Some federal funding agencies, including the National Science Foundation (NSF), have begun demanding visible, practical results of funded research. Calls for research proposals now require that scientists describe how their proposed research will have “broader impacts” by contributing to the growing fund of knowledge and to the near-term public good. As an example, the technology-transfer offices found on many campuses help researchers to increase the commercial effect of their research.

Broader impact activities can include teaching the public, translating research results into instructional materials for classroom use, and increasing the participation of groups that are under-represented in science because of gender, ethnicity, disability, and/or geography.

The Center for the Integration of Research, Teaching, and Learning (CIRTL) works to improve STEM (science, technology, engineering, and mathematics) teaching and learning by preparing graduate students and post-doctoral fellows to be future faculty who are both excellent researchers and excellent teachers.

CIRTL is an NSF Center for Learning and Teaching, and the UW-Madison is home to the prototype learning community, the Delta Program in Research, Teaching, and Learning. Delta offers a curriculum of graduate courses, intergenerational small-group programs, and internships in an interdisciplinary learning community. It’s part of a network of sister projects at Howard University, Michigan State University, the University of Colorado at Boulder, Texas A&M University and Vanderbilt University. Together they develop models of professional-development programs in teaching and learning for graduate students and faculty in STEM disciplines.

CIRTL project director Robert Mathieu, chair of the UW Astronomy Department, says the CIRTL Network aims to create a national STEM faculty who can forge successful research careers while advancing effective teaching and learning practices. Their testimonials (see page 3) reflect this emphasis.

(continued on next page...)
This August marks the 46th anniversary of the founding of the Wisconsin Center for Education Research. It was one of 4 R&D centers started in 1964. Its mission was, and still is, to improve education through programs of research, development, and dissemination. WCER’s strengths lie not only in its longevity, but in its breadth of activities, across academic boundaries and through grade levels, pre-school through graduate school. This issue of Research Highlights reflects that breadth.

You’ll read about the UW-Madison’s Delta Program in Research, Teaching, and Learning. Delta offers a curriculum of graduate courses, small-group programs, and internships in an interdisciplinary learning community. Part of the national CIRTL network, Delta works to improve STEM (science, technology, engineering, and mathematics) teaching and learning by preparing graduate students and post-doctoral fellows to be future faculty who are both excellent researchers and excellent teachers.

Two articles spotlight new research addressing K-12 teaching and learning. The education of English Language Learners in K-12 grades is now a large part of WCER’s focus. Within ELL instruction, formative assessment is growing in importance. Formative assessment occurs regularly during the school year. Part of the WIDA Consortium, the FLARE project helps teachers measure ELL student progress as they develop the essential language needed for success in academic classes in middle and high school.

Professor Amy Ellis studies the processes in mathematics classrooms that support students’ ability to produce generalizations. Knowing how to generalize allows students to identify commonality across cases, to extend their reasoning beyond the range in which it originated, and to derive broader results from particular cases. Ellis pinpoints 6 activities that support students’ generalizing in math classrooms.

Equally important, Mathieu says, CIRTL will continue to influence the culture of higher education in STEM. Mathieu and colleagues plan to expand the network to 20-25 universities. Their ultimate goal is for any U.S. research university that wants its own CIRTL learning community to have one. In testimony before the House subcommittee on Research and Science Education in February 2010, Mathieu explained that, as the CIRTL network matures, the current universities will become nodes of many unique, and highly connected, campus-based learning communities at research universities across the nation. Each community will offer its future faculty—graduate students and post-docs—the opportunity to learn and connect with others across the network, to share best practices among researchers and other professionals, and to develop the expertise to effectively broaden research impacts.

