

**Session Number: 3**

Abstract Name: **Exploring the Maturation of Systems Reform: A Seven Year, K-12 Case Study Analysis of Teacher and System Reform Variables**  
MSP Program: Math and Science Partnership of Southwest Pennsylvania  
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**1. Questions(s) or issue(s) for dialogue at Learning Network Conference session:**

What do reform based behaviors actually look like in the classrooms of teachers who are highly engaged in MSP activities?

What are the teacher and system variables related to the maturation and sustainability of systems reform?

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**2. Context of the work within the STEM education literature and within your MSP project:**

The Math Science Partnership of Southwestern Pennsylvania (MSP) brings together 53 K-12 school districts and is housed at the Allegheny Intermediate Unit (AIU) in Homestead, Pennsylvania near Pittsburgh. The AIU subcontracted with the Collaborative for Evaluation and Assessment Capacity (CEAC) at the University of Pittsburgh, and its own evaluation division, to serve as the project's evaluation team. The K-12 case studies represent one major strand of the evaluation.

To ensure the growth of a STEM workforce, current research supports the need for coherent teacher experiences in science and math specific professional development (Carpenter, T. P., et.al, 1996; Desimone, L. M. 2009; Guskey, T. R., & Sparks, D. 2002; et.al 2006; Shouse, A., & Schweingruer, H. 2008). The MSP aims to provide such experiences. The three main goals of the MSP are to improve student learning in mathematics and science by providing a challenging curriculum for every student, increase and sustain the quality of K-12 math and science teachers via a coherent professional education continuum, and to build relationships between K-12 and higher education institutions to better coordinate the development of a quality education system (Math & Science Collaborative Journal, 2009).

The National Staff Development Council (Sparks, D. & Hirsh, S., 2000) has proposed well accepted standards for professional education experiences that, collectively, guide the development of professional development plans and programs that are focused, practiceembedded, intense, and well-integrated with the reform agenda of schools. Further, the reform literature is replete with recommendations for professional development opportunities that extend beyond the "one-day, make and take" variety of in-service often provided for teachers.

The MSP has articulated its theory of action/impact through the development and refinement of a logic model (attached). The model guides the evaluation team as well as the project staff to align

MSP goals with the Resources/Inputs and Intervention strategies/MSP Activities, Outputs, and Outcomes (Short, Mid-term, and Long term) to preserve a coherent approach to both planning and evaluation.

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**3. Claim(s) or hypothesis(es) examined in the work (anticipating that veteran projects will have claims, newer projects will have hypotheses):**

The K-12 case studies are designed to add depth of contextual understanding to the other data sources. This paper describes the K-12 case study process for The Math Science Partnership of Southwestern Pennsylvania (MSP) over the past seven years. During project Years One, Two, and Three, case studies focused upon levels of teacher participation and depth of reform implementation in the classroom. Years Four, Five, Six, and the current Year Seven case studies were designed as success explorations that concentrate on changes in teaching practice, changes in student engagement, and the maturation of reform adoption. By focusing on sites with high levels of implementation, the paper also explores teacher and system reform variables.

The MSP claims that professional development diffusion can result in pedagogical reform in classrooms and between existing teachers, and has the potential to increase the successful engagement of students in math and science education. Further, the MSP is building an expanding regional capacity, via a critical mass of educators, which can help focus the math and science instruction, and ultimately, student achievement, in K-12 math and science. The case studies, as part of a broader evaluation plan, are designed to explore these claims.

The evaluation team has found that teachers with high levels of MSP participation engage in reform-based behavior that increase the likelihood of achieving the goals of the MSP as discussed in Section Two. Classroom observations are conducted using a revised version of the Lesson Observation protocol earlier developed by Horizon Research, Inc. Year Six case studies document many examples of reform-based behavior. The vast majority of K-12 classroom lessons were well designed as evidenced across all six subcategories that our instrumentation explored, and teachers demonstrated a high level of success in the five subcategories of lesson implementation. The majority of observed teachers demonstrated *effective to highly effective* teaching in the five subcategories of content and across all six subcategories of learning culture. Further analysis of observation data aligned with interview data allows us to hypothesize about the interaction of individual responses to reform (by the teacher) and the cultural responses from the institution (school and district). We can present a theoretical heuristic that we are now attempting to refine and validate in current case studies (Year Seven). Evidence from year Six, along with previous case study years, through use of this heuristic, offer important implications related to the maturation and sustainability of systems reform, especially in relation to capacity building that realizes the potential of reform-minded individuals being supported in key ways by institutions and systems.

