A Rare Opportunity

At many large universities, graduate programs in education and the social sciences are located in different areas of campus. This results in few natural opportunities for graduate students in different schools or departments to network, brainstorm, and support each other’s research interests.

WCER’s Interdisciplinary Training Program (ITP) in the Education Sciences provides a rare opportunity for graduate students from several disciplines to create a research community. A select group of students from sociology, economics, psychology, political science, and social welfare learn to design, carry out, and analyze specialized research in education issues.

Perhaps most importantly, they learn to produce evidence about what education programs and policies can benefit students. UW–Madison education professor Geoffrey Borman directs the program, which draws on the talents and research interests of more than two dozen scholars from departments across the social sciences, education, and public affairs. Most have substantial expertise in education as well as in statistical techniques. Some contribute their methodological skills; others their knowledge of problems of education.

Through specialized academic, professional, and financial supports and field research opportunities, WCER’s program provides training in three areas:

1. design and implementation of field-based randomized studies in schools and other complex, real-world settings;
2. statistical analysis of quantitative survey, observational, and assessment data on education, with special attention to questions of causal inference; and
3. impact of policy innovations at the federal, state, and local levels.

EXAMPLES OF INTERDISCIPLINARY WORK

Fellows are required to work on one or more randomized control trials during their five years in ITP. Over the past 10 years students have collaborated on many projects, resulting in publications and presentations.

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FROM THE DIRECTOR

One of the ironies of STEM higher education is that "pre-service teacher preparation" occurs in large part at research universities. The pre-service teachers of higher education are graduate students and post-doctoral fellows, more typically called "future faculty". Nearly 80% of U.S. STEM Ph.D.s are minted at only 100 research universities. These are the set of institutions of higher education most committed to high research productivity, for which graduate students and post-docs are a crucial component of the workforce. As such, there are structural tensions, even disincentives, around providing the nation’s future STEM faculty with preparation for all facets of their careers. These misalignments can be increased by the apprentice model of graduate education, where the preparation of the graduate student rests largely in the hands of their research advisors. One all-too-common outcome is that STEM faculty walk into their first classrooms having little or no preparation for the work before them, and for the responsibility of ensuring their students' learning. As shown by many studies, the ultimate outcomes for the nation are limited STEM literacy among college graduates, too few STEM majors, and preferential loss of women and under-represented people in STEM, all at a time when the call for a more STEM-capable workforce is a consistent drumbeat.

Fortunately the landscapes of research universities are slowly changing with respect to future faculty preparation, in part due to the activities of the Center for Integrating Research, Teaching and Learning housed at WCER. The impacts of teaching development programs in particular have been studied in depth by the NSF-funded Longitudinal Study of Future STEM Scholars, led by WCER Scientist Mark Connolly. They find that such programs are an effective way to build early-career academics' confidence in their college teaching skills. Crucially, substantial gains in college teaching efficacy beliefs can be made by students who participate in at least 10 hours of teaching development. And they find yet stronger outcomes among those future faculty who also have in-classroom teaching experience. They conjecture that those early career faculty who are better prepared for their teaching role will experience less stress and more balance among their academic responsibilities, presumably leading to greater retention of more effective teachers in faculty positions across the entire higher education landscape.

Robert Mathieu
WCER Director
Vilas Distinguished Professor of Astronomy

“Participating in ITP’s weekly research seminars prepared me by exposing me to researchers in several fields. Learning how they conceived their work and how they designed their analytical strategies prepared me to constructively engage with a diverse set of researchers.” — James Benson

During the first ITP grant (2005-11) seven ITP fellows (from sociology, political science, and social work) participated in a large study of teacher development for elementary science, and drew upon it for their own research findings and publications. In addition, six ITP students (from political science and sociology) worked on an NICHD-funded study of social capital and children’s development.

During the second grant (2009-16): six ITP students in sociology have worked on a Children, Families & Schools project; responsibilities included travel to field sites to recruit participants and collect data; data entry and analysis; and writing reports.