At the same time, WCER researcher Mark Connolly and Co-P.I. Shihmei Barger are leading the Longitudinal Study of Future STEM Faculty (LSFF), a five-year NSF-funded research project that is based in part on the Delta longitudinal study. Because better preparing future STEM faculty for their essential role as teachers and mentors is believed to be a key to improving undergraduate STEM education, Connolly’s research group is examining the effects of “future-faculty” programs on STEM doctoral students, their career choices, and their early-career success. The study includes three research universities—UW-Madison, the University of Washington-Seattle, and Arizona State University—that not only produce large numbers of STEM PhDs each year, but also provide various Teaching-Focused Professional Development (TFPD) programs and activities. Like the Delta study, LSFF is using in-depth interviews with nearly 80 TFPD participants to gauge the impact of these programs. However, the study is also tracking and surveying more than 2,000 late-stage doctoral students in STEM departments at the three participating institutions. Using both survey and interview data, Connolly’s group is determining which factors explain doctoral students’ participation in TFPD programs, what knowledge and skills participants gain from TFPD programs, and what long-term effects, if any, participation has on their subsequent academic careers. And because the five-year study is following the 2000+ study participants into the various kinds of positions and institutions they take, the study will play a critical role in identifying broad trends in the kinds of academic positions STEM PhDs are currently taking.

TESTIMONIALS FROM CIRTL'S DELTA PROGRAM

The following solicited testimonials were submitted by graduates of CIRTL’s Delta program at Madison:

**Sam Pazicni** is Assistant Professor of Chemistry at the University of New Hampshire. The Delta program gave him the tools to begin asking teaching's most difficult questions: "Are my students learning?" and "How can I improve my students' learning?" These questions intrigued him so much that he devotes a good deal of time tackling them in his career in chemistry research. "Because Delta exposed me to issues in teaching and learning early in my graduate career," he says, "I now enjoy translating psychology and education research as I design instructional materials for real chemistry classrooms."

**Alysa Remsburg** is now Assistant Professor of Biology at Unity College, Maine. She emphasizes that earning a PhD alone does not qualify a scientist to be a good teacher. “College students learn so much more from faculty who are focused on student learning,” she says. “Training PhD candidates to be good teachers seems to me an outstanding investment in overall student learning. My involvement with Delta was critical in helping me develop as a teacher.”

**Matt D’Amato** now teaches Physics and Climate Science at New York’s Vanguard High School and is completing a graduate degree at Columbia University. He says the Delta experience gave him the tools and skills to become a better instructor. In particular, Delta’s "teaching-as-research" emphasis is embedded in his practice as he reflects, revises, and improves his instruction, no matter the course or grade-level, high school or college. Delta taught him how to take "cutting-edge" science research and translate that content into meaningful experiences for his students' learning. He says, "The Delta internship shaped my understanding of how to collaborate with researchers and educators to develop, implement, and improve a new educational tool."

**Jenny Gubbels** now teaches at Augustana College in Illinois. She says Delta taught her the importance of thinking critically about teaching methods and of “going many steps beyond just delivering information.” She sees her role as encouraging students to think critically and to consider current issues and moral problems that are related to the topic at hand. She participates in a group that does outreach activities for underserved schools in the Sioux Falls area. She plans to develop classroom labs that are based on experiments she does in her research lab. These labs will teach basic concepts while at the same time exposing students to the types of assays that are done in that particular research field.

**Katie Cadwell** is now a chemistry instructor and general chemistry course coordinator at Madison College. She completed a Delta Teaching-as-Research internship and recalls how the “College Classroom” course emphasized how to determine whether students were comprehending her presentations. Katie was first hired as a postdoctoral researcher in the Interdisciplinary Education Group (IEG) of the UW-Madison Materials Research Science and Engineering Center, where she helped design, deliver and evaluate science education and outreach tools to post-secondary, K-12 and general public audiences. At MATC she applies these techniques to create, deploy and evaluate instructional materials in her chemistry, math, and pre-engineering classes.

**Amy Kamarainen** is now a Post-doctoral Fellow at the EcoMUVE Project, Harvard University. She says her Delta experience gave her the latitude to channel her energies into non-traditional modes of service to the science community. She translates her knowledge of contemporary ecosystems science into classroom curricula and wants to reach middle school students to help them see how science is relevant in their daily lives. Increasing diversity in science fields will only be achieved if young people have a sense of self-efficacy and interest that will carry them through challenging aspects of science training. The Delta community provided role models for how to conduct research and outreach at important interdisciplinary boundaries, she says.
Classrooms across the country are welcoming an ever-growing number of students whose native language is not English.