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**4. Evaluation and/or research design, data collection and analysis:**

During project Years One, Two, and Three, data collection was categorized according to districts' levels of participation and case studies were divided into three groups: high-

participating, mid-level participating, and low-participating districts. In project Years Four, Five, and Six, data collection for the case studies primarily concentrated on districts at the highest level of participation. By focusing the present analysis on teachers who have participated extensively in MSP professional development and activities, we can more thoroughly identify and examine the impact of MSP activities on classroom teaching and learning.

Like Years Four and Five, Year Six case studies were specifically designed as success case study explorations. This year's evaluation includes ten K-12 school districts: eight districts from the NSF-sponsored group and two from those supported by the PDE. Nineteen teachers were observed for a total of 65 lesson observations. Of the 19 teachers observed, eight were elementary math teachers, three were secondary math teachers, one was an elementary science teacher, and seven were secondary science teachers. Case study teachers were selected based upon their high levels of participation in MSP activities and recommended by MSP Coordinators.

Classroom practices were evaluated on four elements: lesson design, lesson implementation, content, and learning culture. For each of the four elements, five to six subcategories were each rated on a rubric as *highly effective*, *effective*, *moderately effective*, or *ineffective*. Subcategories for the element of lesson design included purpose, prior knowledge and common misunderstandings, materials/resources/manipulatives, lesson sequencing, assessment of student understanding, and closure. Lesson implementation was evaluated on the subcategories of misconceptions of science/math, teacher as facilitator, student engagement in learning, teachers' use of questions, and communication of the "big ideas." Lesson content was rated on the subcategories of appropriateness, engagement with "big ideas," science/math as a dynamic body of knowledge, conceptual understanding, and life connections. The final element of learning culture was evaluated on the subcategories of classroom climate, classroom management, equity, rigor, collaboration, and grouping strategies.

Teachers were also asked to complete pre and post-observation surveys in order to provide the evaluation team with teacher expectations and reflections on the observed lesson. When time permitted, on-site interviews based on the post-observation reflection surveys were conducted immediately after a lesson observation. These reflections and interviews are used in this report to discuss the lesson subcategory teachers found most challenging. Data collected from Year Six classroom observations indicate that the vast majority of lessons were well-designed as evidenced in the six subcategories of lesson purpose, identification of prior knowledge & common misunderstandings, use of materials/resources/manipulatives, lesson sequencing, assessment of student understanding, and closure. Those subcategories evidenced most frequently (as *effective*) included designing highly relevant lessons (18 of 19 teachers), identifying prior knowledge and common misunderstandings of students through multiple strategies (18 of 19), and utilizing resources and manipulatives to enhance the lesson (18 of 19). Consistent across Year Six case study observations, teachers had more difficulty providing sufficient time for debriefing, student reflection, or summary. Four instances of *less than effective* teaching were demonstrated in the subcategory of closure. This continues to be a challenge even for the most experienced teachers.

Teachers also demonstrated a high level of success in the subcategories of lesson implementation (misconceptions of math and science, teacher as facilitator, student engagement in learning, teacher's use of questions, and communication of "big ideas"). Every teacher (19 of 19) was rated as *effective* in the subcategories of student engagement and teacher's use of questions. Most teachers were *effective* in the identification and correction of student misconceptions (17 of 19), teacher as facilitator (16 of 19), and communication of "big ideas" (13 of 19). Only five instances of *less than effective* teaching were found across subcategories in lesson implementation.

The majority of observed teachers demonstrated *effective* teaching in the subcategories of content (appropriateness, engagement with "big ideas", science/math as a dynamic body of knowledge, conceptual understanding, and life connections). Those subcategories evidenced most frequently (as *effective*) included appropriateness of content (17 of 19 teachers), engagement with "big ideas" (15 of 19), conceptual understanding (15 of 19) and life connections (15 of 19). Only five instances of *less than effective* teaching were demonstrated across subcategories in content.

Across all six subcategories of learning culture (classroom climate, classroom management, equity, rigor, collaboration, and grouping strategies), observers found the majority of teachers *effective*. Those subcategories evidenced most frequently (as *effective*) included encouraging classroom equity (18 of 19 teachers), providing a consistent climate of respect for students' ideas (18 of 19), providing effective classroom management that supported active student participation (18 of 19), and grouping strategies (15 of 19). Seven instances of *less than effective* teaching were demonstrated across subcategories in culture.

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## **5. Key insights (retrospective for veteran projects, prospective for newer projects) that have value for the Learning Network:**

Year Six case studies document many examples of reform-based behavior, which indicates the likelihood that these teachers will efficaciously continue to use MSP teaching strategies as a core facet of their instruction. Across all years, case study observations demonstrate that high participating MSP teachers implement MSP practices effectively and are reflective practitioners.

Thus the MSP goals of professional development diffusion, the expansion of a critical mass of educators, and the successful engagement of students in math and science education are likely to be met.

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