Four students from economics and sociology worked last year on the “Wisconsin Scholars Longitudinal Study,” a lottery-based randomized assessment of the impact of financial aid on college outcomes in Wisconsin. Also last year four students from sociology, political science, and psychology were involved in an IES-funded study assessing the impact of writing activities intended to mitigate the harmful effects of stereotype threat on students’ grades and test scores.

“DEVELOPING OPPORTUNITY”

ITP Fellows engage in research that emphasizes questions of "what works" in education—questions that are theoretically informed, but stimulated by practical concerns.

Fellows are enrolled full time as doctoral students. They fulfill all the requirements of their disciplinary homes and receive firm grounding in the theories and methods of their respective disciplines, including advanced statistical training. Within the framework of disciplinary requirements, ITP encourages students and their mentors to craft individualized experiences that suit each student’s interests.

ITP Fellows present their research at one professional conference per year and are eligible to receive funds to attend a second conference where they present their research. Typically, in their third year they serve an internship on a large-scale randomized controlled trial in education. Internship opportunities are provided by ITP partners, including Mathematica Policy Research, the Center for Data-Driven Reform in Education, large urban school districts (Milwaukee, Minneapolis, and Cleveland), and studies conducted by program faculty.
Over the past 10 years, ITP faculty supervised 62 PhD students. Thirty have graduated, and the others are on track to graduate in next few years.

Several students recently shared their experiences with the program. The story of Sarah Bruch (PhD ‘12, sociology) is typical. Now an assistant professor of sociology at University of Iowa, she cites four aspects of her ITP experience that proved particularly valuable: exposure to top-notch research, both in terms of substantive questions and research methods being pursued by UW faculty and leading researchers from around the country; working in interdisciplinary teams of faculty and graduate students on large-scale research projects; participating in academic conferences and workshops; and access to leading scholars who embraced the mentoring and training role.

Nicholas Mader (PhD ’10, economics) is now a senior researcher at the University of Chicago’s Chapin Hall, which performs policy research to benefit children, families, and their communities. His project, “Integrated Evaluation Project for Youth Support Service Providers,” cooperates with Chicago Public Schools, the YMCA, Chicago Public Libraries, and other non-profits. “My experience in WCER’s ITP prepared me in two critical ways,” he says. “First, my exposure to the methods and mindsets of the many disciplines represented at ITP enabled me to make my current work more than just the technical, quantitative exercise that was the main training in my economics program. Second, the focus of ITP on understanding the practical policy context of research made this work a natural segue for me, and I could easily understand the potential for academically rigorous research to be used directly in the public sector.”

James Benson (PhD ’10, sociology) is now a program officer at the National Center for Education Research in Washington, D.C., where he monitors funded research projects. He works in two research areas, K–12 standards and postsecondary and adult education. His work is informed by several disciplines and employs a variety of analytical techniques. “Participating in ITP’s weekly research seminars prepared me by exposing me to researchers in several fields,” he says. “Learning how they conceived their work and how they designed their analytical strategies prepared me to constructively engage with a diverse set of researchers. And the ITP visiting scholars lecture series exposed me to researchers who employ leading-edge analytical strategies. That helped me to understand the techniques available to researchers and to conduct research in a more rigorous and thoughtful way. Finally, having a forum over several years in which to share, receive feedback on, and develop my own research provided many insights into what makes the difference between doing some research and doing excellent research.”

