

UNIVERSITY OF PITTSBURGH

CELEBRATING 50 YEARS OF

LRDC





THIS REPORT CELEBRATES THE UNIVERSITY OF PITTSBURGH LEARNING RESEARCH AND DEVELOPMENT CENTER'S (LRDC) 50 YEARS AS A LEADING INTERDISCIPLINARY CENTER FOR RESEARCH ON LEARNING AND EDUCATION. IT PROVIDES GLIMPSES OF LRDC OVER THE YEARS AND HIGHLIGHTS SOME OF THE EXCITING WORK THAT OCCUPIES OUR CURRENT RESEARCH AND DEVELOPMENT AGENDA.



The Center's interconnected programs of research and development have reflected its mission of stimulating interaction between research and practice across a broad spectrum of problems, from the neural basis of learning to the development of intelligent tutors to educational policy. Among research institutions in learning and education, this interconnected breadth is unique. The Center's research has been equally wide-ranging in the domains of learning it has studied. Reading, mathematics, and science—staples of education—have been a continuing focus over much of LRDC's 50 years. However, the Center also has addressed less-studied learning domains (e.g., history, geography, avionics, and law) as well as the reasoning and intellectual abilities that serve learning across domains. Moreover, social settings for learning, including those outside schools; teaching effectiveness; and technology for learning are all part of LRDC's research story.

LRDC's ability to sustain research programs across these diverse, intersecting problems owes much to the cooperation of its partnering schools and departments in the University. The leadership of the University of Pittsburgh has made possible what is often very difficult: a research center that has been able to effectively pursue truly cross-disciplinary research programs. This partnering has allowed for the development of outstanding faculty members and the training of graduate students and postdocs in research on learning and education.

Understanding learning in its many forms and how it can be enhanced by learning environments, teaching, and learning tools will increase in importance in the coming decades across human societies. LRDC aims to continue to play a significant role in innovative research and development that furthers such understanding.

A handwritten signature in black ink that reads 'Charles A. Perfetti'.

Charles A. Perfetti
Director, LRDC
Distinguished University Professor



University of Pittsburgh

Chancellor of the University

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Mark A. Nordenberg
*Chancellor and Distinguished
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October 4, 2013

University of Pittsburgh
Learning Research and Development Center
Charles A. Perfetti
3939 O'Hara Street
Pittsburgh, PA 15260

Dear Chuck,

I am writing to offer my congratulations to the faculty, students, and staff of the Learning Research and Development Center (LRDC) on its 50th anniversary. Since its establishment in 1963, LRDC has earned a well-deserved reputation as one of the world's most respected research centers focusing on learning and instruction, with an overarching goal of advancing the sciences of learning and education.

The Center's programs of basic and applied research contribute to the science of learning, and its practical school implementation efforts work to obtain sustained improvement in achievement for all children. The Center has made significant research-based contributions to national discussions focusing on educational change. It is no wonder, then, that LRDC has been called upon to play a major role in educational reform and school restructuring throughout the country.

The Center has worked to foster cross-campus collaborative research in areas such as cognitive psychology, cognitive neuroscience, artificial intelligence, and educational science. Its collective work product has had a profound impact on our understandings of how people learn and has broadly influenced approaches to education.

Our University takes great pride in its 226-year legacy of building better lives, and we are fortunate that LRDC has been a part of those efforts for the past 50 years. We are proud of the contributions LRDC has made to the progress of the University and look forward to continuing our efforts to advance the University ever forward.

Sincerely,

A handwritten signature in black ink that reads "Mark A. Nordenberg".

Mark A. Nordenberg
Chancellor

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LRDC

Founding and Follow-through

THE LEARNING RESEARCH AND DEVELOPMENT CENTER (LRDC) SPRANG FROM A PROPOSAL WRITTEN BY FOUNDING DIRECTOR ROBERT GLASER AND UNIVERSITY ADMINISTRATOR J. STEELE GOW IN 1963. THEIR IDEA, AS EXPRESSED IN THE OPENING SENTENCE OF THE PROPOSAL, WAS TO ESTABLISH A CENTER THAT STIMULATED INTERACTION BETWEEN EDUCATIONAL PRACTICE AND SCIENTIFIC KNOWLEDGE:

The problem area on which this Center focuses its attention is that of expediting fruitful interaction between learning research in the behavioral sciences and instructional practice in the schools.

In 1964, the U.S. Department of Health, Education, and Welfare, the precursor to the U.S. Department of Education, funded LRDC at the University of Pittsburgh as a national center for the study of learning, making the Center one of the world's first institutions dedicated to the study of learning and instruction for the improvement of educational practice.

Since LRDC's beginnings in the mid-1960s, its research has reflected several broad themes, including the nature of human learning, knowledge, skill, and expertise across domains; the features of effective teaching and instructional environments; and the development of educational materials and technologies that support learning. In the early years, LRDC's researchers conducted basic studies in instruction that brought behavioral science to instructional design and learning. This period saw the first efforts to tap the computer's potential as an educational tool using what were then state-of-the-art teaching machines. Center research increasingly embraced the "cognitive revolution," which provided descriptions of mental processes, including language, thinking, and problem solving. This period also saw innovative research on the nature of expertise as a way to understand the knowledge and skills that learners approximate as they become more proficient in particular domains.

LRDC became a source of important research on human cognition, including learning in mathematics, literacy, and the aptitudes that constitute intelligence,

as well as on new and challenging areas—high-demand technical skills, specific subject matter learning, expertise in teaching, and learning from texts, among others. LRDC came to be recognized as a model research institute in the cognitive science of learning and instruction. It hosted invitational conferences on emergent issues, many of which resulted in influential published volumes.

With research funding from both federal agencies and foundations, the Center tackled some of education's most persistent problems. Among the many projects during the late 1980s were the U.S. Department of Education's designation of LRDC as a National Research Center on Student Learning; the Andrew W. Mellon Foundation's support of a program of research on the development of reasoning and thinking skills in various school disciplines; and the Ford Foundation's, in one of its largest grants at the time, funding of the Quantitative Understanding: Amplifying Student Achievement and Reasoning (QUASAR) project to examine the feasibility and effectiveness of implementing high-demand mathematics instruction programs in schools serving high-poverty neighborhoods. The New Standards Project of the early 1990s (based on the idea that all students can learn how to think and reason at high levels) was just one of the many education policy projects that aimed to set high standards for student learning. This idea is now guiding the Institute for Learning, which works with school districts and states to improve educational practices. In the 2000s, with support from the National Science Foundation,

Since LRDC's beginnings in the mid-1960s, its research has reflected several broad themes, including the nature of human learning, knowledge, skill, and expertise across domains; the features of effective teaching and instructional environments; and the development of educational materials and technologies that support learning.



the Center joined Carnegie Mellon University in the creation of the Pittsburgh Science of Learning Center to further study the educational technologies that support learning.

At the same time that substantial funding supported large projects, single-investigator projects, generally of smaller scope and shorter length, have continually been conducted by the Center's researchers.

LRDC's research agenda has responded to new problems and opportunities throughout the years, while, at the same time, a continuing commitment to both basic and applied research in interaction with practical problems of learning and education has remained its keystone.

The Center has enjoyed an unusual continuity in its leadership, with only three directors over the course of its 50 years. Robert Glaser led the Center from its establishment in 1963 to 1997. Lauren Resnick was codirector from 1977 to 1997 and director from 1997 to 2008. Charles Perfetti became LRDC's third director in 2008, leading a Center whose renown as an institution for research on learning had been established years before.

The LRDC building was designed by the architectural firm Harrison & Abramovitz and completed in 1974



Mission

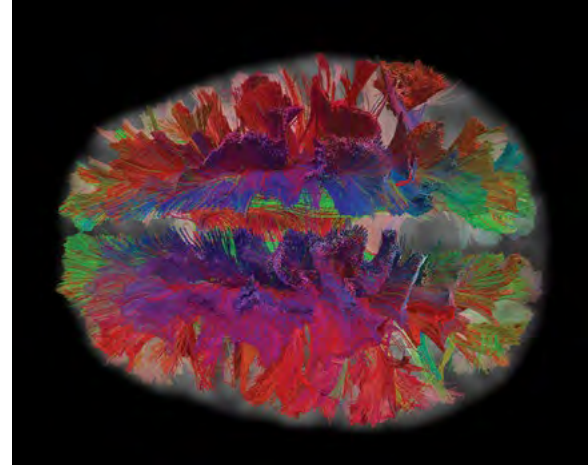
THE MISSION OF THE LEARNING RESEARCH AND DEVELOPMENT CENTER (LRDC) IS TO ADVANCE THE SCIENCE OF LEARNING BY BRINGING TOGETHER RESEARCHERS IN THE COGNITIVE, SOCIAL, AND EDUCATIONAL SCIENCES. THIS MISSION HAS GUIDED LRDC IN ITS PROGRAMS OF BASIC AND APPLIED RESEARCH, ITS DEMONSTRATION PROJECTS, AND ITS WORK IN EDUCATIONAL IMPROVEMENT. IN THE CENTER'S MULTIDISCIPLINARY SETTING, SCIENTISTS STUDY LEARNING IN ITS COGNITIVE, NEURAL, SOCIAL, AND ORGANIZATIONAL ASPECTS, MAKING RESEARCH AND DEVELOPMENT LINKS TO FORMAL EDUCATION PRACTICE, POLICY, AND OUT-OF-SCHOOL SETTINGS.

LRDC has pursued this mission by promoting research that evolves over time and is informed by varied perspectives across multiple disciplines.

Today, research is organized around the following broad areas:

- Cognitive Neuroscience
- Education Policy and Practice
- Higher-level Learning Processes
- Learning Technology
- Out-of-School Learning
- Reading and Language
- Social and Motivational Factors in Learning

Cognitive Neuroscience



OVER THE LAST 20 YEARS, ADVANCES IN THE FIELD OF NEUROIMAGING HAVE ALLOWED LRDC TO LAUNCH STUDIES OF THE NEURAL BASES OF THE COGNITIVE PROCESSES THAT ARE PART OF LEARNING.

Walter Schneider, who brought cognitive neuroscience to LRDC with functional magnetic resonance imaging (fMRI) studies in the early 1990s, has initiated a new effort to develop methods for studying the connections between brain regions and the changes that can occur as a consequence of learning, development, or brain injury. Schneider and his team have generated fundamental advances and new tools for high definition fiber tracking. This bold step forward in imaging technology has opened up new avenues for research and produced tools for understanding how the brain changes in response to learning or injury.

Julie Fiez is studying how the brain uses feedback to learn about words and numbers. Fiez and her collaborators have shown that the basal ganglia facilitate individuals' use of information about positive and negative outcomes to subsequently improve their performance on a task. This research has guided the development of educational interventions that improve basic number representations in the brain and that yield gains in complex math abilities.

authority on reading and how students recognize words. Using behavioral and event-related potential (ERP) methods, Perfetti and researchers in his lab have established that good readers are more effective than poor readers at integrating information about the visual and spoken forms of words and their meanings. This not only helps good readers identify words more quickly and accurately, it also helps them achieve higher levels of reading comprehension.

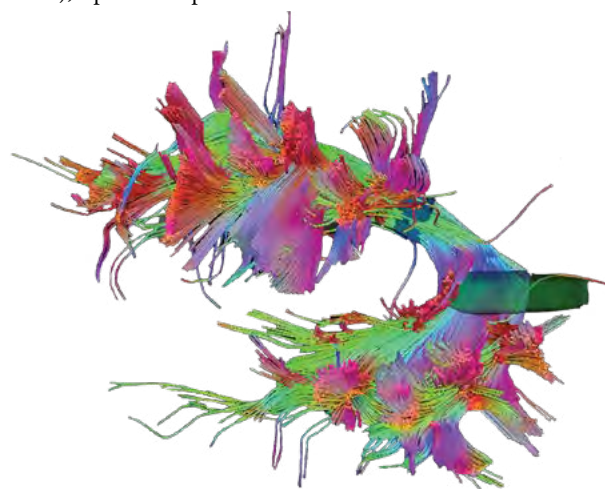
In addition to these core studies, LRDC faculty members apply cognitive neuroscience to a range of domains. In foreign language learning, researchers examine how the brain responds to words in learning a second language. In studies of reading, researchers examine linguistic and conceptual influences on sentence comprehension and how individuals learn to control their eye movements during reading. In the realm of mathematics and science, faculty members use cognitive neuroscience to understand higher-level reasoning processes and the development of mathematical reasoning.

Through its participation in the Center for the Neural Basis of Cognition (CNBC), a partnership of the University of Pittsburgh and Carnegie Mellon University, LRDC contributes to education and training in cognitive neuroscience. LRDC aims to be a leader in the use of neuroimaging methods to study how the brain supports cognition and learning.

Many interacting brain systems and functions are involved in learning, and LRDC research has studied perceptual, attention, memory, and reward systems that support this learning.

Above: Image of the whole brain using High Definition Fiber Tracking (HDFT)

Below: An HDFT image of the language tract



CURRENT FACULTY MEMBERS

- Julie Fiez
- Melissa Libertus
- Charles Perfetti
- Walter Schneider
- Christian Schunn
- Natasha Tokowicz
- Tessa Warren
- Mark Wheeler (departing in 2014)

Many interacting brain systems and functions are involved in learning, and LRDC research has studied perceptual, attention, memory, and reward systems that support this learning. Mark Wheeler has investigated the neural mechanisms of sensory-specific memories and the decision making that depends on memory and perceptual systems.

