Session Title:
Examining Evidence of Project Impact and Effectiveness

MSP Project Names:
- Louisiana Math and Science Teacher Institute (LaMSTI)
- Mathematics Teacher Leadership Center (MathTLC)
- Mathematics Teacher Transformation Institutes (MTTI)

Presenters:
James J. Madden, Louisiana State University
Shandy Hauk, WestEd
Jodie Novak, University of Northern Colorado
Roger Peach, Lehman College, CUNY

Authors:
James J. Madden, Louisiana State University (Lead)
Shandy Hauk, WestEd (Lead)
Jodie Novak, University of Northern Colorado (Lead)
Roger Peach, Lehman College, CUNY (Lead)
Serigne Gningue, Lehman College, CUNY
Barbara Schroder, The Graduate Center, CUNY

Collaborative Session

Strand 3

Summary:
The purpose of this session is to generate discussion among projects in order to a) identify common problems of reasonable specificity in research and evaluation and b) find ways of exchanging solutions. The three presenting projects differ somewhat in design and objective, but the presenters have found significant common ground. All have responded to challenges in matching the evaluation/research design to the overall project vision, balancing the research/evaluation portfolio, articulating useful theoretical models, acquiring data, and generating publishable findings. This session is intended to initiate lasting communications between projects, leading to productive cooperation with focused objectives and possible joint activities in the future.

Section 1: Questions framing the session:
All three projects have responded to challenges in matching the evaluation/research design to the overall project vision, balancing the research/evaluation portfolio, articulating useful theoretical models, acquiring data, and generating publishable findings. While we will address all these common themes in the session, in the present written submission we will comment mainly on the issues related to building logic models.

The ultimate aim of most MSP projects is to increase student learning in STEM disciplines. Strategies include improving teachers' content-knowledge, altering teachers' beliefs, habits of mind and instructional practices, developing professional communities, and interacting with school and district leaders. An excellent measure of the quality of evidence is the extent to which it can be relied upon to guide future project design decisions. Are we getting evidence of this quality? If so, when, where and how? If not, what is missing?

Projects typically create numerous inputs, most of which are expected to influence student-learning only indirectly. Increased content-knowledge, for example, does not by itself improve instruction, but does so only when teachers succeed in using it in certain ways and under specific circumstances. Thus, if increasing content-knowledge is used as a strategy for improving instruction, project designers must be mindful of the causal chain linking changes in knowledge to changes in instruction. In addition to operating indirectly, the various inputs are expected to operate at different system levels. STEM courses for teachers aim to alter the individual mind-sets and behaviors of teachers, but at a different level their effect is to bring about new, enduring relationships between teachers and college faculty, which may influence instruction in other ways. Lesson study—or what is probably much more common: simple trading of lesson ideas between teachers—focuses on intentional alterations in the instructional process itself. Leadership training aims to modify relationships between teachers, thus facilitate useful exchanges of materials, models and supports. Summit meetings for district authorities may seek to modify the overall characteristics and goals of complex organizations, bringing about agreements on common purposes.

Another challenge in collecting and interpreting evidence arises from the fact that project effects may be modified or even overshadowed by other influences. Many states are beginning to employ global teacher-evaluation systems. Often these use student results on state-mandated tests, and it is well-known that this can have a powerful influence on teaching practices. Some states—Louisiana is an example—are introducing teacher-evaluation systems that have observation-based components. When these systems have consequences for employment decisions—as in Louisiana—we may expect teachers to act in such a way as to maximize their scores. How do we separate the effects of the MSP from such influences? A third influence is the transition to new content standards, which is well underway in mathematics and coming up fast for the sciences. This is often accompanied by state- or district-led professional-development initiatives to support the transition. Here again, we need a data plan that separates the effects of these inputs from project effects.

A third serious complication is that most instruments for measuring changes in teacher-knowledge, instructional practice, teacher community and student learning do not have simple, unequivocal meanings, and may be valid only under prescribed conditions. Standardized tests, which are now available in most states, are not generally designed to detect the kinds of learning effects that many projects aim for. Instruments intended to detect changes in teacher knowledge, instructional practices and professional communities are available, but in many cases the broad significance of what they detect

is not known. For example, the widely used Reform Teaching Observation Protocol (RTOP) measures the degree to which classroom instruction in mathematics or science is reformed, but we know little about the value of "reformed" instruction in comparison to high-quality alternatives.

We can summarize the issues raised here by posing three major questions that need serious consideration in determining what evidence to gather and how to interpret it and what its ultimate value may be:
1. What are the precise causal relationship between project inputs and improved student learning? What agents or processes are affected?
2. What factors external to the project impinge on teacher performance and student-learning and what is their strength relative to project inputs?
3. What is the validity of the surveys, tests or other instruments employed to gauge program effects?