Lesley Lavery (PhD ’11, political science) is now assistant professor at Macalester College, St. Paul, Minn. “WCER’s training program enabled me to work with Dan Goldhaber, director of the Center for Education Data and Research (CEDR) at the University of Washington-Bothell,” she says. “We worked on a contract with the Gates Foundation’s Measures of Effective Teaching Program. I ended up staying on at CEDR to develop a process to code collective bargaining agreements in Washington State, and that led to several publications. My work at CEDR informed the design of my dissertation research project in the Seattle Public Schools and has opened up a network of scholars who offer important feedback on my work.”
Doctoral Student Teaching Development Programs Make a Difference

Only 19% of college students receiving a bachelor’s degree will graduate with a science, technology, engineering, and mathematics (STEM) degree, despite industry demands for workers with training in a STEM field. Poor teaching is a primary reason for students’ switching out of a STEM major, and poor teaching remains a source of concern for those students who remain, according to a landmark 1997 study by Seymour and Hewitt.

At research-intensive universities teaching development (TD) activities are seldom offered to doctoral students in a coordinated fashion, says WCER researcher Mark Connolly, who studies postsecondary teaching and learning graduate education.

Faculty advisors in STEM fields often stigmatize participation in TD, says Connolly. These skeptical advisors consider the time that doctoral research students spend in TD programs a waste of time—or perhaps a way to avoid one’s research.

As a result, improving one’s teaching is typically a “do-it-yourself” experience. Helping doctoral students find TD programs and assess the potential return on the time invested would benefit them—and the undergraduates they eventually will teach.

Connolly says that one’s self-confidence as a teacher is a strong predictor of successful teaching performance, and that doctoral training is a crucial time to develop that confidence. That’s especially important when one considers that one of every three STEM PhDs will teach college courses within 6 years of completing a doctorate.

Connolly and colleague You-Geon Lee measured the effects of teaching-focused professional development at three U.S. research universities. Their study used social cognitive career theory (SCCT) to analyze the short- and long-term effects of TD on instilling the belief that one can be an effective teacher.

SCCT posits that the beliefs that people hold about themselves are key to their personal agency. It attempts to explain how personal career goals, career expectations, and one’s sense of personal efficacy collectively shape an individual’s career choices. SCCT considers many things including how students form their career interests, how they make career-related choices, what constitutes effective job performance, and what makes for satisfying work.

Within that framework, Connolly and Lee hypothesized that TD offerings are the kind of learning experience that directly influence one’s self-efficacy beliefs toward college teaching, indirectly influence one’s career interest and choice, and contribute to subsequent job performance and satisfaction.

This research was part of the Longitudinal Study of Future STEM Scholars, which is following a group of more than 3,000 late-stage doctoral students. It explores the short- and long-term effects of TD participation on students’ pedagogical preparation, career choices, and early-career success.

Connolly and Lee measured college-level teaching along 6 components: course planning, teaching methods, creating learning environments, assessing student learning, interacting with students, and mastering subject knowledge. The study determined that participation in TD activities had a statistically positive impact on STEM early-career academics’ college-teaching efficacy beliefs. Compared to non-participants, participants were more confident in course planning, teaching methods, assessing student learning, and mastering subject knowledge.

The study found that participation in TD especially benefits women. The more women participate and engage in TD activities, the more effective they are in college teaching. In STEM fields, more women than men leave doctoral programs before completion. But those who are better prepared for their teaching role by doctoral TD may experience less stress and more balance among their academic responsibilities.

In general, more intensive engagement in TD led to greater gains in teaching efficacy. Findings suggest that substantial gains in college teaching efficacy beliefs can be made by students who participate in at least 10 hours of TD. Combining TD with actual teaching experience has the greatest effect. Connolly says that STEM doctoral students should be encouraged to participate in both types of activities during their doctoral training, and that these activities work best when integrating theory and practice.
Community College Can Boost STEM Momentum

A high school student who wants to succeed in a science, technology, engineering, or mathematics (STEM) career that requires a bachelor’s degree is best advised to start at a 4-year institution.

If that’s not possible, attending a community college can provide an important boost toward a STEM degree. In fact, says UW–Madison higher education professor Xueli Wang, community colleges do a better job of cultivating STEM momentum, when compared to their 4-year counterparts. STEM momentum, measured by first-term STEM “quality points” (QPs), has a statistically significant and positive effect on student outcomes. QPs are a measure used in national studies of student transcripts.