LRDC Director Charles Perfetti is a leading

Education Policy and Practice

LRDC'S RESEARCH ON CLASSROOM-BASED TEACHING AND LEARNING HAS EXPANDED OVER THE PAST DECADE TO INCLUDE RESEARCH ON HOW ORGANIZATIONS AND POLICIES SHAPE INSTRUCTION AND AFFECT STUDENT LEARNING. TOGETHER WITH LRDC'S EVALUATION FOR LEARNING GROUP AND THE INSTITUTE FOR LEARNING, THE FACULTY MEMBERS WHO MAKE UP THE EDUCATION POLICY AND PRACTICE GROUP BRING CONSIDERABLE POWER TO THE ANALYSIS OF PROBLEMS OF PRACTICE AT VARIOUS LEVELS WITHIN THE EDUCATION SYSTEM. THESE RESEARCHERS ALSO CONTRIBUTE TO DEVELOPING NEW METHODOLOGIES FOR DESIGNING, IMPROVING, AND TESTING THE EFFECTIVENESS OF INTERVENTIONS TO ALLEVIATE THOSE PROBLEMS.

Classroom-based research on instructional practice coupled with analyses of teacher knowledge and teacher learning is a mainstay of LRDC's educational research. Researchers including Gaea Leinhardt, Margaret Smith, Associate Director for Educational Research and Practice Mary Kay Stein, and Margaret McKeown conduct intensive investigations of instructional practice and student learning in classrooms. Many of their findings have been incorporated broadly across the country in the form of instructional materials for students or casebooks for teacher professional development. Using a design-based approach to research, Christian Schunn designs and studies interventions in a variety of areas, including

science and writing, with similarly wide-scale uptake and use. Lauren Resnick's work using an instructional concept called Accountable Talk® examines reasoning in student discussions about classroom content.

Over the past several years, this group has expanded its reach to include the ways in which policy and organizations shape what happens in schools and classrooms. For example, Jennifer Lin Russell examines how teachers' social networks

influence the quality of their instruction. She uses social network analyses to study teacher learning at multiple levels of the educational system, including the role played by organizations. Richard Correnti applies his statistical expertise to the measurement of instruction in both literacy and mathematics as well as to the design of large-scale quantitative studies that are well positioned to answer questions of causality.

Several of the researchers in this group are associated with the Learning Policy Center (LPC). Established in 2007 as a joint venture between LRDC and the University of Pittsburgh School of Education, LPC advances ideas that lie at the intersection of policy and learning by conducting and disseminating research on educational reform. With Stein as its founding director, LPC is based on the proposition that ambitious policies—such as standards-based reform—require professionals at all levels of the education sector to learn how to think and behave in new and complex ways.

According to School of Education Dean and LRDC Senior Scientist Alan Lesgold, "The value of having a policy center located in a Research I University such as Pitt is the availability of scholarly talent who can buttress arguments made to policymakers with both theoretical acumen and empirical evidence."

In related research on learning organizations, the Evaluation for Learning (EFL) Group, codirected by William Bickel and Research Associate Jennifer Iriti, works with local and national institutions on the design, evaluation, and strategic assessment of a wide variety of educational programs and reform efforts.

The value of having a policy center located in a Research I University such as Pitt is the availability of scholarly talent who can buttress arguments made to policymakers with both theoretical acumen and empirical evidence.

CURRENT FACULTY MEMBERS

William Bickel

Richard Correnti

Lindsay Clare Matsumura

Margaret McKeown

Anthony Petrosky

Lauren Resnick

Jennifer Lin Russell

Christian Schunn

Margaret Smith

Mary Kay Stein



A theme of the EFL work is using evaluative inquiry to support improved decision making by educational leaders, practitioners, and policy shapers.

The Institute for Learning (IFL) at LRDC, founded by Resnick and now codirected by Associate Dean of the School of Education Anthony Petrosky, has become a major source of expertise for school systems (especially those in urban areas) as they attempt to restructure themselves to respond to the demands for higher standards in schooling for all students. Since 1995, IFL has worked with more than 70 urban districts across the country that have adopted high academic standards and assessments geared to those standards. IFL fellows work on site and online to help leaders establish school-based professional development systems that prepare their staffs to teach effectively to these standards. The Institute conducts seminars on instruction and learning and professional development, provides tools for analyzing and improving classroom practice, and runs programs for school principals who are learning to function as instructional leaders. IFL's professional development activities are enhanced with materials—texts, videos, and interactive media—that are tailored to the needs of the districts. IFL also produces curricula and assessments to help districts and states meet the requirements of the Common Core State Standards.



Top: A teacher and students at Falk Laboratory School, which is affiliated with Pitt's School of Education

Above: Fellows and staff of LRDC's Institute for Learning



Above: High school students and their poster at the annual University of Pittsburgh/Westinghouse Electric Company High School Innovative Design Competition

Right: Young students at the Lawrence Hall of Science at the University of California, Berkeley, a research project site



The Regents of the University of California

Higher-level Learning Processes

CENTER RESEARCHERS HAVE A RICH TRADITION OF STUDY FOCUSED ON UNDERSTANDING THE COGNITIVE PROCESSES UNDERLYING HIGHER-LEVEL REASONING IN COMPLEX TASKS. EARLY WORK LED TO IMPORTANT DISCOVERIES ABOUT THE NATURE OF EXPERTISE, THE ROLE OF SELF-EXPLANATION IN LEARNING, AND THE DEVELOPMENT OF DOMAIN KNOWLEDGE. CURRENT RESEARCH IN THIS AREA CUTS ACROSS ALMOST ALL THEMATIC AREAS IN THE CENTER.

A broad conceptual definition of a psychology of expertise was advanced by Robert Glaser and Senior Scientists Michelene Chi and James Voss. They discovered that experts and novices in a domain represent problems in fundamentally different ways and use fundamentally different approaches in solving complex problems. Another seminal discovery demonstrated that student learning is particularly effective when students try to explain to themselves as they read.

A unique feature of the Center's early work was its content-specific analyses of knowledge, learning, expertise, and teaching, specifically in the areas of mathematics and science. An important continuing theme is that learning is both general (guided by general learning processes) and domain dependent (influenced by the specific content of a domain).

and has led to an array of casebooks and tools for teachers and teacher educators. Christian Schunn studies the reasoning of scientists and engineers as they work to solve problems and relates these studies to reforming science curricula. Schunn's work also has included engineering as a motivator for middle and high school students' learning science and using mathematics to model scientific processes. Timothy Nokes-Malach studies problem solving, including analogy, collaborative problem solving, conceptual change, and expertise.

Studies of higher-level learning processes cross boundaries into other disciplines as well. Combining his background in law and computer science, Kevin Ashley studies legal reasoning to understand cognitive processing, which in turn informs his work on intelligent tutoring systems for legal education.

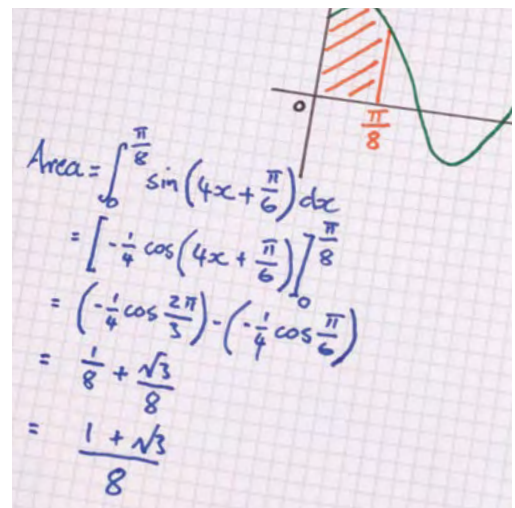
Other research, both past and present, has focused on reasoning and learning in less well-structured domains, including medicine, applied science (e.g., weather forecasting), social science (e.g., political science), and humanities (e.g., history). Looking forward, there will be increasing cross-connections among work on higher-level reasoning, educational policy, social aspects of learning, educational technologies, and even cognitive neuroscience.

Looking forward, there will be increasing cross-connections among work on higher-level reasoning, educational policy, social aspects of learning, educational technologies, and even cognitive neuroscience.

CURRENT FACULTY MEMBERS

- Kevin Ashley
- Muhsin Menekse
- Timothy Nokes-Malach
- Benjamin Rottman
- Christian Schunn
- Mary Kay Stein

More recent work on the use of instructional tasks in classrooms has been influential in both research and practice. Mary Kay Stein's research on the ways in which teachers and students can either maintain or decrease the cognitive demand of instructional tasks as they work on them has inspired a line of research in mathematics education



Learning Technology



TECHNOLOGY IN THE SERVICE OF LEARNING AND TEACHING HAS BEEN A CONTINUOUS THEME AT LRDC. ALTHOUGH THE FOCUS CHANGES WITH ADVANCING TECHNOLOGY AND NEW UNDERSTANDING OF LEARNING PROCESSES, A SUSTAINING PRINCIPLE IS THAT TECHNOLOGY MUST ACCOMMODATE PRINCIPLES OF LEARNING AND TEACHING IN ITS DESIGN. THIS PRINCIPLE HAS GUIDED THE DEVELOPMENT OF INSTRUCTIONAL SYSTEMS SINCE THE INCEPTION OF THE CENTER.

Technology in the service of learning and teaching has been a continuous theme at LRDC. Although the focus changes with advancing technology and new understanding of learning processes, a sustaining principle is that technology must accommodate principles of learning and teaching in its design.

LRDC researchers have developed educational software in a range of domains, such as guided discovery environments in microeconomics and middle school science (Robert Glaser and Research Associate Kalyani Raghavan). Research in intelligent tutoring has included the development of an avionics tutor (Alan Lesgold), a physics tutor (Senior Scientist Kurt VanLehn and colleagues), and research on improving intelligent tutor explanation capabilities (Senior Scientist Johanna Moore and colleagues). Graduate students working on these projects came primarily from the University of Pittsburgh Intelligent Systems Program (ISP), a multidisciplinary graduate program dedicated to the study of applying artificial intelligence to the fields of education, law, medicine, and business.

teaching science to Christian Schunn's creation of Web-based environments for teaching writing in the disciplines via peer review.

Jingtao Wang's research focuses on learning via mobile devices. His work includes exploring motivation for micro-learning, or short-term learning activities. Wang also studies adaptive learning and cognitive workload and, in collaboration with Walter Schneider, is creating a programming environment for designing learning tasks on smartphones and tablet devices.

Kevin Ashley is extending artificial intelligence technologies into ill-defined domains such as ethics and law. Ashley is combining computer-supported argument diagramming with Schunn's peer review tools in order to help students understand the process of reasoning with rules and cases as illustrated in U.S. Supreme Court oral arguments. Both Ashley and Litman also are adding intelligent scaffolding to Schunn's peer review tool based on artificial intelligence technologies. In particular, natural language processing first determines whether the feedback comments produced by students during peer review are of good quality. If not, the system intervenes in ways designed to help students revise and improve their feedback. In other work, Litman is exploring the use of natural language processing to support fully automated writing assessments.

Research at the Center today extends that work and the connection to the ISP program, of which

Diane Litman is director. Litman has been developing computational tutorial dialogue systems that allow students to interact with computer tutors using typed and spoken natural language conversations. These systems engage students in conversations during both problem solving and postsolution reflection and respond not only to what students say but also how they say it.

CURRENT FACULTY MEMBERS

Kevin Ashley
Alan Lesgold
Diane Litman
Walter Schneider
Christian Schunn
Jingtao Wang

Researchers also are building systems to explore issues in learning via peer instruction. Approaches range from Research Associates Pamela Jordan and Sandra Katz's development of automated computer dialogue agents that can participate in interactions for

Today, researchers are part of the emerging discipline of educational data mining, the use of educational databases to help inform educational and learning processes. Here, technology is being used to develop methods for exploring the unique types of data that come from educational settings in order to better understand students and the settings in which they learn.

Top: Multidimensional data on handheld devices

Right: Early example of students pacing their learning

Far right: Example of a contemporary student using an intelligent tutoring system



Out-of-School Learning

RESEARCH IN OUT-OF-SCHOOL LEARNING EXAMINES WHAT IT MEANS TO DEVELOP AND LEARN AS A RESULT OF EXPERIENCES AND SETTINGS BEYOND THE CLASSROOM. WHEREAS EARLY RESEARCH FOCUSED ON ADULT LEARNING IN NONACADEMIC SETTINGS, TODAY'S SCHOLARSHIP REFLECTS THE REALITY THAT LEARNING OCCURS IN MANY SETTINGS AND THAT LEARNERS ARE TAKING INCREASED CONTROL OVER THEIR OWN LEARNING IN NONTRADITIONAL AND OUT-OF-SCHOOL ENVIRONMENTS.



Today's scholarship reflects the reality that learning occurs in many settings and that learners are taking increased control over their own learning in nontraditional and out-of-school environments.

In the 1980s and 1990s, Center research in this area included Alan Lesgold's development of intelligent tutoring systems for avionics trainees in the U.S. Air Force. In the area of medical training, Lesgold studied how radiologists develop expertise to interpret X-rays. Lesgold also collaborated with companies such as Intel Corporation to develop standardized technology for intelligent technical training systems and with the World Bank to undertake cognitive task analysis of complex training tasks. More recently, Frits Pil has explored the factors that influence decisions related to which workers receive training investments by companies.

The Center's long-term involvement in apprenticeship and school-to-work programs, such as the state of Pennsylvania's "Jobs for the Future" projects, also were part of early out-of-school research.

