessons?

Meaningful Assessment for Professional Development Education in the Software Architecture Domain

Elsa Golden (Coaches: Sharon Carver and Brian Junker)

Collaborators from the Software Engineering Institute - Post-Grad Certificate Courses

How can adult learning from short-term workshops be effectively assessed?

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