Learning English is tough enough, especially so when you’re a student learning academic content at the same time.

Helping students meet academic goals while negotiating a new language challenges teachers, too. Each English language learner (ELL) has a unique set of abilities and educational experiences. At any given grade level, and in any given subject, their academic preparation differs, as does their familiarity with informal and academic English. To be of most assistance, teachers need to know how well each student is doing in any given area, at any moment.

The WIDA Consortium (World Class Design and Assessment) helps educators and administrators teach and monitor the progress of ELL students. Now supporting a consortium of 23 states, WIDA designs and helps implement curriculum and assessments for ELL students of all kinds, including those with learning disabilities.

One area of assessment—formative assessment—has recently grown in importance. Formative assessment occurs regularly during the school year and helps teachers and students monitor learning progress. Formative assessments help teachers identify where students are, and where they need to be, relative to learning goals. Teachers and students then address these gaps.

H. Gary Cook directs the WIDA FLARE project. FLARE (Formative Language Assessment Records for ELLs) focuses specifically on academic English language literacy for ELLs in secondary school. Cook explains that formative assessment is cyclical and ongoing. It involves gathering, interpreting, and evaluating information, and taking action based on these results. In other words, formative assessment goes beyond mere documentation of performance. FLARE helps teachers measure student progress as they develop the essential language needed for success in academic classes at middle and high school.

In field testing and development sites teachers and students use FLARE’s Language Learning Targets to set goals for language instruction and learning. The learning progressions span four academic disciplines: English-language arts, mathematics, science, and social studies. These progressions are framed by linguistic components including language functions, vocabulary, grammar, and language discourse.

The heart of the model (see diagram) is its assessments: student self-assessments, an assessment toolbox for teachers, and benchmark tests.
This field testing is taking place in 3 school districts: Garden Grove (Calif.) Unified School District; Chicago Public Schools; and Charlotte-Mecklenburg (N.C.) Public Schools. Because each district has a unique ELL context, Cook says, each adds to our understanding of how to most effectively implement formative assessments.

Prior to 2002, few ELL assessments were created from state-adopted English language proficiency standards. Now, all states have assessments that relate in some way to such standards, Cook says. And substantial progress has been made in developing large-scale ELL summative assessments. Yet formative assessments have received little attention until now.

Cook says that in the current educational context, a useful formative assessment system must integrate itself with mandated state and district academic standards and assessments. It’s important to investigate how teachers can meet the accountability requirements, but at the same time, be able to assess for formative purposes in the classroom.

As development of formative assessment systems continues, Cook says, attention must be paid to the need for deep and sustained professional development and support. FLARE is funded by the Carnegie Corporation of New York.

Adapted from an article originally appearing in the Summer 2010 issue of AccELerate, the newsletter of the National Clearinghouse for English Language Acquisition
In mathematics classrooms, generalization is an important part of the curriculum. When students know how to generalize they can identify commonality across cases, extend their reasoning beyond the range in which it originated, and derive broader results from particular cases. But generalization remains difficult for students to do, and for teachers to support.

UW-Madison education professor Amy Ellis studies the processes that support students’ productive generalizing in their math classrooms. She considers generalization a dynamic social process as well as an individual cognitive activity.

She studied an 8th-grade math class during a 3-week unit on quadratic growth. The class sessions focused on relationships between the height and area of growing rectangles (see illustration). As they grew, the rectangles retained the same height-to-length ratio.

Ellis observed and catalogued all the actions that promoted students’ generalizations. These actions involved teachers, students, problems, and artifacts, all interacting with each other. As the 6 students and their teacher-researcher explored problems in quadratic growth, Ellis found patterns: Students created and refined their generalizations through cyclical interactions. Each round of generalizing prompted the development of new generalizations. The 6 activities that she found to support students’ generalizing were:

**Publicly generalizing**: when students create generalizations in a public manner, sharing ideas and results with others or generalizing out loud.