CURRENT FACULTY MEMBERS

Kevin Crowley

Frits Pil

Jennifer Lin Russell

Jingtao Wang

Gaea Leinhardt's Museum Learning Collaborative linked researchers and museums to provide theoretical explanations for the learning that occurs in museums.

Current research in this area continues to examine learning in a variety of

environments. Kevin Crowley, an early collaborator of Leinhardt's, studies the way museums—especially science museums—serve as forums for family learning. Now director of the Center for Learning in Out-of-School Environments (UPCLOSE), Crowley conducts a wide range of research—the use of robots to understand the impact of technology experiences on learning, examining how the public engages with

climate change education, and studying learning in art-based studio settings. Crowley was key in founding the Center for Lifelong Science Learning at Pittsburgh's Carnegie Museum of Natural History. Ongoing research at the Carnegie Museum investigates how a natural history museum can become a positive force for local and national educational improvement. Crowley also studies how informal educational organizations, such as museums and community centers, collaborate with schools and districts to expand educational opportunities for children and youth.

Out-of-school learning has always encompassed the organizational aspects of learning in diverse settings. Jennifer Lin Russell examines educational improvement initiatives through an organizational perspective, specifically the ways in which organizations and organizational networks shape students' opportunities to learn. Pil continues to study organizational learning, adaptability, and change in a host of industries. Jingtao Wang investigates how to support learning on mobile technology—smartphones and tablet devices—and how students engage with mobile devices.

LRDC is actively working on professional development and policy issues in out-of-school learning as well. UPCLOSE developed and continues to host Informal Science, the field's primary Web site for collecting, sharing, and using research and evaluation tools in the context of informal science. UPCLOSE also coleads the national Center for Advancement of Informal Science Education, which works to connect the informal science education community, including film and broadcast media, science centers and museums, zoos, aquariums, nature centers, digital media, and after-school programs, to name a few.

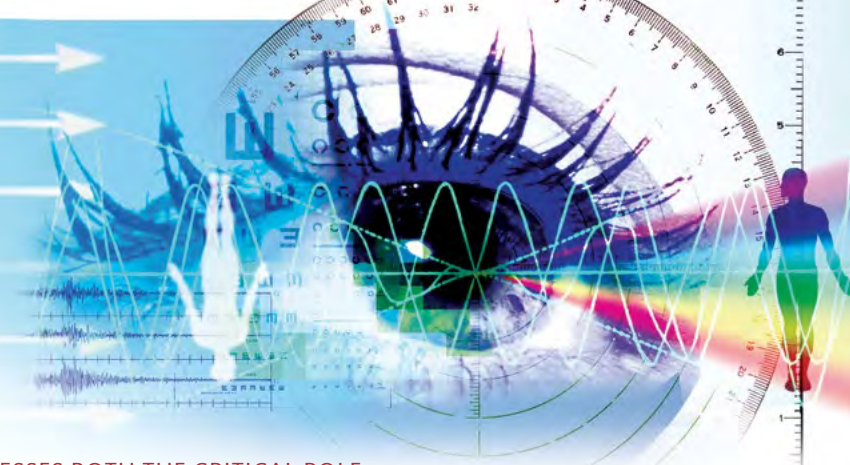
Above: Children at Pittsburgh's Carnegie Museum of Natural History and, right, at the Children's Museum of Pittsburgh—both research project sites



children's
museum
PITTSBURGH



Reading and Language



LRDC'S RESEARCH ON READING AND LANGUAGE ADDRESSES BOTH THE CRITICAL ROLE OF LITERACY IN EDUCATIONAL ACHIEVEMENT AND THE IMPORTANT SCIENTIFIC QUESTIONS THAT HAVE MADE LANGUAGE AND READING CENTRAL TOPICS IN COGNITIVE SCIENCE.

A foundation for reading is learning to decode written language into spoken language. In the 1970s, Isabel Beck and her colleagues developed a decoding program that included teaching children to “blend” letter sounds into syllables, solving one of the alleged obstacles to decoding instruction. During the same period, research by Charles Perfetti and Alan Lesgold demonstrated strong links between word decoding ability and text comprehension. Later research by Perfetti established that even skilled adult readers accessed the sounds of words while reading silently.

Research also has addressed comprehension of the meanings of texts, sentences, and words. Beck and Margaret McKeown study both word learning (vocabulary) and text comprehension and have developed instruction to support students’ learning of semantically rich concepts and to help students get meaning from text (questioning the author). Complementing this instructional work is basic research on learning and using word meanings, including studies of the neural correlates of word learning by Perfetti. Researchers at the Center were among the first to extend the study of comprehension

to learning and integrating information from multiple texts and documents.

CURRENT FACULTY MEMBERS

Isabel Beck (Emerita)

Julie Fiez

Margaret McKeown

Charles Perfetti

Walter Schneider

Natasha Tokowicz

Tessa Warren

Eye tracking and event-related potential (ERP) methods have allowed a close-up view of word identification, word learning, and comprehension. An influential model of how attention, perception, and cognition coordinate to drive eye movements during reading was developed by Erik Reichle and colleagues.

Tessa Warren’s research on comprehension uses eye movements to track the word-by-word processes that lead both to momentary difficulties and ultimate success in comprehension, demonstrating the roles of knowledge of language and real-world knowledge. Perfetti and Natasha Tokowicz use ERPs, recordings of electrophysiological processes in the brain, to study word-by-word reading and comprehension processes.

Second language learning and bilingualism are now prominent in research, with studies of adult learners of Chinese, Spanish, German, and English. Tokowicz studies the effects of knowing two languages on language processing, an important topic in a world in which most people speak two or more languages. Her studies have identified difficulties encountered in a second language because of translation ambiguity, as when a word in one language corresponds to two or more words in another language.

Comparative research has sought to identify the shared and distinctive processes that function across different languages and writing systems. Research by Perfetti and Julie Fiez found that writing systems as different as Chinese and English show both similarities and differences in reading at both behavioral and brain levels.

The cognitive neuroscience of reading is now a key part of LRDC’s research on language learning and reading. For example, Fiez has developed a new method to clarify the role of the left hemisphere’s “visual word form area” by introducing writing consisting of human faces, which do not ordinarily engage this area of the brain. This work may suggest that alternative reading pathways in the brain (involving the right fusiform) can be exploited in reading.

LRDC’s research on reading and language addresses both the critical role of literacy in educational achievement and the important scientific questions that have made language and reading central topics in cognitive science.

Left: Placing an electrode cap to record event-related potentials (ERPs)



Social and Motivational Factors in Learning

KNOWLEDGE ACQUISITION AND USE, BOTH INSIDE AND OUTSIDE THE CLASSROOM, ARE STRONGLY INFLUENCED BY THE SOCIAL CONTEXT IN WHICH LEARNING OCCURS. IN PARTICULAR, THIS CONTEXT OFTEN HAS POWERFUL EFFECTS ON MOTIVATION TO LEARN. EARLY LRDC RESEARCH IN THIS DOMAIN INCLUDED GAEA LEINHARDT'S RESEARCH ON TEACHER-STUDENT INTERACTION, JOHN LEVINE'S WORK ON SOCIAL COMPARISON, SHARON NELSON-LE GALL'S DISCOVERIES ABOUT HELP SEEKING IN CLASSROOMS, AND JANET SCHOFIELD'S INVESTIGATIONS INTO THE SOCIAL DYNAMICS OF DESEGREGATED SCHOOLS AND THE EFFECTS OF TECHNOLOGY IN CLASSROOMS.

Today, researchers are engaged in several lines of work designed to clarify the impact of social and motivational factors on learning and performance. This work is eclectic in regard to the questions asked, the contexts studied, the methodologies employed, and the relative emphasis on theoretical and applied issues.

For example, Levine and Timothy Nokes-Malach are using laboratory experiments to investigate the conditions under which disagreement and debate in small groups enhance participants' thinking and learning. Levine also is conducting experiments on group learning, with a special focus on the conditions under which newcomers change the work practices of teams they enter. Nokes-Malach is investigating how students' beliefs about the nature

of intelligence affect their ability to profit from different forms of instruction.

CURRENT FACULTY MEMBERS

Kevin Crowley

John Levine

Timothy Nokes-Malach

Frits Pil

Christian Schunn

Ming-Te Wang

This laboratory research is complemented by field research in a variety of settings, including automobile plants, schools, and science museums.

Frits Pil is studying various aspects of organizational learning, including where organizational knowledge originates, where it resides,

and how it is transferred and leveraged within and across organizational boundaries. Christian Schunn and Kevin Crowley are examining the bidirectional relationship between early (in- and out-of-school)

science learning experiences and combinations of motivations and skills that lead to gradually increasing or decreasing long-term engagement with science in career choices and in everyday use of science.

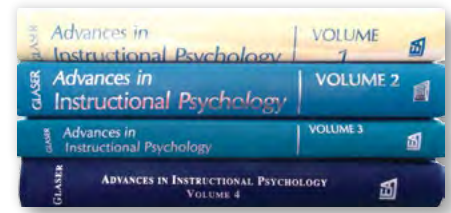
Looking forward, researchers are increasingly examining the conjoint relationship of cognitive and affective factors in learning—how motivations and social beliefs drive the use of particular cognitive strategies of learning. Other areas of investigation include how social relationships between learners influence knowledge acquisition and use at the level of the individual and the group and how particular learning strategies produce learning-related affective experiences and attitudinal shifts.

Knowledge acquisition and use ... are strongly influenced by the social context in which learning occurs. In particular, this context often has powerful effects on motivation to learn.



Left and right: Children at Pittsburgh's Carnegie Museum of Natural History, a research project site

Contributions to Research and Development



LRDC SCIENTISTS HAVE CONTRIBUTED TO THE RESEARCH AREAS OF THEIR ACADEMIC DISCIPLINES AND TO THE EMERGING CROSS-DISCIPLINARY SCIENCES OF LEARNING AND EDUCATION. THESE CONTRIBUTIONS INCLUDE INFLUENTIAL RESEARCH ARTICLES, FIELD-SHAPING CONFERENCES, AND INNOVATIVE EDUCATIONAL TOOLS, SOME OF WHICH ARE HIGHLIGHTED IN THE SECTIONS THAT FOLLOW.

CONTRIBUTIONS TO RESEARCH

To facilitate the rapid dissemination of research in the predigital age, and at a time when few journals published cross-disciplinary work, the Center created its own series of publications, beginning in 1967 with Robert Glaser’s “The New Pedagogy” as the first in a series of 60 “Working Papers” published from 1967 to 1970. Then, launched in 1970, the “LRDC Publications Series” produced reprints of journal publications and peer-reviewed prepublication technical reports, averaging between 25 and 30 papers per year.



Among many important publications in the earlier years of LRDC are two landmark series that helped to shape the emerging field of instructional science. In 1979, Glaser edited the first volume of *Advances in Instructional Psychology* (Vol. 1, 1979) and he later edited four subsequent volumes to document progress in this new field. In 1982, Lauren Resnick founded *Cognition and Instruction*, the first journal dedicated to “issues concerning the mental, socio-cultural, and mediational processes and conditions of learning and intellectual competence.”

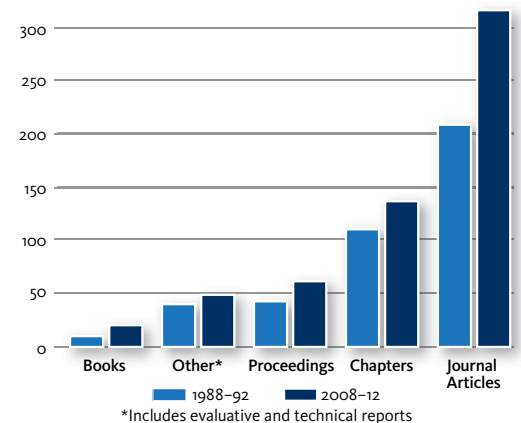
Publications Over the Years

The figure at right provides a snapshot of LRDC’s publication profile at two five-year intervals: from 1988 to 1992 and 20 years later, from 2008 to 2012. The number of LRDC faculty members was the same across the two periods (26–27); however, the number of graduate students and postdoctoral fellows increased. There are small increases across time in most categories, with journal articles showing a marked increase during the

2008–12 period. The trend toward more journal articles relative to chapters and books reflects a general trend in academic publishing in the sciences. However, the comparison shows an overall increase in publications, including the continued publication of chapters and books. Recent chapter contributions, including those to handbooks and encyclopedias, are indicative of the accomplishments and professional standing of senior faculty members.

Bibliometrics

Across all LRDC research areas, there has been a sustained record of publications, many with substantial impact, that has come to be assessed by various bibliometrics. The number of citations for all papers published is an indicator of overall impact. Among LRDC senior scientists (who are full professors), the average number of citations was more than 7,000 as of September 2013. Because total citations can be skewed by a single publication with many citations (e.g., a textbook), a more refined measure is the h-index, which captures the number of papers that have been highly cited. The h-index is the number of papers (n) that have received at least n citations. An h-index of 10 means an author has published at least 10 papers, each of which has been cited at least 10 times, with some having been cited many more times. Among LRDC senior scientists currently active in research, all have h-indexes (tallied through Google Scholar) of 15 or more, while 10 have h-indexes of more than 30—a benchmark for very high impact by any measure.



CONTRIBUTIONS TO DEVELOPMENT

Development of Educational Tools

The development of instructional materials has been an important part of LRDC from its inception. A common idea about the design of educational tools, including professional development materials, curricula, and tutoring systems, is that researchers make discoveries about learning that are then translated into useful applications by someone else. However, the reality is usually different from this one-way, linear research-to-development route. It involves complex multidirectional interactions among researchers and practitioners and almost always relies on researchers who see the value of development. At LRDC, researchers have been involved in the development of educational tools across almost all domains of study.