Arguably, the most important question for all projects is, "What is the most effective way to achieve the final project goals?'' This question provides a useful benchmark by means of which to evaluate the quality of evidence, for what more could we possibly ask for than findings that are clear enough to bring about solid agreement on project design and trajectory, with reasonable expectation of specific desired outcomes?

Section 2: Conceptual framework:
The Louisiana Math and Science Teacher Institute (LaMSTI) at Louisiana State University in Baton Rouge is built around a special track of the LSU Masters of Natural Sciences (MNS) Degree Program. Designed for practicing middle- and high-school math or science teachers, the academic program is developed and taught primarily by STEM faculty in the LSU College of Science, though faculty in the LSU College of Human Sciences and Education and in the LSU College of Humanities & Social Sciences contribute significantly. The theory of action of LaMSTI is that the College-of-Science-based MNS Degree Program and the people in it—the degree candidates themselves, the scientists and mathematicians who teach and advise, and the district and school leaders who interact with the candidates—will become a hub in the professional network of math and science teachers and leaders in the greater Baton Rouge area and a source of scientific knowledge, best practices and research-based innovations. The central aim is to create a teacher community with high "professional capital," with the assumption that this creates the conditions for improved student learning. LaMSTI partners with East Baton Rouge Parish Schools and Iberville Parish Schools (core partners), and several other districts within a 45-mile radius of Baton Rouge (supporting partners). LaMSTI research has focused on defining the nature of teacher expertise and studying how it is acquired and on the impact of LaMSTI on teacher-networks in the diverse contexts of participant teachers. To date, 76 candidates have been admitted and 20 have graduated (9 in math and 11 in physical sciences). LaMSTI is in the fourth year of its funding.

The Mathematics Teacher Transformation Institutes (MTTI) at Lehman College, The City University of New York, works with second-stage Bronx middle and high school teachers (those with 4 to 10 years' experience) who are building their leadership skills

through learning opportunities in mathematics, classroom-inquiry projects, and direct leadership development. MTTI is directed by a Partnership Leadership Team (PLT) consisting of faculty in mathematics and mathematics education as well as staff from the Institute for Literacy Studies (ILS), the New York City Mathematics Project, and the New York City Department of Education (NYCDOE). In addition to developing teacher leaders in the schools, MTTI seeks to influence teacher preparation at Lehman College through new certificates, courses, and innovative pedagogy. The research component of MTTI seeks to broaden the knowledge base on teaching and learning in mathematics related to (1) the study of conceptually-challenging mathematics—particularly in algebra and geometry— and how it benefits second-stage teachers; (2) how classroom-based action research contributes to critical and analytical understanding of the relationships between teaching practices and student learning; and (3) how multi-levels of support prepare second-stage teachers for leadership roles. MTTI is funded to support 80 teachers in two cohorts; Cohort 1 ended in June 2011, Cohort 2 began in July 2011. MTTI is in its fourth year of funding.

The Mathematics Teacher Leadership Center (Math TLC) is a partnership led by the University of Northern Colorado, with core partners the University of Wyoming, the Colorado school districts of Greeley (Weld District 6), Morgan County, and Poudre County and the Wyoming school districts of Laramie County and Carbon County. Math TLC supports a new master's in Mathematics for Secondary Teachers program, which began June 2009, and is offered jointly between the University of Northern Colorado and the University of Wyoming. In this 2-year program, current secondary math teachers engage in rigorous mathematics, explore pedagogical content knowledge, learn to connect research and practice, explore culturally relevant and responsive teaching. The Mathematics Teacher Leadership Program (TLP) is a two-year, graduate-level experience designed to offer math teachers the opportunity to advance as instructional leaders. Participants learn about mentoring mathematics teachers, designing and conducting professional development, evaluating curriculum, conducting teacher research, analyzing and interpreting data, and motivating and sustaining change. The research goals of the TLC are: (1) to build knowledge about the content and impact of professional development of mathematics teachers by examining the mathematical understandings, pedagogical content knowledge, and practices among Math TLC participants and staff as well as the achievement of K-12 students and (2) to acquire knowledge about teacher leadership development by researching, through a design experiment, the Math TLC leadership development model. The master's program will serve 60 to 72 teachers in four cohorts, and the leadership program will serve 30 to 36 in three cohorts. The Math TLC is in its fourth year of funding.

