

Abstract Title: Key Variables for Establishing and Sustaining Highly Effective Professional Learning Communities

MSP Project Name: Project Pathways: Opening Routes to Math & Science Success for All Students

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120 word summary:

This session describes attributes of *Pathways Professional Learning Communities* (PLC's) that have emerged in research projects to be effective for shifting mathematics teachers' instruction. These shifts have led to greater student learning as assessed by the Precalculus Concept Assessment (PCA), an instrument that has been validated (Carlson & Oehrtman, 2010) to assess foundation concepts and reasoning abilities for learning calculus. Effective Pathways PLC's: i) are focused on teaching and learning content in a specific course; ii) have a facilitator who holds teachers to high standards for discourse about learning specific ideas, iii) are situated in a school in which the principal and department chairs support teachers' PLC participation. In this session we will describe the context in which Pathways PLC's have been effective and the attributes of PLC facilitators that led to PLC members engaging in deep reflection on the effectiveness of their curriculum and teaching in relation to student learning.

Section 1: Questions for dialogue at the MSP LNC.

- What are key attributes of teacher professional learning communities (PLCs) that lead to improved teaching and greater student learning?
- What is the role of the PLC facilitator in establishing and maintaining high quality discourse among PLC members about issues of learning and teaching the content of a course?

Section 2: Conceptual framework.

Pathways Interventions and Key Findings

Project Pathways is a professional development and research project that has generated a sustainable model for the ongoing improvement of secondary mathematics and science teaching and student learning. *Project Pathways*, now in its 6th year, provides school-based interventions that include a sequence of four graduate courses¹, workshops, and school-based professional learning communities (PLCs—see description of *Pathways Professional Learning Community Model* below). The *Pathways Project* supports mathematics and science teachers within a school to improve their students' learning by using inquiry methods and conceptually oriented curriculum in their instruction. For schools in early Pathways cohorts (1-4) our interventions focused on improving the teachers' content knowledge

¹ Course 1 of the 4-course sequence is foundational for shifting teachers' content knowledge and images of effective teaching towards inquiry and focus on understanding concepts. Some teachers have chosen to take only one of the other 3 graduate courses, while devoting more time to their PLCs and changing their teaching. This choice does not appear to be having a negative influence on their ability to improve their own teaching and students' learning.

for teaching secondary mathematics and science, and in supporting teachers in learning to evaluate and reflect on the impact of their teaching on student learning. Our data over the first four years revealed that the *Pathways Professional Development Model* realized significant shifts in teachers' content knowledge and the quality of PLC discourse, and minor shifts in teachers' classroom practices. Classroom observations revealed positive shifts in teachers' questioning and increased student engagement, although their curriculum, mandated exams, and school leaders were often obstacles for their making the shifts in their curriculum and instruction that were needed to realize significant shifts in students' learning and interest in mathematics and science. This resulted in our using our 5th and 6th *Pathways* cohorts as opportunities to implement the *Pathways Professional Development Model* (PPDM) in schools in which the principal, and math and science chairs were supportive of *Pathways* interventions and philosophies, and the school principal was willing to establish required course-based Professional Learning Communities (PLCs) for all science and mathematics teachers within his school.

Our research over the first four years revealed that most secondary mathematics and science teachers (prior to beginning our project) did not possess the deep and connected understanding of the content that is needed to engage in high quality reflection on their teaching or their students' learning. This is not surprising since the current school culture does not support teachers in developing these abilities and knowledge. Their initial image of good teaching can be characterized as 'effective showing and telling'. Our assessments of the teachers' beliefs when beginning their participation in *Pathways* further supported that teachers believed that they viewed good teaching as making learning easy for students by providing clear explanations of how to find answers and carry out procedures. Their image of good teaching did not include student construction of conceptual knowledge, student engagement in inquiry methods, or student development of problem solving abilities. To further complicate matters, the teachers believed that their teaching was already highly effective, resulting in their having little motivation to consider alternative instructional approaches. This led to our developing interventions to address the obstacles we had encountered, including PLC facilitator workshops and a PLC facilitator coaching model to support the PLC facilitators in providing school-based leadership in examining their students' learning and views of what constituted effective teaching practice, while also engaging them in deep conversations about what was involved in understanding, learning and applying central concepts of a course

The Pathways Professional Learning Community Model

Teachers meet weekly for 1 to 3 hours to discuss, reflect on, and adapt their teaching toward the goal of improving student learning. Project staff provide PLC agendas and meaningful tasks that promote reflection and advancement of the teachers' knowledge of what is involved in understanding and learning key concepts. Over the period of the first year, each PLC designs and conducts three interviews (using the tasks they had previously discussed) to investigate their student's understanding of that idea. The data they collected is then shared and discussed in subsequent PLC meetings. During the second semester the PLC's collaborate in developing two-day lessons for the purpose of shifting their teaching of an idea to be more conceptual and inquiry oriented. Over the summer the PLC groups meet for 4 hours per day for 6 weeks to develop inquiry based and conceptually oriented tasks to use in their teaching during the upcoming academic year.