Early examples of curriculum materials include the New Reading System, an adaptation of commercially available materials (Isabel Beck and colleagues), and Individualized Science, an exploration of how elementary students think about science (Audrey Champagne and Leo Klopfer). Other projects include Model-based Analysis and Reasoning in Science (MARS), a curriculum in which students learn by reasoning with models (Robert Glaser and Research Associate Kalyani Raghavan), and several

approaches for teaching reading comprehension and vocabulary: Questioning the Author, Text Talk, and Robust Vocabulary Instruction (Beck, Margaret McKeown, and colleagues). Literacy software (Syllasearch) and text materials (Text Talk) also have been developed by Beck, McKeown, and their colleagues. QUASAR researchers Mary Kay Stein and Margaret Smith, along with Senior Scientist Edward Silver, focused on the development of casebooks for use in teacher

professional development. Christian Schunn has developed Scaffolded Writing and Reviewing in the Disciplines (SWoRD), a Web-based reciprocal peer review system used to support writing instruction in discipline courses such as history and science. SWoRD is currently licensed by Panther Learning, a firm that specializes in the large-scale deployment of scalable assessment.

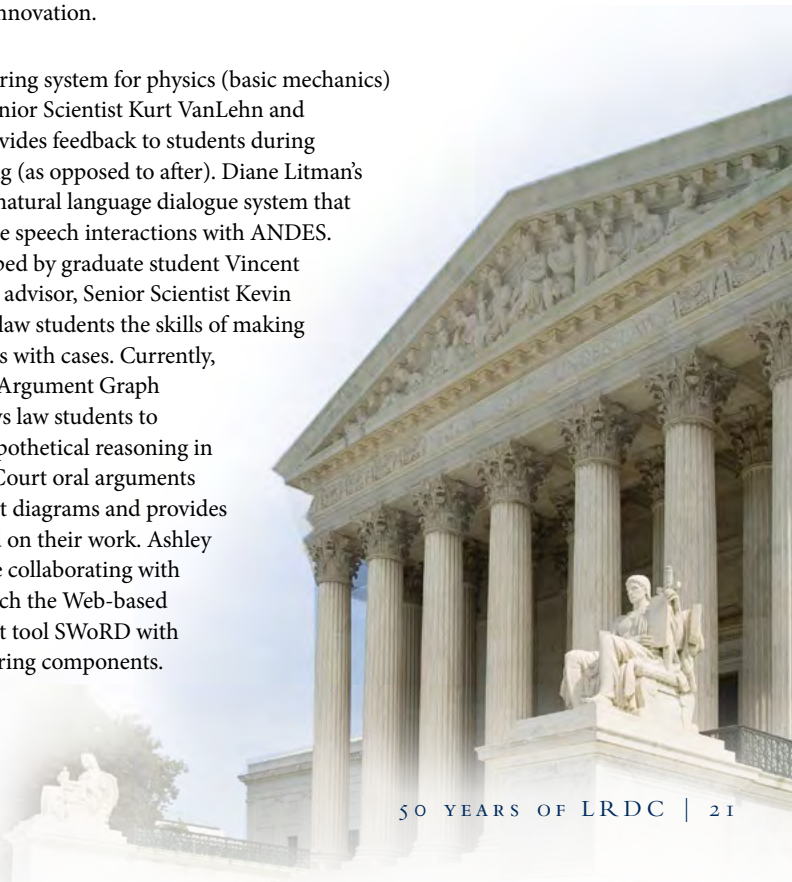
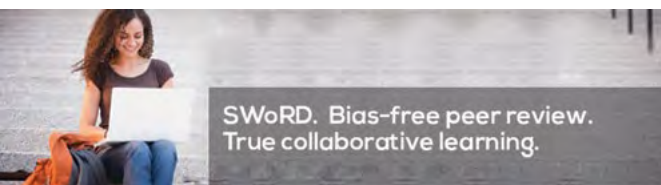
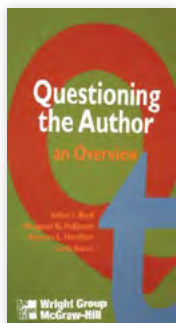
The Institute for Learning (IFL) develops and produces materials, including texts, videos, and interactive media, for its training programs;

among them are Principles of Learning: Study Tools for Educators, Clear Expectations: Putting Standards to Work in the Classroom, and the e-book *Principles of Learning for Effort-based Education*. Keeping pace with today's technology-rich learning environments is IFL's Accountable Talk: Conversation That Works, among the first of the University of Pittsburgh's massive open online course offerings released in the fall of 2013 through Coursera.

Learning Tools with Artificial Intelligence

LRDC researchers have developed computer-delivered instruction, including intelligent tutoring systems, and current technological advances, such as natural language processing, in several domains. Early systems built on advances in cognitive psychology that illuminated reasoning and thinking skills in various disciplines. Sherlock, an avionics tutoring system, was designed by Alan Lesgold and Research Associate Sandra Katz for the U.S. Air Force to give trainees coached practice ("learning by doing") in a simulated avionics workshop environment. Katz recently expanded Sherlock with natural language dialogues that allow students to review problems and research platforms in order to test hypotheses about the language features that influence effective tutoring. Lesgold also developed Belvedere with Dan Suthers and colleagues to help students envision arguments graphically and develop them more completely. Smithtown, an intelligent tutoring system created by Research Associate Kalyani Raghavan along with Robert Glaser, assisted students in learning the principles of economic reasoning. Smithtown won EDUCOM/IBM Awards for Best Social Sciences Software and Best Instructional Innovation.

ANDES, a tutoring system for physics (basic mechanics) designed by Senior Scientist Kurt VanLehn and colleagues, provides feedback to students during problem solving (as opposed to after). Diane Litman's ITSPROKE is a natural language dialogue system that allows real-time speech interactions with ANDES. CATO, developed by graduate student Vincent Aleven and his advisor, Senior Scientist Kevin Ashley, taught law students the skills of making legal arguments with cases. Currently, Ashley's Legal Argument Graph Observer allows law students to reconstruct hypothetical reasoning in U.S. Supreme Court oral arguments using argument diagrams and provides feedback based on their work. Ashley and Litman are collaborating with Schunn to enrich the Web-based writing support tool SWoRD with intelligent tutoring components.

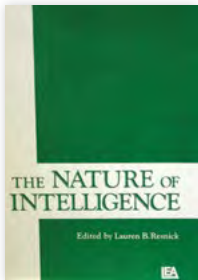


A Convener of Field-shaping Conferences

THE CENTER HAS ORGANIZED PERIODIC INVITATIONAL CONFERENCES ON IMPORTANT EMERGING ISSUES, A NUMBER OF WHICH HAVE RESULTED IN HIGHLY CITED PUBLISHED VOLUMES. A FEW OF THESE ARE AS FOLLOWS:

1966: APPROACHES TO THOUGHT

At a time when studies of complex cognition were just emerging, this October 1966 conference brought thinking into focus from a wide variety of perspectives. *Approaches to Thought*. (1969). James F. Voss, Editor, Merrill Publishing.



1974: THE NATURE OF INTELLIGENCE

Researchers at this March 1974 conference examined cognitive and adaptive processes involved in intelligent behavior and investigated how these processes might be related to intelligence. *The Nature of Intelligence*.

(1976). Lauren B. Resnick, Editor, Lawrence Erlbaum Associates (LEA).

1976: RESEARCH AND DEVELOPMENT AND SCHOOL CHANGE

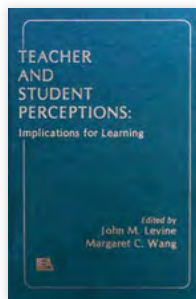
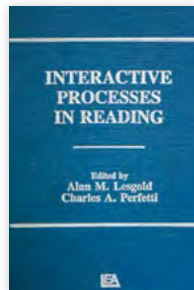
Held in March of 1976, this symposium marked the dedication of LRDC's new building and was a tribute to Ralph W. Tyler, retiring chair of LRDC's Board of Visitors. *Research and Development and School Change*. (1978). Robert Glaser, Editor, LEA.

1976: THEORY AND PRACTICE OF EARLY READING (VOLUMES 1, 2, 3)

A series of three conferences beginning in 1976 featured researchers from across the spectrum of reading and literacy. Participants considered the goal of reading instruction, how reading skill is acquired, and what the process of acquiring reading skill suggests for reading instruction. Three volumes resulted. *Theory and Practice of Early Reading, Vols. 1, 2, and 3*. (1979). Lauren B. Resnick and Phyllis A. Weaver, Editors, LEA.

1979: INTERACTIVE PROCESSES IN READING

This September 1979 conference was a call to consider the interactive influences of word identification and higher-level comprehension processes in reading. The book includes some of the most highly cited chapters in the reading field as well as the editors' whimsical "Bill of Fare of the Reading Restaurant." *Interactive Processes in Reading*. (1981). Alan M. Lesgold and Charles A. Perfetti, Editors, LEA.



1979: TEACHER AND STUDENT PERCEPTIONS: IMPLICATIONS FOR LEARNING

This conference reflected the increasing awareness of the importance of social processes in classrooms, including students' feelings and beliefs about themselves and their responses to others both inside and outside the school environment. *Teacher and Student Perceptions: Implications for Learning*. (1983). John M. Levine and Margaret C. Wang, Editors, LEA.

1985: THINKING AND LEARNING SKILLS

With support from the National Institute of Education, this conference examined educational practices and scientific investigation concerned with students' abilities to understand, reason, solve problems, and learn. *Thinking and Learning Skills: Vol. 1: Relating Instruction to Research. Vol. 2:*

Thinking and Learning Skills: Research and Open Questions. (1985). Susan F. Chipman, Judith W. Segal, and Robert Glaser, Editors, LEA.

1988: THE NATURE OF EXPERTISE

Spurred by innovative research on expertise and sponsored by the Personnel and Training Research Program of the Office of Naval Research, this conference examined expertise in its many disparate domains, from waiters memorizing restaurant orders to radiology technicians interpreting X-ray pictures. *The Nature of Expertise*. (1988). Michelene T.H. Chi, Robert Glaser, and Marshall J. Farr, Editors, LEA.



1989: PERSPECTIVES ON SOCIALLY SHARED COGNITION

This February 1989 conference brought together researchers who represented emerging and diverse approaches to thinking as a sociocognitive activity to stimulate an agenda for future research. *Perspectives on Socially Shared Cognition*. (1991). Lauren B. Resnick, John M. Levine, and Stephanie D. Teasley, Editors, American Psychological Association.



1991: INFORMAL REASONING AND EDUCATION

The increasing realization that much of reasoning occurs in situations outside well-structured domains led to this Office of Education-sponsored conference, which



contributed broadly to the developing field of informal reasoning. *Informal Reasoning and Education*. (1991). James F. Voss, David N. Perkins, and Judith W. Segal, Editors, LEA.

2007: HUMAN AND SOCIAL CAPITAL IN LEARNING SYSTEMS

This February 2007 conference brought scholars and policymakers from around the country to discuss the ways in which social and human capital are influenced by school district approaches to reform and how these forms of capital influence teachers' uptake of instructional innovation.

2009: RESEARCH FOR PRACTICE

This one-day conference in April 2009 featured some of the country's leading education voices to consider new ways of configuring the relationship between research and the improvement of educational practice. Speakers included the former director of the Institute of Education Sciences and the president of the Carnegie Foundation for the Advancement of Teaching.

2011: SOCIALIZING INTELLIGENCE THROUGH ACADEMIC TALK AND DIALOGUE

This September 2011 conference brought together researchers from diverse disciplines to discuss evidence for the role of dialogic interaction in acquiring disciplinary knowledge, transfer, academic language development, and argumentation and reasoning skills. *Improving Teaching at Scale: Design for the Scientific Measurement and Development of Discourse Practice*. (In press). Lauren B. Resnick, Christa Asterhan, and Sherice Clarke, Editors, American Educational Research Association.

FESTSCHRIFTEN

A FESTSCHRIFT, A BOOK CELEBRATING THE WORK OF A SCHOLAR, USUALLY CONTAINS ORIGINAL CONTRIBUTIONS FROM COLLEAGUES, FORMER STUDENTS, AND OTHERS IN THE SCHOLAR'S FIELD.



ROBERT GLASER

The Festschrift for Robert Glaser marked the 20th anniversary of the Center and was commemorated by a five-day conference of unusual intellectual liveliness during which issues of fundamental importance to the cognitive science of instruction were debated. *Knowing, Learning, and Instruction: Essays in Honor of Robert Glaser*. (1989). Lauren B. Resnick, Editor, LEA.

LAUREN B. RESNICK

Talk and Dialogue: How Discourse Patterns Support Learning was a three-day conference held in May 2005 and served as a Festschrift for then LRDC Director Lauren Resnick. Speakers presented papers on one of Resnick's many areas of interest and expertise: the role of talk and dialogue in learning.

ISABEL BECK

A May 2007 conference honored Isabel Beck by hosting researchers whose work was influenced by or related to her work in basic reading, vocabulary, and comprehension. *Bringing Reading Research to Life*. (2010). Margaret G. McKeown and Linda Kucan, Editors, The Guilford Press.



