

Session Title:

Using Social Network Analysis to Study How Teacher Communities of Practice Affect Science Curricula Enactment

MSP Project Name:

Maine Physical Sciences Curriculum Partnership: Research and Infrastructure for Ongoing Educational Improvement (MainePSP)

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Project Session**Strand 3****Summary:**

A primary mission of the MainePSP is improving science teaching practice in rural settings by building and training a community of educators. The core mechanism for improving teaching practice has been formation of three teacher communities that enact common curricula materials across diverse, rural settings in grades 6-9. Consequently, study of the relationship between community participation and changes in teaching practice is a primary research focus. Social network analysis (SNA) is central to the research design. In this session we introduce key issues and questions that have emerged in application of SNA to the study of teacher communities, and we initiate an ongoing online conversation with participants to improve sharing of SNA know-how and research findings across MSP projects.

Section 1: Questions framing the session:

- (1) How can use of social network analysis (SNA) contribute to understanding of the relationship between teachers' participation in communities of practice and changes in teaching practice?
- (2) How can we address the methodological challenges inherent in using SNA to explore conjectures about overall community structure (socio-centric analysis), rather than just conjectures about the networks for individual teachers (ego-centric analysis), even as the network expands to include new participants?
- (3) How does the SNA research, with its focus on community structures and interactions, fit together with and complement more traditional approaches to education research?
- (4) How does this combination of SNA and traditional education research inform MSP project implementation and provide the foundation for Design Based Implementation

Research, thereby increasing understanding of how the innovations that are central to an MSP project are implemented in different school and classroom contexts and how these innovative practices might be sustained beyond the term of the funding?

Section 2: Conceptual framework:

The proposed talk will address questions in the conference strand on **Evaluation, Research and Implementation: The Feedback Loop**. Specifically our presentation speaks to “How do we know if we are making a difference?” and “How do we know what aspects are contributing to the difference?” The MainePSP approaches these questions through use of a research framework recently described in a position paper by Penuel and Fishman (2012) titled “Large-Scale Science Education Intervention Research We Can Use.”

Penuel and Fishman (2012) distinguish between “effectiveness research,” designed to gather data about the effectiveness of an educational innovation, and a new approach to research that they call “Design Based Implementation Research” (DBIR). DBIR collects data to support understanding of how different approaches to implementation, placed within in the context of different educational settings, can render an innovation more or less effective. The MainePSP, which provides supports for communities of teachers as they work together to implement research based science curricula over grades 6-9 in contexts shaped by *A Framework for K-12 Science Education* (National Research Council, 2012), is a DBIR study.

Penuel and Fishman (2012) describe four research “arcs” that are ideal for DBIR as schools and teachers begin to implement new science teaching practices aligned with new science standards that will emerge from the K-12 Framework (NRC, 2012). One arc concerns “organizational strategies for crafting coherent science programs,” including research into how participation in teacher communities shapes teaching practice. The MainePSP, with teacher communities at the center of its theory of action, focuses on this connection between community and practice.

Our study of community participation uses the framework that Etienne Wenger developed in *Communities of Practice* (1998). Wenger describes distinct but complementary dimensions of research into social learning, including (1) research into situated experience in response to formal social structures (e.g., an individual teacher’s implementation of science education standards), and (2) research into social practice and community membership. The framework provides the MainePSP with a way to integrate research along both of these dimensions, for example, integrating studies of teacher responses to new demands on practice (e.g., how teachers conceive of and implement assessment in a curriculum focused on learning content through practice) together with studies of the structure and dynamics of teacher communities.

The central focus of the presentation will be on SNA techniques used to analyze data about teacher interactions as understood within this conceptual framework. A second focus will be on methodological issues emerging in application of SNA techniques. Both of these foci support the strand’s focus on **Evaluation, Research and Implementation:**

The Feedback Loop through SNA's ability to inform near-term implementation decisions as well as to contribute to research objectives. Section 4, below, provides examples of such SNA feedback loops.