Section 3: Explanatory framework:
The "standard model" of professional development (as discussed for example in Desimone 2009) posits the following causal chain: teachers' experiences in professional development lead to increases in teachers' skills and knowledge and changes in their attitudes and beliefs. This leads in turn to improvements in the design and content of instruction and as a result student learning increases:

Professional Development	→	Teachers' Knowledge and Values	→	Improved Instruction	→	More Student-Learning
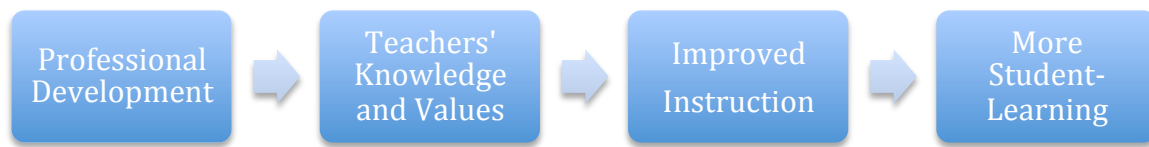
However, in examining the design, execution, and outcomes of the three MSP projects represented here, we find that the "standard model" is not appropriate as a framework for meaningful analysis of findings. A central problem is that the "standard model" implicitly assumes that instructional outcomes are primarily attributable to the agency of individual teachers, while the projects all address variables at the organizational and inter-organizational levels.

All three projects include the following components
1. advanced content training within a graduate degree program
2. separate, specialized leadership training
3. action research projects or theses
4. various means to influence instructional practices.

Projects seek evidence pertaining to each component. To assess participants' mathematics knowledge, all projects rely on broad instruments as well as project-specific/in-course measures of particular concepts. For pedagogical content knowledge, all the projects employ written tests (e.g. instruments like Michigan's Learning Mathematics for Teaching). To measure teacher-leadership development, MTTI relies on self-report surveys and reports from teacher-consultants who have worked in the schools with the participants. Math TLC uses cognitive interviews and is developing a written instrument to gauge teacher leader knowledge. LaMSTI uses self-reports of leadership roles and also analysis of documents provided by schools or districts. Action-research projects result in written documents that potentially contain a wealth of information. For example, there are certain questions and themes that recur in the work of numerous teachers. To detect changes in pedagogy the projects use various classroom observation protocols. LaMSTI has videotaped teachers and analyzed the video while the Math TLC has developed and validated a real-time in-class protocol.

Most project activities are expected to have results that are removed in time and context from the delivery site. Creating meaningful evidence depends on having a fully explicit theory that relates changes in each of the four components listed above to subsequent changes that contribute to increased student-learning. In some cases, we have a good beginning. For example, Schoenfeld (2009) lays out a framework for understanding instructional behavior that makes specific the whys and hows with respect to the effect of increased content knowledge on instruction.

With respect to the ultimate goal of increasing student learning, to varying degrees the projects face the problem of obtaining and interpreting student achievement data gathered by states. Such data may be difficult to gain access to due to legal restrictions, or simply due to the difficulty of extracting the relevant data from a complex database. There is

also the problem of interpretation. If reliable teacher "value-added" scores are available for teacher participants for several years before and after attending an academic program, then a "regression discontinuity" design could detect changes in teacher effectiveness attributable to program inputs.

References
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181-199.
- Schoenfeld, A. (2011). *How We Think: A Theory of Goal-Oriented Decision Making and Its Educational Applications.* Studies in Mathematical Thinking and Learning Series, Taylor & Francis US.

Section 4: Discussion:
We can draw two contrasting models to describe how a university-led project might help to increase student learning. One model sees student learning as a function of the individual efforts of teachers. In this case, the aim of the program will be to alter teachers in positive ways, such as equipping them with instructional strategies already associated with effective teaching. The complementary model acknowledges that what teachers do in their classrooms is a primary determinant of student learning, but it posits that this is dependent on factors that are more immediate and at times more powerful than what an academic program delivers. For example, specific directives from the employing district may override an instructional move towards innovation. In this case, it makes more sense for programs to gather evidence about the factors that affect teacher-behavior, understand them and to act in a manner that leverages them. The teacher professional community is one powerful influence on teacher-behavior that an academic program is in an excellent position to shape. The person-to-person connections that are made when people with similar goals face with similar challenges over a significant period of time in an academic setting may be the most valuable things one obtains from a high-quality degree program. Some of the strongest evidence we have about program effects confirms this. It is clearly the case that all three projects pay careful attention to how they affect the teacher professional community, and this raises new challenges and opportunities for gathering and interpreting evidence.

Section 5: How will you structure this session? What is your plan for participant interaction?
The collaborators are preparing a systematic comparison of research/evaluation problems and solutions that contrasts the three projects. In order to provide a meaningful context, we will prepare and distribute a comparison matrix of program objectives, program environment, program components, causal theory, evaluation design and instruments, research program and findings, etc., in which we identify points of concern relative to evidence production. Following a brief review of the matrix, participants will have an opportunity to report the evidence problems and solutions encountered in their projects. We hope to compile a broader overview, and finish the session with an action plan for a collaborative effort to improve communications across projects and ultimately raise the

quality and exchangeability of the evidence used determine how MSP projects bring about lasting changes linked to improved student-learning.