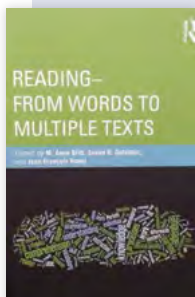
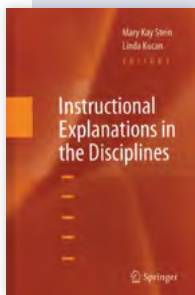
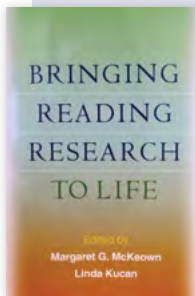
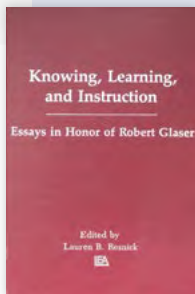
GAEA LEINHARDT

A May 2008 conference honored Gaea Leinhardt through presentations featuring various perspectives on instructional explanations, a core focus of Leinhardt's research. *Instructional Explanations in the Disciplines*. (2010). Mary Kay Stein and Linda Kucan, Editors, Springer.

CHARLES PERFETTI

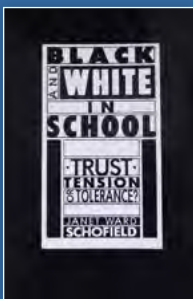
A symposium was held in July 2011 in Poitiers, France, to honor current LRDC Director Charles Perfetti. The resulting book celebrates the wide impact of Perfetti's research on reading and text comprehension. *Reading—From Words to Multiple Texts*. (2013). M. Anne Britt, Susan R. Goldman, and Jean-François Rouet, Editors, Routledge.

Top: Robert Glaser with family and friends at his retirement celebration
Above: Isabel Beck with family and friends at her Festschrift celebration



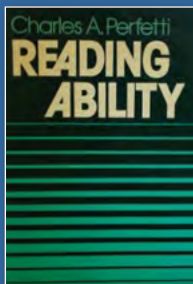
Sample Publications by LRDC Senior Scientists

MANY LRDC PUBLICATIONS HAVE HAD SIGNIFICANT IMPACT ON THEIR RESPECTIVE FIELDS, AS SUGGESTED BY BIBLIOMETRIC MEASURES OR OTHER INDICATORS OF INFLUENCE. BELOW, REPRESENTING SOME OF THIS IMPACT OVER THE PAST 50 YEARS, ARE SAMPLES OF INFLUENTIAL PUBLICATIONS FROM EACH OF 24 PAST AND PRESENT LRDC SENIOR SCIENTISTS.



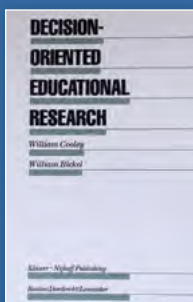
Janet Schofield received the Gordon Allport Intergroup Relations Prize for her 1982 book *Black and White in School: Trust, Tension, or Tolerance?* Schofield's research has been cited in two U.S. Supreme Court cases on integration.

James F. Voss, Terry Greene, Timothy Post, and Barbara Penner's "Problem-solving Skill in the Social Sciences" (*Psychology of Learning and Motivation*, 1983) extends the paradigm of problem solving from the hard sciences to the more ill-structured problems of the social sciences.



Charles Perfetti's book *Reading Ability* (1985), cited more than 2,000 times, integrates his early research on reading with that of others, helping to shape understanding of the cognitive and linguistic components of reading skill.

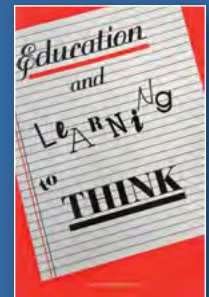
Gaea Leinhardt and James Greeno's "The Cognitive Skill of Teaching" (*Journal of Educational Psychology*, 1986) is based on studies of expert and novice teachers. This paper, cited nearly 900 times, frames teaching as a case of complex cognitive skill with teaching-specific knowledge structures.



William Cooley and William Bickel's book *Decision-oriented Educational Research* (1986) examines how educational research can be designed to support educational decision making.

Lauren Resnick's National Academy of Sciences monograph *Education and Learning to Think* (1987) has more than

1,800 citations and tackles the teaching of thinking skills. Her presidential address for the American Educational Research Association, "Learning In School and Out," with more than 2,000 citations, has shaped thinking about learning and teaching in both formal and informal settings.



Alan Lesgold, H. Rubinson, P. Feltovich et al. "Expertise in a Complex Skill: Diagnosing X-ray Pictures," *The Nature of Expertise* (M.H. Chi, R. Glaser, and M. Farr, Eds. 1988). Examines the perceptual-cognitive expertise of skilled radiologists and has more than 600 citations.

Michelene Chi, Miriam Bassok, Matthew Lewis, Peter Reimann, and Robert Glaser's article "Self-explanations: How Students Study and Use Examples in Learning to Solve Problems" (*Cognitive Science*, 1989) is an ISI "citation classic," cited more than 4,000 times, that documents the effectiveness of student-generated explanations for learning.

Kevin Ashley's book *Modeling Legal Argument: Reasoning with Cases and Hypotheticals* (1990) shows that legal reasoning can be a paradigm for case-based argument and reports on an artificial intelligence system that models case-based reasoning.

John Levine, Lauren Resnick, and E. Tory Higgins' "Social Foundations of Cognition" (*Annual Review of Psychology*, 1993), with more than 540 citations, summarizes research on how social factors influence both the content of cognition and the processes underlying cognitive activity. It stimulated theoretical and empirical work on cognition as a social process.

Edward Silver's article "On Mathematical Problem Posing" (*For the Learning of Mathematics*, 1994) demonstrates the important role of framing and reframing problems during as well as before and after students work on problems.

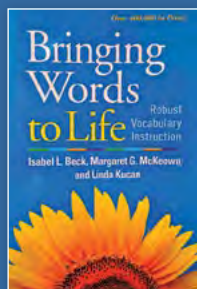
Mary Kay Stein, B.W. Grover, and M. Henningsen's paper "Building Student Capacity for Mathematical Thinking and Reasoning: An Analysis of Mathematical Tasks Used in Reform Classrooms" (*American Educational Research Journal*, 1996) found that cognitive demand of instructional tasks often declines during classroom enactment and has more than 500 citations.

Julie Fiez and Steven Petersen's paper "Neuroimaging Studies of Word Reading" (*Proceedings of the National Academy of Sciences*, 1998) identifies brain areas that support reading, shows how imaging results can inform cognitive theories of reading, and has about 600 citations.

Kevin Crowley's paper "Shared Scientific Thinking in Everyday Parent-Child Activity" (*Science Education*, 2001) demonstrates that children's learning of science in a museum setting, especially their use of evidence, is supported by conversations with parents.

Frits Pil and Carrie Leana's article "Social Capital and Organizational Performance: Evidence from Urban Public Schools" (*Organization Science*, 2006) uses a combination of teacher and parent surveys and principal time diaries to show how social capital in school contexts affects student achievement. The paper won the Alfred P. Sloan Foundation Industry Studies Best Paper Prize in 2007.

Isabel Beck, Margaret McKeown, and Linda Kucan's book *Bringing Words to Life: Robust Vocabulary Instruction*, published in 2002 with a second edition in 2013, presents research-based ideas about vocabulary instruction for teachers and has more than 1,100 citations.



Walter Schneider and Jason Chein's paper "Controlled and Automatic Processing: Behavior, Theory, and Biological Mechanisms" (*Cognitive Science*, 2003) is an influential updating of the dual processes of automatic and controlled information processing. The original 1977 *Psychological Review* classic by Schneider and Shiffrin has more than 4,000 citations.

Diane Litman and Scott Silliman's paper "ITSPOKE: An Intelligent Tutoring Spoken Dialogue System" (*Proceedings of the Human Language Technology Conference*, 2004) describes a spoken dialogue system that supports students in tutor-based physics problem solving.

Kurt VanLehn, Collin Lynch, and their colleagues' paper "The Andes Physics Tutoring System: Lessons Learned" (*International Journal of Artificial Intelligence in Education*, 2005) follows the development of an intelligent systems tutor to support physics problem solving and reviews research on the use of the system by students at the U.S. Naval Academy.

Kwansu Cho and Christian Schunn's article "Scaffolded Writing and Rewriting in the Discipline: A Web-based Reciprocal Peer Review System" (*Computers & Education*, 2007) describes the SWoRD system for supporting writing practice through student peer review and shows its effectiveness in improving writing quality.

Margaret Smith and Mary Kay Stein's 2011 book *Five Practices for Orchestrating Productive Mathematics Discussions* supports teachers in facilitating effective classroom discussions and has made an important contribution to the field of mathematics professional development as evidenced by its selling 35,000 copies in its first two years (published by the National Council of Teachers of Mathematics and Corwin Press).



Marks of Distinction

REFLECTING BOTH HIGH-IMPACT RESEARCH AND PROFESSIONAL LEADERSHIP, VARIOUS NATIONAL AND INTERNATIONAL HONORS HAVE BEEN BESTOWED UPON A NUMBER OF LRDC FACULTY MEMBERS.

Literacy research: Charles Perfetti received the Distinguished Research Award from the Society for the Scientific Study of Reading and the Distinguished Scientific Contribution Award from the Society for Text & Discourse; Isabel Beck received the International Reading Association's William S. Gray Citation of Merit as well as the association's "Hall of Fame" (with Margaret McKeown). Beck's work also has been awarded the Oscar O. Causey Award by the National Reading Conference.

Social and affective research: John Levine received the Joseph E. McGrath Award for Lifetime Achievement in the Study of Groups (shared with University of Pittsburgh psychology professor Richard Moreland).

Cognitive neuroscience: Julie Fiez received the American Psychological Association (APA) Distinguished Scientific Award for Early Career Contributions.

Educational technology: Alan Lesgold received the EDUCOM Medal for contributions to educational technology. Kalyani Raghavan and Robert Glaser received EDUCOM/IBM Awards for their work on Smithtown, an economics intelligent tutoring system. Smithtown also received the Best Social Sciences Software and Best Instructional Innovation awards from APA.

Educational application: Glaser received the James McKeen Cattell Fellow Award from the American Psychological Society for a lifetime of outstanding contributions to the area of applied psychological research. Both Lesgold and Lauren Resnick were presented with the APA award for Distinguished Contributions of Applications of Psychology to Education and Training. Three LRDC faculty members have received the E.L. Thorndike Award for Career Achievement in Educational Psychology: Glaser, James Greeno, and Resnick.



Four faculty members have been elected to the National Academy of Education: Beck, Michelene Chi, Greeno, and Resnick. Resnick was recently elected to the American Academy of Arts & Sciences, and Lesgold is a Lifetime National Associate of the National Research Council of the National Academies.

Above: Former Director Robert Glaser and former Codirector Lauren B. Resnick

THE CENTER FOR ADVANCED STUDY IN THE BEHAVIORAL SCIENCES AT STANFORD UNIVERSITY

The Center for Advanced Study in the Behavioral Sciences at Stanford University provides a yearlong interdisciplinary retreat for scholars. Former fellows include 22 Nobel laureates, 14 Pulitzer Prize winners, 44 winners of MacArthur Foundation "Genius Awards," and seven LRDC senior faculty members:

Michelene Chi (1996–97)
William Cooley (1972–73)
Robert Glaser (1969–70)
James Greeno (1998–99)
Gaea Leinhardt (1990–91)
Lauren Resnick (1976–77)
Kurt VanLehn (1996–97)

International Distinctions

LRDC RESEARCHERS HAVE EARNED INTERNATIONAL RECOGNITION IN VARIOUS FORMS.

Three faculty members have received the United Kingdom's Leverhulme Visiting Professorships (Diane Litman, Perfetti, and Reichle), which are awarded to eminent international researchers to enhance the knowledge and skills of the academic staff or the student body at the universities they visit. Faculty have held honorary and visiting professorships at various international universities, including the University of Kent (John Levine), University of Auckland (Perfetti), Monash University (Mary Kay Stein), and the Universities of Cambridge and Oxford (Frits Pil).

Senior scientists have been fellows of the Institute for Advanced Studies; University of Bologna; and European University Institute in Florence, Italy, (Kevin Ashley); the Netherlands Institute for Advanced Studies in the Behavioral Sciences and Max Planck Institute for Psycholinguistics (Charles Perfetti); and the Hanse Institute for Advanced Study in Germany (Erik Reichle).

Three faculty members have been awarded honorary degrees from international institutions: Robert Glaser from the University of Gothenburg (Sweden), the University of Trondheim (Norway), the University of Leuven (Belgium), and McGill University (Canada); Alan Lesgold from the Open Universiteit Nederland (Netherlands); and Lauren Resnick from the University of Gothenburg (Sweden) and the Université de Genève (Switzerland).

Faculty have served in advisory capacities to the Behavioural Science Institute, Radboud University Nijmegen (Perfetti); Royal Thimphu College, Bhutan (Janet Schofield); and the Université de Fribourg (Universität Freiburg), (James Greeno). Christian Schunn is chair of the Executive, and Resnick is a fellow of the International Society for Design and Development in Education. Resnick is a founding member of the European Association for Research on Learning and Instruction and a recipient of its Oeuvre Award for outstanding contributions to the science of learning and instruction.

LRDC scholars have presented their research worldwide, from Belgium to Bhutan. In just the last five years, faculty have been invited to present lectures or keynote addresses in at least 27 countries: Australia, Austria, Belgium, Bhutan, Canada, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Taiwan, Turkey, and the United Kingdom.