**Prompting a generalization**: when a member of the class directly encourages a generalizing behavior on the part of another member.

**Publicly sharing**: when a student shifts a generalization, or draws a solution or idea, from the private arena to the public arena for other students to consider, react to, and build from, by revoicing, requesting sharing, validating, or even rejecting.

**Encouraging reflection**: when a student is asked to explain, clarify, justify, or prove a solution, pattern, or generalization. Clarifying actions request a clearer statement, explanation, or a re-statement of a generalization, solution, or idea.
The Wisconsin Doctoral Research Program (DRP) has served UW-Madison School of Education graduate students since its inception in 1996. This fall, the program is being restructured and will have a new leader. John Rudolph, a professor in the department of Curriculum & Instruction, takes over as WCER’s Director of Graduate Training and the DRP, bringing experience teaching DRP seminars and serving on its advisory committee.

A popular DRP program has been the Tuesday lecture series. During the coming academic year second-year DRP students will continue to design and run the Tuesday lecture series, but the program will transition to new formats. In Spring 2011 the program will pilot a new school-wide lecture course that will address important questions in education research. Coordinated by Curriculum & Instruction professor Diana Hess, the course will feature faculty from across the School of Education who will present their work and their knowledge of education research.

In subsequent years the lecture course will be offered to graduate students in the Fall semesters. Those interested will apply for admission to the DRP then. This design will give students maximal flexibility in taking courses that meet their particular professional needs and start students on their way to productive careers in research.

Another new DRP feature is a series of newly designed minicourses that will address issues of importance to developing scholars. The courses will cover topics including writing a literature review, grant writing in education, making effective presentations, and the DRP lecture series. Different mini-courses will be offered each semester and admitted students will be required to take three 1-credit courses during their graduate careers.

For more information see http://drp.wceruw.org/

---

**Building on an idea or generalization:** when a student (or an artifact) builds on another student’s idea or conclusion.

**Focusing attention:** when a teacher encourages students to attend to a specific feature of a problem, idea, or representation.

During this study Ellis repeatedly pressed the students to reflect on the generalizations they were developing—in particular, to explain why their strategies and ideas made sense. These reflection efforts, combined with Ellis’s revoicing acts, supported the students’ development of new generalizations. These efforts then provided the building blocks for students to refine and adjust their generalizations.

Ellis kept the group’s attention on each generalization or strategy by revoicing it and repeatedly encouraging students to reflect on its utility. This fostered an environment in which the students could refine their own ideas and build on one another’s work.

Ellis found, however, that the teacher is not the only one capable of providing leadership. Students who collaborate can also play this role. The act of making conjectures and generalizations public creates opportunities for students to respond to, accept or reject, reflect on, refine, and build on initial attempts. Students sift through ideas to pinpoint those that are mathematically powerful.
WCER Research Highlights is published by the Wisconsin Center for Education Research, School of Education, University of Wisconsin–Madison. WCER is funded through a variety of federal, state, and private sources, including the U.S. Department of Education, the National Science Foundation, and UW–Madison. The opinions expressed in this publication do not necessarily reflect the position, policy, or endorsement of the funding agencies. Fourth-class, bulk-rate postage is paid at UW–Madison, Madison, WI. Send changes of address to WCER, 1025 West Johnson Street, Madison, WI 53706 or call (608) 263-4200. Include the address label from this issue.

No copyright is claimed on the contents of WCER Research Highlights. In reproducing articles, please use following credit: "Reprinted with permission from WCER Research Highlights, published by the Wisconsin Center for Education Research, UW–Madison School of Education." If you reprint, please send a copy to Research Highlights.

WCER Research Highlights is available on the Web at http://www.wcer.wisc.edu.

ISSN 1073-1822
Vol. 21, No. 4
Summer 2010

This Newsletter is archived in PDF form on WCER's website:

www.wcer.wisc.edu/publications

WCER Today is a monthly email newsletter reaching more than 1900 readers at more than 700 organizations. A sample issue and subscription information are available here, www.wcer.wisc.edu/publications/index.php.