The concept of STEM momentum builds on the notion of “academic momentum,” which represents the choices students make in their academic careers. These include entering college directly from high school, carrying a substantial per-semester credit load, and taking summer courses, among others. These decisions require commitment of time and effort, and sticking with them sets students on a promising academic trajectory toward obtaining a degree.

Wang found that community colleges can increase the positive effect of STEM momentum on students’ studies, especially in the case of STEM-aspiring students who are disadvantaged. That’s important because a disproportionately large number of traditionally disadvantaged students attend community colleges. By serving as an affordable entry to postsecondary education, Wang says community colleges present a unique opportunity to enable more diverse student groups to attain baccalaureate degrees in STEM fields.

The Community College Advantage

Wang’s study is one of the first to evaluate the extent to which community colleges promote students’ subsequent 4-year attainment of degrees in STEM fields. Recall that STEM momentum is measured by first-term STEM “quality points” (QPs). They represent the product of students’ course credits and grades; in other words, the speed at which students successfully progress in STEM coursework. Wang’s study found that the number of STEM credits students attempted during the first term exerts a significantly positive, indirect effect on their baccalaureate STEM success, by way of its direct positive influence on QPs.

The study found that beginning at a community college had a significant, positive influence on one of the STEM momentum indicators: the quality points students received for their first-term STEM courses—the same momentum indicator that positively influenced baccalaureate STEM success.

The probability for a typical student to complete a bachelor’s degree in a 4-year STEM field after 6 years is .466 if the student begins at a public 4-year institution and .110 if the student starts at a community college. However, increases in STEM QPs for a beginning community college student are related to a higher percent increase in the probability of baccalaureate STEM success than those for a student at a 4-year institution. In a 4-year context, with a one-point increase in QPs above the mean, and holding other variables constant, the predicted probability of STEM success increases from .446 to .479, a 2.8% increase. By comparison, in a community college setting, that same one-point increase in QPs boosts the predicted probability of STEM success from .110 to .116, or a 5.5% increase.

Wang calls this “the community college advantage.” And the percentage increase in predicted probability of STEM success enlarges as additional QPs are added to the scenario.

Although STEM-aspiring students starting at community college are less likely to achieve a degree in STEM, this gap can be reduced by the positive influence of community colleges on STEM QPs, which in turn positively impacts baccalaureate STEM success. Wang says that increases in STEM QPs might have a stronger encouragement effect for STEM-aspiring students who begin at a community college than for students beginning at 4-year institutions.

But she warns that her findings suggest that community colleges in general have not yet evolved into a pathway to a baccalaureate in STEM that is comparable to public 4-year institutions. And that highlights the need to explore viable policy and practice for community colleges to improve the educational experiences and promote the success of STEM-aspiring students.
Accountability Versus Local Control: 
Making Early Childcare Work

A 4-year kindergarten (4K) program in Wisconsin catalyzed statewide opposition that district leaders did not anticipate.

Designed a decade ago, the 4K program caused private childcare providers to lose an important portion of their business: 4-year-olds. That loss made it harder for providers to cover the costs of more expensive infant and toddler care.

UW–Madison education professor Beth Graue and colleagues describe a more democratic, community-based approach that solved the problem could serve as a model for the rapidly growing public preK movement.

The early education and care sector is typically private, and varies highly from community to community. The K–12 system is largely public, and increasingly standardized at state and national levels. These two systems have quite different philosophies of practice, financing, teacher requirements, and regulations.

The early childhood community honors child-centered pedagogy, which builds curriculum developmentally. That does not fit well with many models of public school accountability, which focus on grade-level benchmarks and readiness and now are reaching into the early education arena, as with Wisconsin’s 4K program. Currently, 43 states spend more than $5.3 billion for public preK programs that serve more than 1.3 million 3- and 4-year-olds.