Designation as a fellow of a professional or academic society is a recognition of exceptional achievement. Although the selection process for fellows varies, all fellows must meet high standards of "significant" and "sustained" contributions over long periods. Among LRDC's senior faculty are fellows of the following societies (when there is more than one fellow, the number is in parentheses).

- Advanced Institute of Management, Economic, and Social Science Research
- Association for the Advancement of Artificial Intelligence
- American Association for the Advancement of Science (five)
- American Educational Research Association (nine)
- American Psychological Association (seven)
- American Psychological Society (six)
- Cognitive Science Society (six)
- Society of Experimental Social Psychology



LRDC People

LRDC IS HOME TO TECHNICAL, FISCAL, AND RESEARCH STAFF; GRADUATE STUDENTS; POSTDOCTORAL FELLOWS; AND RESEARCH ASSOCIATES AS WELL AS FACULTY MEMBERS, ALL OF WHOM CONTRIBUTE TO THE CENTER'S OVERALL RESEARCH MISSION.

GRADUATE STUDENT AND POSTDOCTORAL RESEARCHERS

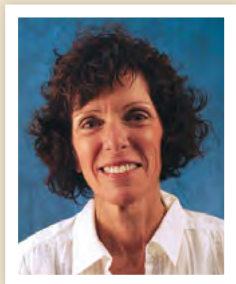
As a research center, LRDC has been a training ground for graduate students who work on PhDs in various departments of the University of Pittsburgh, especially in the Kenneth P. Dietrich School of Arts and Sciences and the School of Education. PhD students play a major role in all phases of research—initiating projects, presenting results at national conferences, and authoring papers. Programs of funded research annually support 40–50 graduate student researchers.

The Center also is home to postdoctoral researchers and fellows, who begin their post-PhD research careers working closely with LRDC faculty members before moving on to more long-term academic or nonacademic positions.

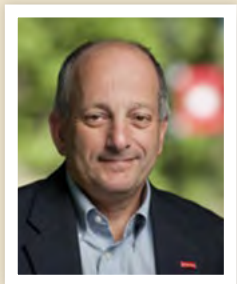


LRDC DISTINGUISHED ALUMNI AWARD

To recognize the accomplishments of the many graduate students who have earned their PhDs while at the Center, LRDC instituted the Distinguished Alumni Award in 2011.

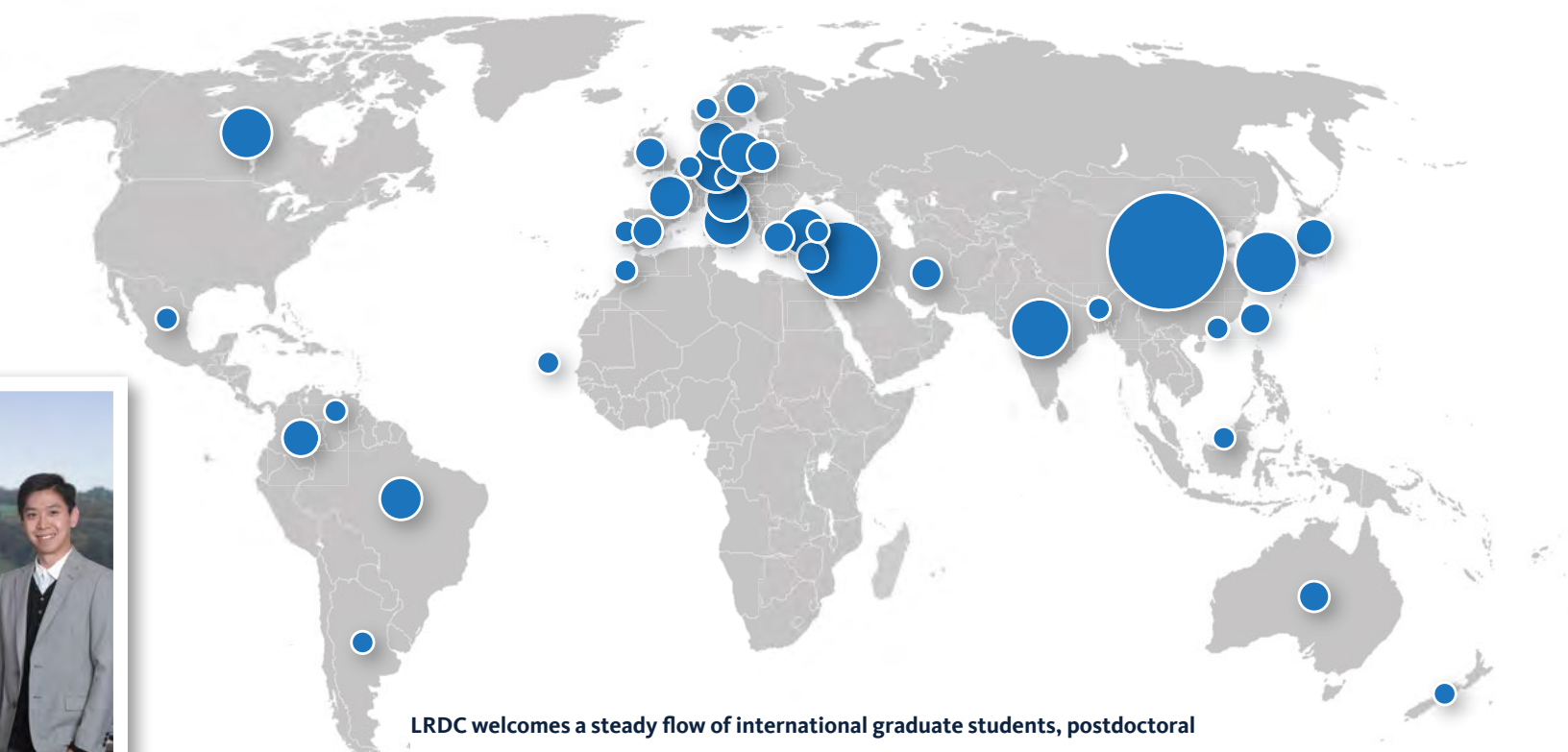


2011 Awardee
Susan Goldman (A&S '75G, '78G), Distinguished Professor of Psychology and Education, University of Illinois at Chicago



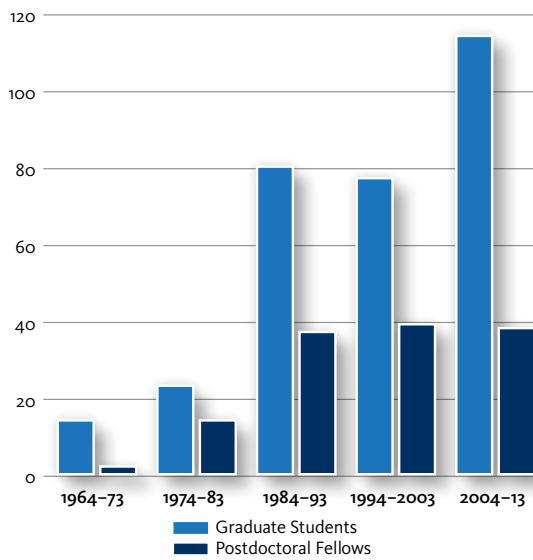
2012 Awardee
Drew Gitomer (A&S '82G, '84G), Rose and Nicholas DeMarzo Chair in Education, Rutgers University





LRDC welcomes a steady flow of international graduate students, postdoctoral fellows, and visiting scholars, creating a community that extends well beyond the borders of the Pitt campus. The circles on this map are a proportional representation of international scholars—both the countries from which international scholars have come and the countries where graduates and postdoctoral fellows have accepted professional positions upon leaving LRDC.

LRDC celebrates the hundreds of graduate students and postdoctoral fellows whose early careers included research at the Center. The graph to the right shows the number of students and postdocs entering the Center over the past 50 years.



TIM POST AWARD

The Tim Post Award is given to a psychology graduate student to recognize research excellence and is named in honor of Post, a graduate student in cognitive psychology who earned his PhD in 1986. Shortly after earning his degree, Tim was diagnosed with leukemia. In the final months of his life, his family asked that a memorial award be set up to honor his memory.





Administrative, Technical, and Research Staff

LRDC RELIES ON A DEDICATED, ACCOMPLISHED STAFF IN
IMPORTANT SUPPORT, PERSONNEL, AND TECHNICAL POSITIONS.

ADMINISTRATIVE STAFF

Elizabeth S. Rangel, Director
of Communications

Wendy Bennett, Assistant
to Director Perfetti

Patsy Guzzi, Director
of Administration

ADMINISTRATIVE AND FISCAL SERVICES

Audrey Antosik

Carol Beringer

Marge Gibson

Bradley Hyland

De Ivanhoe

Jo-Anne Krevy

Michael Laughlin

Lynne Welshons

COMPUTING SERVICES

Anthony Taliani, Manager
of Computing Services

Jeff Flotta

Eric Fussenegger

Shari Kubitz

Brian Wiedor

PROJECT RESEARCH STAFF AND PROGRAMMERS

Stefani Allegretti

Nancy Artz

Denise Balason

Alison Bank

William Bird

Emily Braun

Jon Chmura

Corrine Durisko

Brittany Eltman

Catherine Fissell

Deepa Krishnaswamy

Sudhir Pathak

Deanna Weber Prine

Ben Rickles

Carmela Rizzo

Mary Sartoris

Catherine Stainton

Shelley Tavis

Josh Tremel

Lauren Wagener

Sarah Woo

INSTITUTE FOR LEARNING

Colleen Briner, Executive Director

Nancy Bee

Carol Chestnut

Sara DeMartino

Keith Gwillim

Jean Herskowitz

Mica Jochim

Carolyn Mazzella

Faith Milazzo

Becca Naughton

Molly Petruska

Ted Trunzo

Erin Ward

Zhou Yuan

Researchers

THE CENTER'S RESEARCH COMES FROM FACULTY AND NONFACULTY RESEARCHERS FROM ACROSS DISCIPLINES AND SPECIALTY AREAS—EDUCATIONAL RESEARCH, COGNITIVE SCIENCE, COMPUTER SCIENCE, SOCIAL PSYCHOLOGY, NEUROSCIENCE, ORGANIZATIONAL SCIENCE, AND EDUCATION POLICY.

CURRENT FACULTY



DIRECTOR

Charles Perfetti, Distinguished University Professor, Department of Psychology. The cognitive science of language and reading, including

the nature of reading ability, word learning, comprehension, and writing system factors in first and second language reading. His approach aims to achieve a richer view of language and reading processes through the combination of cognitive (behavioral) and neuroscience methods.



ASSOCIATE DIRECTOR FOR EDUCATIONAL RESEARCH AND PRACTICE

Mary Kay Stein, Professor, School of Education, and

Founding Director, Learning Policy Center. Mathematics teaching and learning in classrooms and policy and organizational influences on teachers' practice. Research examines how the learning demands of different curricula can influence teacher implementation of innovative programs and how educative curricula can serve as a learning tool for teachers in large-scale improvement efforts.



Kevin Ashley, Senior Scientist and Professor, School of Law. Computational models and intelligent computer systems to educate students and assist practitioners to

develop case-based and analogical reasoning as techniques for representing and acquiring knowledge in artificial intelligence programs and to improve legal information retrieval.



William Bickel, Senior Scientist and Professor, School of Education. Evaluation methodology and how the use of evaluative inquiry in educational systems and related organiza-

tional and policy settings can contribute to improved practice. He currently codirects the Evaluation for Learning Group (EFL).



Richard Correnti, Research Scientist and Associate Professor, School of Education. Educational innovations and their influence on teacher practice and student learning, how

policy and educational reform initiatives can improve instruction and student learning, and how these efforts are influenced by issues of implementation and scaling-up.



Kevin Crowley, Senior Scientist and Professor, School of Education. Relationships among learners, mediators, environments, and experiences in out-of-school settings. Work

explores what it means to learn and change in everyday environments, including museums, community settings, on the Web, and at home. He directs the Center for Learning in Out-of-School Environments (UPCLOSE).



Julie Fiez, Senior Scientist and Professor, Department of Psychology. Cognitive neuroscience approach to studying the neural basis of language

processing and basic learning systems in the human brain. How cognition may be optimized by reinforcement learning signals mediated by the basal ganglia and error correction signals mediated by the cerebellum.



James Greeno, Center Associate and Adjunct Professor, School of Education. Methods of interaction analysis focusing on discourse to evaluate hypotheses about conceptual

understanding and reasoning in communication between students or between students and a teacher.



Alan Lesgold, Senior Scientist, Professor and Dean, School of Education; and Professor, Department of Psychology and Intelligent Systems Program. Currently

involved as an advisor on projects dealing with intelligent tutors for occupational specialties, cognitive aspects of medical errors, and evaluation of teacher preparation programs.



John Levine, Senior Scientist and Professor, Department of Psychology. Group processes. Currently studying innovation and creativity in work teams, the impact of

conflict and disagreement on learning, and the social dynamics of online health support groups.

continued

CURRENT FACULTY, CONTINUED



Melissa Libertus, Research Scientist and Assistant Professor, Department of Psychology. Representation of numerical information, how numerical information is processed in the human mind, and how it changes over the course of development. She also investigates individual differences in math abilities and how they relate to other cognitive functions.



Diane Litman, Senior Scientist and Professor, Department of Computer Science. Artificial intelligence, tutoring systems, and reasoning and natural language processing.

With colleagues, she has developed computational tutorial dialogue systems to analyze learning through conversation.



Lindsay Clare Matsumura, Research Scientist and Associate Professor, School of Education. Implementation and effectiveness of instructional reform programs and policies

in urban schools. Develops measures of instructional quality and examines the links among classroom discussions, writing tasks, and students' literacy skill development.