Section 3: Explanatory framework:

The proposed presentation is primarily intended to stimulate deep, useful, ongoing discussion with others in the MSP community about approaches to using SNA to understand the interaction of teacher community structure and teaching practice. We will support such ongoing discussion through initiation of an MSPnet.org workgroup (see below). However, to initiate and inform the discussion, we will of course share research techniques and findings from the MainePSP.

The MainePSP's implementation design is informed by expectations about how the teacher communities grow. These expectations emerged from the literature on diffusion of innovation (e.g., Everett Rogers, 2003) and were framed as testable hypotheses. The hypotheses include: (1) Initiation of the community depends on teachers who differ from others in terms of community role; (2) Within-group cohesion will increase as teachers work together; (3) The community of teachers will expand over time and become better connected; (4) New members will be attracted to the community through ties to existing members.

The proposed presentation will show how SNA techniques were used to evaluate evidence regarding each of these hypotheses. Findings from our research suggest that teachers who elected to become part of the initial cohort of project participants were significantly more likely to be central in networks with regard to being turned to for advice ($p < 0.001$). Tests of cohesion showed a strong increase in within-group cohesion for the initial cohort over the first year of implementation. With regard to overall community structure, data after the first year show a dramatic increase in internal connectivity among teachers participating in the project. The hypothesis about attraction of new members is supported by evidence of a strong outward facing focus, as opposed to within-group cohesion, among the teachers who became the second cohort.

Section 4: Discussion:

One reason that the MainePSP seeks to create dynamic, functional teacher communities of practice is because it sees such communities as essential to sustained use of the innovations introduced over the course of the project. Consequently, data that informs the MainePSP about matters such as the ability of the different communities to admit new members, the lifecycle of communities, and connections between communities is important to the project's ability to make adjustments to strengthen teacher communities. For example, the MainePSP is currently using SNA to study the different responses to the program across the first two cohorts. This analysis will inform the structure of evening workshops provided to teachers over the next year.

Another function of our study of teacher communities of practice is its role in the MainePSP's research, as described above under "Conceptual Framework." As an example, two of the communities have begun to develop assessments with the goal of creating common assessments. One research strand being initiated this spring will look at

commonalities and differences in teacher enactment related to assessment, including conceptualization of instructional objectives, engagement of the learner, selecting and constructing assessments, interpreting assessments, providing feedback, and reflections on assessment practice. The complementary, community-oriented strand will look at how such conceptions, enactment, and reflections emerge from and are reinforced by community structure and are folded into community decision-making, with particular focus on the roles played by different members of the community. We believe that improved understanding of the effects of teacher communities on teaching practice will be highly relevant to other MSPs and to other science education change initiatives associated with implementation of instructional practice aligned with the new K-12 Framework (NRC, 2012).

Section 5: How will you structure this session? What is your plan for participant interaction?

Our intent is to use this session to initiate an ongoing interaction with participants and with others from the MSP community who are interested in applications of SNA in MSP projects, with particular focus on teacher communities and teacher practice. As part of our participation we will create a workgroup on MSPnet.org that will serve as the locus of moderated discussions and file sharing related to these issues. Before the conference we will populate the workgroup with illustrative data and analyses and with seeds of discussion threads on important topics related to SNA tools and techniques as well as research design.

The actual presentation at the conference will introduce key ideas and issues, as described in this proposal, using data and analyses from the MainePSP project to illustrate concepts. Because the presentation is necessarily brief, this introduction will be a survey of important issues rather than an in-depth discussion of any single issue. The presentation will include an illustrative interactive SNA analysis using Gephi, an open source graph visualization and manipulation software tool, which we will use to stimulate discussion about ways to use SNA data to explore community structure, engaging participants in the exploration.

We will close the session with an introduction to the MSPnet workgroup, which participants can use to continue the conversation. We will engage participants in real-time, face-to-face conversation about things we might talk about at more length online. We seek to stimulate a discussion about SNA methodology and applications that will improve our work and that of other MSP projects.

References:

- National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K-12 Science Education Standards. Washington, DC: The National Academies Press.
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Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.