To determine how the public and private systems might work together more efficiently, Graue and colleagues Bethany Wilinsky and Amato Nocera recently interviewed Wisconsin educators and state policymakers. “Wisconsin is a good example [of] the rapidly evolving policy landscape,” Graue says. It has a mature public preK program and serves students in 92% of the state’s school districts. Wisconsin’s design, which incorporates public schools and community childcare centers, shows the challenges of implementing a preK program in this political moment.

The “Policy Paradox”
“Traditional models of policy making suggest that the public policy process is linear,” Graue says. “An issue is defined, policy alternatives are created, evidence is considered, and the best policy option is determined and implemented.”

Following this model, a policy challenge, like low-quality schools, is identified, and a policy solution, like the development of uniform educational standards, is implemented after evidence shows this to be the best solution.

But the “policy paradox,” as coined by professor Deborah Stone in 2001, describes how policymaking represents less a choice between alternative solutions than a battle over how political issues are defined and policy solutions represented.

“Political ideas are fluid and they reflect power relations,” Graue says. This takes local control and standardization into contested terrain. The boundaries of these priorities are not always clear and policies often reflect elements of both ideas.

In response to local needs and concerns, Wisconsin developed a 4K “community approach” (4K-CA) that exemplified the paradigm of local control.

One participant said, “Traditional 4K is a school-based, school-driven, thing. . . . The Community Approach brings all the players into the room—all the childcare people, all the kindergarten people, all the special education people, all the Montessori people, private sector, and public sector. And you say, ‘If we created one program for all the kids and all of us are players in this, what would it look like?’”
State policymakers and school administrators said they valued having the parameters of 4K determined at the local level. Policymakers also said they considered private childcare centers important community institutions, with knowledge and values that would be left out if 4K were implemented through schools.

Yet, 4K would need to find its place in a larger early childhood economy—one that included some children not being served by any program, some already in full-day childcare, others in part time nursery school, and others in Head Start or informal friend and family care.

Using terms such as “empowerment” and “representation,” many people interviewed praised 4K-CA for taking a democratic approach to administering 4K, particularly when compared to the alternatives. In its purest form, 4K-CA symbolized a preK program that reflected the values and needs of each community.

**Rating the Providers**

YoungStar is a Quality Rating and Improvement System that rates childcare providers on a scale of one to five stars, based on points the provider earns for education qualifications and training, learning environment and curriculum, professional and business practice, and child health and wellbeing practices. Providers with a rating of four or five stars receive additional childcare subsidies.

A growing national emphasis on standards and new assessment measures left some participants feeling that YoungStar was inadequate. The superintendent of the state Department of Public Instruction considered YoungStar a worthy model, but he believed that future initiatives needed to expand beyond providing just a quality rating of programs and to incorporate student assessment.

Interview subjects told Graue and colleagues about a cluster of initiatives that were changing 4K by drawing it into new assessment systems in hopes of improving quality.

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These included new ways to identify learning needs, track student growth and, potentially, evaluate programs. Although Wisconsin has no mandated curriculum for 4K, discussions indicated that might change soon.

“What started as standards-based reform in 4K developed into assessment policy,” Graue says. “Now it has the potential to turn into a unified curriculum.” These developments suggest a significant shift in Wisconsin’s 4K that challenges a tradition of local control, as well as early childhood practices more generally.

“Policymakers are blending policy ideas derived from both accountability reforms and a strong history of local control to determine the future of 4K policy,” Graue says.

Graue and colleagues continue to study the politics of accountability and encourage other educators to learn more about how policymakers bring together elements of contradictory discourse in the way they think about preK.

Research in Mathematical Sciences Education integrated research on learning, teaching, curricular reform and assessment to produce Mathematics in Context. This middle-grades curriculum used realistic contexts to engage and motivate students and has been adopted by schools in Atlanta, Philadelphia, Chicago and elsewhere.

Mathematics researchers also produced Cognitively Guided Instruction (CGI), a professional development program for teachers of math in early grades.