Margaret McKeown, Senior Scientist and Clinical Professor, School of Education. Acquisition of vocabulary in school-age children, literacy, and instructional

strategies for vocabulary development. The effects of learner and text characteristics on learning and instructional design and teacher professional development based on cognitive principles.



Muhsin Menekse, Research Scientist. Higher-level reasoning in complex tasks in STEM domains and how classroom activities and learning environments affect

conceptual understanding in science and engineering. His second line of research is on verbal interactions in collaborative learning settings with a focus on dialogue patterns.



Sharon Nelson-Le Gall, Senior Scientist and Professor, Department of Psychology. Children's help-seeking and achievement motivation, socialization

of social and intellectual competence, and cultural contributions to the developmental resiliency of Black children and underrepresented groups who grow up experiencing social inequalities in the United States.



Timothy Nokes-Malach, Research Scientist and Associate Professor, Department of Psychology. Identifying, predicting, and promoting knowledge transfer.

Topics include cognitive and collaborative processes that support transfer; the relationship among motivation, cognition, and transfer; and instructional theories of learning and transfer in math and science.



Anthony Petrosky, Associate Dean, School of Education, and codirector of the Institute for Learning. Professional learning and curriculum development in English

and literacy for school and district leaders in large urban school districts and assessment.



Frits Pil, Research Scientist and Professor, Joseph M. Katz Graduate School of Business. Organizational learning and how knowledge is transferred and

leveraged within and across organizational boundaries.



Lauren Resnick, Senior Scientist and Distinguished University Professor of Psychology and Cognitive Science; and Former Director, LRDC; Founder and

Codirector of the Institute for Learning. Classroom dialogue; school reform; assessment; the nature and development of thinking ability; and learning and teaching of literacy, mathematics, and science.



Benjamin Rottman, Research Scientist and Assistant Professor, Department of Psychology. Causal learning, or how people learn cause-effect relationships from

their experiences (e.g., "This new medicine I have been trying seems to work well."). Medical decision making—how doctors make diagnosis, testing, and treatment decisions.



Jennifer Lin Russell, Research Scientist and Assistant Professor, School of Education. Policy and other educational improvement initiatives and organizational perspective.

Recent work examines two primary issues: how schools create social and organizational structures that support reform and how interorganizational collaborations can be structured for educational improvement.



Walter Schneider, Senior Scientist and Professor, Department of Psychology. Dynamic cortical processing in human behavioral and brain imaging studies,

which focus on the understanding of human learning, and executive control and attention. Has developed methods to map human network-level cortical processing, providing information on the component structures of learning.



Christian Schunn, Senior Scientist and Professor, Department of Psychology. STEM reasoning (studying practicing scientists and engineers) and learning (developing and studying integrations of science, engineering, and math), neuroscience of complex learning (in science and math), peer interaction and instruction (including the development of a broadly used system called SWORD), and engagement and learning (especially in science).

oping and studying integrations of science, engineering, and math), neuroscience of complex learning (in science and math), peer interaction and instruction (including the development of a broadly used system called SWORD), and engagement and learning (especially in science).



Margaret Smith, Senior Scientist and Professor, School of Education. Teachers' capacity to design and enact rigorous mathematics instruction for all students,

creating research-based materials for use in professional education settings, designing learning experiences for teachers drawing on these materials, and studying what teachers learn from these experiences.



Natasha Tokowicz, Research Scientist and Associate Professor, Department of Psychology. Cognitive processes of adult second language learning and use,

translation ambiguity, and second language morphosyntactic processing. Uses event-related brain potentials in addition to traditional measures, such as reaction time and accuracy, to examine these issues.



Jingtao Wang, Research Scientist and Assistant Professor, Department of Computer Science. Educational technology, mobile devices as tools

for learning, learning games on mobile devices, cooperative learning technologies, applications of machine learning in user interfaces, and the use of mobile devices for behavioral experiments.



Ming-Te Wang, Research Scientist and Assistant Professor, School of Education. Effect of family socialization on adolescent motivational beliefs and engagement;

the behavioral, social, and emotional development of youths from diverse socioeconomic and cultural backgrounds; and the impact of interventions targeting children's academic skills and developmental problems.



Tessa Warren, Research Scientist and Associate Professor, Department of Psychology. The roles that syntax, semantics, pragmatics, and world knowledge

play during comprehension and how they influence eye movements during reading. Her work is guided by linguistics and cognitive psychology.



Mark Wheeler, Research Scientist and Associate Professor, Department of Psychology. Effect of physical activity and healthy aging on decision behavior.

Uses behavioral and functional imaging approaches to understand how brain signals relate to choice outcome, particularly when prior expectations inform decisions.

EMERITUS FACULTY



Isabel Beck, Senior Scientist and Professor Emerita, School of Education. Literacy education.



Gaea Leinhardt, Senior Scientist and Professor Emerita, School of Education. Teaching effectiveness and improvement of instructional practice.

RESEARCH ASSOCIATES



Patricia Albacete, Learning Technology. Natural language dialogue systems that engage students in deep reasoning dialogues after students solve quantitative

problems in Andes, an intelligent tutoring system for physics.



Amy Crosson, Reading and Language. Vocabulary and reading, comprehension instruction, biliteracy development, and language minority students.



Elizabeth Hirshorn, Reading and Language and Cognitive Neuroscience. The neural basis of language processing, articulatory and phonological codes in

verbal working memory, and how writing systems influence the representation and processing of orthographic information.

continued

**RESEARCH ASSOCIATES,
CONTINUED**



Jennifer Iriti, Codirector, Evaluation for Learning Group. Design, documentation, evaluation, and strategic assessment of a wide variety of educational programs and reform efforts.



Lynette Jacobs-Priebe, Out-of-School Learning. Creation and validation of a battery of measures that predict sustained, long-term engagement with science opportunities across in- and out-of-school settings.



Pamela Jordan, Learning Technology. Natural language technology for educational applications, natural language-based tutorial systems, analysis of natural language dialogue and discourse, knowledge representation and reasoning, and software systems development.



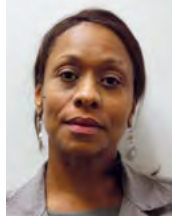
Sandra Katz, Learning Technology. Use of natural language dialogues that allow students to review problems and research platforms to test hypotheses about the language features that influence effective tutoring.



Karen Knutson, Out-of-School Learning. Associate Director, UPCLOSE. Collaborative creative thinking and communication processes in the design and development of museum spaces, visitors' learning and meaning making, and museum education strategies.



Marti Louw, Out-of-School Learning. UPCLOSE lead for the Center for the Advancement of Informal Science Education. Conceptualization, development, and design of informal science learning engagement with digital media and technology.



Birdy Reynolds, Higher-level Learning Processes. Reform science curriculum with traditionally underrepresented students and professional development to translate effort-based education research findings into practical actions in science instruction.



Cheryl Sandora, Reading and Language. Comprehension of text through discussion. Trains teachers in discussion strategies and provides on-site support for implementation of these programs.



Janine Fiorina
Cody



Kristin
Klingensmith



Allison Escher



Virginia
Loh-Hagan



Pam Goldman



Patricia Magruder



Rebecca Grainger



Fran Mossberg

IFL FELLOWS



Rosa (Rosita)
Apodaca



Victoria Bill



Deborah Jordan



Nancy Owen



Donna DiPrima
Bickel



Sandra Campo



Stephanie
Kane-Mainier



Laurie Speranzo



Sam Spiegel



Lynn Woods

CENTER ASSOCIATES

ONE WAY THAT LRDC PROMOTES CONNECTIONS ACROSS DISCIPLINES IS THROUGH APPOINTMENTS OF UNIVERSITY OF PITTSBURGH FACULTY MEMBERS AS LRDC CENTER ASSOCIATES.



Mary Besterfield-Sacre, Associate Professor and Fulton C. Noss Faculty Fellow, Swanson School of Engineering. Empirical and cost modeling applications for

improvement in manufacturing, service organizations, and engineering education evaluation methodologies.



Alan Juffs, Associate Professor and Director, English Language Institute, Department of Linguistics. Linguistic theory, second language acquisition, syntax and

semantics, teachers of English to speakers of other languages (TESOL), and working memory and sentence processing.



Carrie Leana, George H. Love Professor of Organizations and Management, Joseph M. Katz Graduate School of Business. Organizational behavior and management in

diverse settings, including steel mills, public schools, insurance claims offices, police departments, and nursing homes.



Chandralekha Singh, Professor, Department of Physics and Astronomy, and Director, Disciplined Based Science Education Resource Center. Sources of student difficulties in learning physics, both

at the introductory and advanced levels, and the design, implementation, and curricula/ pedagogies that may significantly reduce these difficulties.



Elizabeth Votruba-Drzal, Associate Professor, Department of Psychology. Impact of key contexts that support learning and socio-emotional development during the transition to school and the elementary school years.



Tanner LeBaron Wallace, Assistant Professor, School of Education. Motivational consequences of instructional interactions, measuring effective teaching in

urban high schools, schools as developmental contexts, and applied research design.

FORMER FACULTY MEMBERS

THROUGHOUT ITS 50 YEARS, MANY FACULTY MEMBERS HAVE BEEN IMPORTANT IN SHAPING LRDC'S RESEARCH AND BUILDING ITS REPUTATION. SOME OF THOSE WHO WERE PART OF LRDC FOR AT LEAST 10 YEARS ARE LISTED BELOW.

Lloyd Bond, Retired. Educational measurement.

Audrey Champagne, Retired. Science and mathematics education.

Michlene Chi, Professor, Division of Educational Leadership and Innovation, Mary Lou Fulton Teachers College, Arizona State University. Cognition and learning and conceptual change.

William Cooley, Retired. Assessment, evaluation policy, and research methods. Codirector of LRDC from 1969 to 1977.

Leopold Klopfer, Retired. Science learning and science education.

Johanna Moore, Professor, School of Informatics, and Director, Human Communication Research Centre, University of Edinburgh. Computational approaches to language and communication.

James Pellegrino, Liberal Arts and Sciences Distinguished Professor and Distinguished Professor of Education, College of Education, University of Illinois at Chicago. Cognition, instruction, and assessment.

Erik Reichle, Professor of Cognitive Psychology, Faculty of Social and Human Sciences, University of Southampton. Reading and computational modeling.

Janet Schofield, Retired. Computer use in classrooms.

Jonathan Schooler, Professor, Department of Psychology & Brain Sciences, University of California, Santa Barbara. Cognition and consciousness.

Edward Silver, William A. Brownell Collegiate Professor, School of Education, and Professor, Department of Mathematics; College of Literature, Science, and the Arts, University of Michigan, and Dean, School of Education, University of Michigan-Dearborn. Mathematics education.

Kurt VanLehn, Professor and Diane and Gary Tooker Chair for Effective Education in Science, Technology, Engineering, and Math; School of Computing, Informatics, and Decision Systems Engineering; Arizona State University. Cognitive science and intelligent tutoring.

James Voss, Retired. Complex cognition, text comprehension, and social science problem solving.

LRDC also has had many connections with faculty members in the University of Pittsburgh School of Education and the Kenneth P. Dietrich School of Arts and Sciences who have contributed to the Center's mission, including Karen Block, John Bolvin, Cynthia Coburn, R. Tony Eichelberger, Kimberley Gomez, Louis Gomez, James Holland, Roger Klein, C. Mauritz Lindvall (deceased), Anthony Nitko, Diane Scott-Jones, Warren Shepler (deceased), Jerome Taylor, Margaret Wang (deceased), John Yeager, and Naomi Zigmond.



At the University of Pittsburgh

Faculty members on LRDC balcony pose for photo included in the 20th Anniversary Profile

An important factor in LRDC's success is the joint appointments of its faculty members in other units of the University. Today, faculty members hold joint primary appointments in departments and schools across campus, including the Kenneth P. Dietrich School of Arts and Sciences Department of Computer Science, Intelligent Systems Program, and Department of Psychology; Joseph M. Katz Graduate School of Business; School of Education; and School of Law. Additional connections exist through secondary appointments in the Department of Communication Science and Disorders, Department of Linguistics, Department of Neuroscience, Department of Psychiatry, Department of Neurological Surgery, and Department of Radiology.

These connections throughout the University have allowed faculty and students to work on cross-disciplinary learning and education projects while supporting graduate training programs. The Center's commitment to cognitive research was important in establishing a PhD program in cognitive psychology

within the Department of Psychology. Similarly, Center faculty members working on intelligent tutoring systems played important roles in establishing the cross-disciplinary Intelligent Systems Program.

The strong connection to the School of Education has been an important part of LRDC's educational research programs from the beginning, with the establishment of the Learning Policy Center and a new PhD program in learning sciences and policy as the most recent examples. As LRDC developed its research in cognitive neuroscience, the Center for the Neural Basis of Cognition, which spans Carnegie Mellon University and the University of Pittsburgh, became an important connection for faculty and students in LRDC. The Center also is a partner in another cross-campus collaboration, the National Science Foundation-funded Pittsburgh Science of Learning Center, which brings together researchers to study robust learning in science, mathematics, and languages.

Board of Visitors

LRDC's Board of Visitors has been drawn from distinguished scholars and educators who attend to the most important questions confronting the practical, empirical, and theoretical worlds of learning. Leslie Salmon-Cox, in her role as then-assistant director for institutional relations, served as liaison to the Board for many years. The first Board of Visitors consisted of some of the leading figures in education and psychology, including Benjamin Bloom, John B. Carroll, Robert M. Gagne, Ralph W. Tyler, Paul F. Lazarsfeld, and Arthur W. Melton.

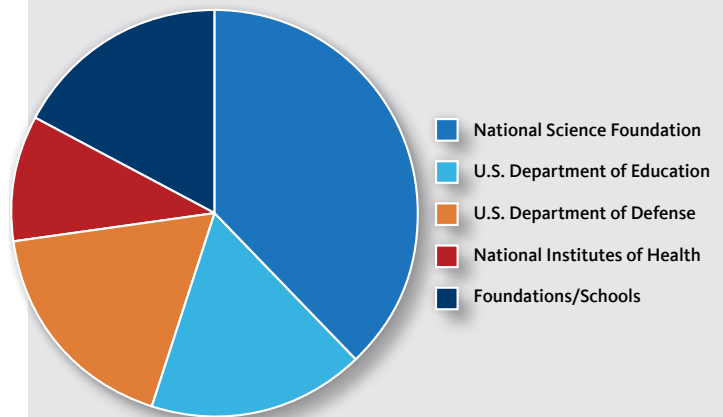
Below is a list of board members and the terms they served.

Carl Bereiter 1984–97	Wayne Holtzman (chair) 1970–85
Gautam Biswas . . . 2014–present	Phyllis Hunter 2000
Benjamin Bloom 1970–78	James Jenkins 1971–73
Hilda Borko 2014–present	Judith Johnson 2001–06
Ann Brown 1990–98	Walter Kintsch (chair) 1992–2001
Anthony S. Bryk 2000–03	Magdalene Lampert . . 1986–97
Jill Burstein 2014–present	Paul F. Lazarsfeld 1964–72
Iris Carl 1992–97	Carol D. Lee 2010–present
Thomas H. Carr . . 2010–present	Nonie K. Lesaux . . 2010–present
Ruben A. Carriedo . . 1992–2000	Finlay McQuade 1986–94
John B. Carroll 1964–70	Arthur W. Melton 1964–72
Paul Cobb 2006–12	Samuel Messick 1978–88
Virginia Crandall 1980	James Minstrell 1992–2003
Joseph M. Cronin 1975–77	Johanna D. Moore 2006–12
Patrick Daly 1977–79	Peter H. Odegard 1964–66
Goery Delacote 2003	Brian J. Reiser 2006–present
James P. Dixon 1964–66	Leona Schauble (chair) 1998–present
Guinevere Eden . . 2006–present	Judah Schwartz 1989–98
William Estes (chair) . . 1977–92	Timothy Shanahan 2006–present
Helen Faison 1977–2010	Richard Shavelson . . 1987–2000
Susan Fuhrman 2006	Lee Shulman 1984–92
Robert M. Gagne 1966–78	Alberta E. Siegel 1975–80
Adam Gamoran 2006–12	Diana T. Slaughter-Defoe 1987–2006
Rochel Gelman (chair) 1978–98	Catherine Snow 1998–2006
Jacob W. Getzels 1973–79	Reed Stevens 2014–present
Carol Gibson 1980–88	Robert M. Travers 1964–72
Louis M. Gomez 2003–06	Ralph W. Tyler (chair) . 1964–78
John I. Goodlad 1964–66	Ruth Wattenberg 2000–06
Edmund Gordon 1980–90	Sheldon White 1973–74
Arthur Graesser 2000–06, 2014–present	Sam Wineburg 2003–06
Bert Green 1980–88	
Kenji Hakuta 1998–2003	
Judith Harackiewicz 2014–present	

Research Support Overview

LRDC is one of four independent centers at the University of Pittsburgh.* The director reports to the provost, whose office provides support for the Center through joint appointments. Support for research comes from external sources. Over the past five years, LRDC has averaged approximately \$21 million per year in total active external grant support, with federal agencies as the main source of funds. As shown below, these include the National Science Foundation, 38 percent of the total; U.S. Department of Education, 17 percent; U.S. Department of Defense, 18 percent; and National Institutes of Health, 10 percent.

AVERAGE FUNDING PER YEAR BY FUNDING AGENCIES 2009–13



An additional important source of external support comes from foundations and other sources that make up 17 percent of the Center's external funding portfolio. Foundations that have provided funding for LRDC include the Grable Foundation, William T. Grant Foundation, Heinz Endowments, William and Flora Hewlett Foundation, John D. and Catherine T. MacArthur Foundation, James S. McDonnell Foundation, Andrew W. Mellon Foundation, Gordon and Betty Moore Foundation, Pittsburgh Foundation, Alfred P. Sloan Foundation, Spencer Foundation, Sprout Fund, SPRY Foundation, and Wallace Foundation.

One of the ways that the Center supports external funding applications is through the LRDC Internal Grants Program. This program has supported a small number of two-year proposals from LRDC faculty to initiate new cross-disciplinary projects. The program stimulates new directions in Center research and leads to larger collaborative grant applications to funding agencies.

* The three other centers are the University Center for International Studies, University Center for Social and Urban Research, and University of Pittsburgh Cancer Institute.

University of Pittsburgh Distinctions

LRDC FACULTY MEMBERS HAVE EARNED RECOGNITION FROM THE UNIVERSITY OF PITTSBURGH CHANCELLOR'S DISTINGUISHED AWARDS PROGRAM AND THE PROVOST'S ADVISORY COUNCIL ON INSTRUCTIONAL EXCELLENCE.

The Chancellor's Distinguished Research Awards annually recognize outstanding scholarly accomplishments and are awarded in two categories: Senior Scholar and Junior Scholar. The Senior Scholar category recognizes faculty members who have achieved prominence in their fields. Robert Glaser (1995), Charles Perfetti (2000), Isabel Beck (2003), and Michelene Chi (2006) have received this award. The Junior Scholar category recognizes faculty members who, by virtue of the exceptional quality of their early contributions, have demonstrated great potential as scholars. Kevin Ashley (2000) and Julie Fiez (2001) have been recognized with the Junior Scholar award.

The Chancellor's Distinguished Public Service Award annually recognizes outstanding public service contributions by members of the faculty. Lauren Resnick (1991) and Beck (2005) have earned the Public Service Award. The Chancellor's Distinguished Teaching Award, designed to highlight exemplary teaching achievements, was awarded to Margaret Smith (2006).

The Provost's Advisory Council on Instructional Excellence (ACIE) Innovation in Education Award has been earned by two LRDC faculty members, Ashley (2009) and Jingtao Wang (2011). The ACIE award recognized Ashley's A Peer Review-based Student Model for Ill-defined Problem Solving, a project that was created to help students assess their own writing by reviewing each other's writing. Wang's ACIE award for Software as a Service for Mobile Computing focused on his development of a course to teach students programming for mobile devices.

The Department of Psychology counts among its faculty a total of three University Professors—two of whom are LRDC Director Perfetti and former Director Lauren Resnick.



LRDC's 50th Anniversary



IN 2013, LRDC CELEBRATED ITS 50TH ANNIVERSARY (DATED FROM THE YEAR OF THE PROPOSAL THAT LED TO ITS FOUNDING). THE MAJOR SCHOLARLY COMPONENT OF THE YEARLONG CELEBRATION WAS THE 50TH DISTINGUISHED SPEAKER SERIES, WHICH FEATURED THE FOLLOWING RENOWNED SCHOLARS FROM THE UNITED STATES AND ABROAD:

50th Anniversary Distinguished Speaker Series

Mitchel Resnick, LEGO Papert Professor of Learning Research and academic head of the program in Media Arts and Sciences at the MIT Media Lab, spoke on “Sowing the Seeds for a More Creative Society.”

Kate Nation, professor in experimental psychology and fellow at St. John’s College at the University of Oxford, presented “Learning to Read and Learning to Comprehend.”

Gautam Biswas, professor of electrical engineering and computer science at Vanderbilt University, presented “Open-ended Environments That Help Middle School Students Develop Metacognitive Strategies for Learning Science.”

Bruce McCandliss, Patricia and Rodes Hart Chair and professor of Psychology and Human Development at Vanderbilt University (and former LRDC postdoc), discussed “Educational Neuroscience: Points of Mutual Influence between Developmental Cognitive Neuroscience and the Science of Education.”

Marshall “Mike” Smith, former under-secretary of education, U.S. Department of Education, and former Dean, Stanford University Graduate School of Education, spoke on “Federalism and School Reform in a Changing Environment.”

Judith Harackiewicz, professor of psychology at the University of Wisconsin–Madison, presented “Optimal Motivation in Education.”

Computer-Supported Argumentation Workshop

On May 9 and 10, LRDC hosted the invitational Workshop on Educational Applications of Computer-supported Argumentation Tools, organized by Senior Scientist Kevin Ashley. Its aims were to develop a community of researchers interested in expanding argument diagramming techniques, computer-supported peer review, and data resources into new educational domains and to develop a research corpus on argumentation in educational contexts.

Alumni Symposium

The principal alumni event was the May 16 conference, “New Directions in Research on Learning and Education: A Symposium Celebrating 50 Years of LRDC.” The conference featured 10 accomplished former graduate students as speakers, all of whom received their PhDs from Pitt while working at LRDC. These students addressed more than 120 attendees on the following topics:

Education Improvement

Paul LeMahieu (EDUC ’83G), Senior Vice President for Programs and Administration, Carnegie Foundation for the Advancement of Teaching, “Accelerating Our Capacity to Learn to Improve in Education: Networked Communities Engaged in Improvement Research”

Jinfa Cai (EDUC ’94G), Professor, Department of Mathematical Sciences, University of Delaware, “Improving Student Learning: Lessons from Two Decades of Adventures and Exploration”

Learning and Thinking

Jeff Bisanz (A&S ’79G), Professor, Department of Psychology, University of Alberta, “A Detour in the Development of Mathematical Thinking”

Michael Ranney (A&S ’87G), Professor of Cognition and Development, Graduate School of Education, and Affiliated Professor, Department of Psychology, University of California, Berkeley, “Science, Numeracy, and Society: ‘LRD’ Lessons from Conceptual Change to Climate Change and Back”

Jennifer Wiley (A&S ’96G), Professor, Department of Psychology, University of Illinois at Chicago, “Diversity, Collaboration, and Learning by Invention”

Cognitive Foundations for Learning: Reading and Working Memory

Iris Berent (A&S ’93G), Professor, Department of Psychology, Northeastern University, “Reading Is Recycling—It’s Human Nature”

Jason Chein (A&S ’04G), Associate Professor, Department of Psychology, Temple University, “Based on a True Story: The Science, and Fiction, of Working Memory Training”

Technology in Support of Learning

James Slotta (A&S ’94G), Associate Professor; Department of Curriculum, Teaching, and Learning and the Centre for Science, Mathematics, and Technology Education; Ontario Institute for Studies in

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Education; University of Toronto, "Smart Classrooms and Knowledge Communities: New Designs for 21st-Century Learning"

Vincent Aleven (A&S '97G), Associate Professor, Human-Computer Interaction Institute, Carnegie Mellon University, "Games for Collaborative Science Inquiry for Grades K-3"

Cristina Conati (A&S '95G), Associate Professor, Department of Computer Science, University of British Columbia, "Modeling Student Behaviors and Cognition for Personalized Exploratory Learning Environments"

A gala dinner was held the evening of May 16, with more than 200 LRDC alumni, faculty, staff, and guests celebrating at Pittsburgh's historic Phipps Conservatory.

To help celebrate its 50th anniversary, local cartoonist David Coulson created a cover for a cartoon book about Oakland that was published by Pittsburgh's ToonSeum



Robert Glaser

Founding LRDC Director Robert Glaser was a Distinguished Professor of Psychology and Education at the University of Pittsburgh; he passed away on February 4, 2012. His career spanned more than 60 years, and his work had profound influences in the field he helped to develop, instructional psychology. Glaser helped laboratory and experimental psychologists to see how their work could be relevant to education and encouraged educators to use research in their efforts to improve instruction.

Glaser was a prolific author and esteemed colleague. His contributions were captured by the American Psychological Association's 1987 Distinguished Scientific Award for the Applications of Psychology, which honored him for:

"Uniquely combining advances in psychological theory with issues of instructional theory and practice, thereby defining the field of instructional psychology. His seminal work on criterion-referenced testing and the cognitive analysis of aptitude and subject matter expertise has laid the foundation for a science of instructional design."

Beyond his own contributions to research, his capacity to support and encourage the work of others was a hallmark of Glaser's leadership. Nowhere is this more evident than in the institution that he founded.

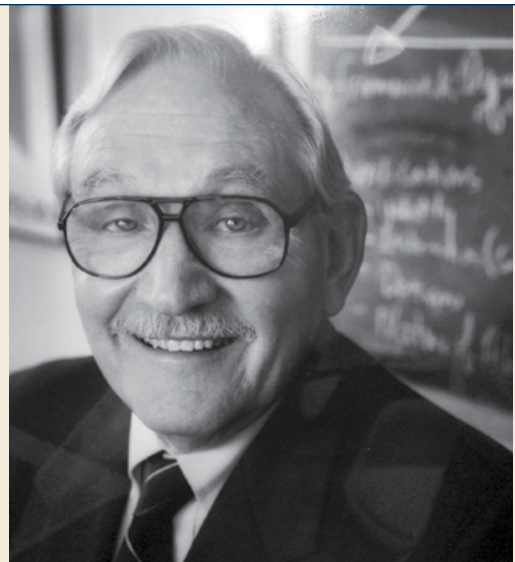


Photo: Karen Glaser



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