The Role and Training of a Professional Learning Community Facilitator

Each PLC initially (for at least the first two years) has a designated facilitator who is responsible for leading their colleagues in discussing what is involved in understanding and learning an idea central to the course they are teaching. The facilitator is also held accountable for promoting high quality discourse around issues of learning and teaching the content of the course that is the focus of that PLC. The PLC facilitator attends a series of workshops to support her/him in posing questions that promote reflection and high quality explanations by all members of her PLC. During the first year of the school-based PLC a Pathways faculty member provides the initial tasks and questions for each PLC. A PLC coach (a lead faculty in the project) meets weekly with the PLC facilitators to model quality discourse around issues of learning and teaching the ideas central to the task². Between each coaching session the PLC coach³ reviews a video of the previous PLC meeting. The PLC coach then poses direct questions about their attentiveness to: i) their colleague's thinking; ii) the quality of their questions relative to their effectiveness in supporting their colleagues in reflecting, making connections, etc.; and iii) holding PLC members to high standards in providing meaningful explanations and solutions.

Claim(s)

- PLCs with effective facilitators engage in quality discourse about teaching and learning key ideas of a particular course that are critical for improvements in teaching and student learning.
- A PLC facilitator who has a strong understanding of the content of the course that is the focus of the PLC and who is effective in listening to and acting on the thinking of others for the purpose of advancing their thinking is 'highly effective' in supporting teachers within the PLC to advance their understandings, teaching practice and students' learning.
- The school principal and department chairs' views and support of the project goals is critical for advancing and sustaining productive PLCs within a school.

Section 3: Explanatory framework.

Evaluation and/or research design, data collection and analysis

Over a four-year period we studied the effectiveness of our PLC interventions by video recording all PLCs within four different schools during two school years. The PLC video data of 9 PLCs were video taped and analyzed using Strauss and Corbin's open coding techniques (1995) to study the quality of discourse and to detect attributes of facilitators that were effective and not effective.

Analysis of the video data (Carlson, Bowling, Moore, Ortiz, 2007) led to regular refinements of our interventions. Our data revealed that the PLC facilitator is critical in promoting quality discourse about teaching and learning. The facilitator is also plays a central role in supporting their colleagues in confronting their beliefs about what constitutes effective teaching and learning. The data also revealed that during the first year of establishing a PLC, project staff were needed to mentor the PLC facilitators in setting high standards for reflection and discourse about what is involved in understanding and learning key ideas central to the course that was the focus of the PLC (e.g., algebra II). We continued to collect and analyze video data to determine attributes of facilitators that facilitate discourse that leads to gains in student learning.

² The tasks require have previously been used in research to reveal strengths and weaknesses in student thinking relative to a central idea of the PLC course.

³ The PLC coach is typically a project faculty that has expertise about understanding and learning the key concepts of the course that is the focus of the PLC.

Framework for Analyzing Attributes of PLC Facilitators

When examining a PLC facilitator's interactions with his/her students, we drew from Piaget's (1955) construct of *decentering*, described as an action of placing one's own perspective aside to understand another person's thinking. We also drew from Steffe and Thompson (2000) who effectively used Piaget's idea of decentering to characterize interactions between a teacher and a student. In their theory they describe decentering actions in terms of first- and second-order observers. A first-order observer listens to another person and may recognize that the person is thinking differently, however, the observer does not attempt to understand what the person is thinking or why the other person is thinking about the situation differently. If an individual is speaking such that he or she believes another member understands her or his utterances just as intended, the individual is acting in a non-decentered way. A person can also be a first-order observer if she realizes another's thinking is different than her own but does not attempt to understand or build a model of this thinking. On the other hand, a second-order observer recognizes that another person's thinking differs from his/her own and then creates a model of the other person's thinking for the purpose of interacting productively with that person in conversation. For example, if an individual makes a claim that data is growing exponentially, a first-order observer may agree or disagree with the statement based on his/her own thinking and understanding of the idea of exponential growth. However, a second-order observer will ask questions to understand what the other person means by stating that the data is growing exponentially. The second-order observer will attempt to create a model of how the other person is thinking about the quantities represented in the data and may pose questions to determine if the other person's model includes and understanding of ideas of multiplicative growth, growth factor and percentage growth to determine the rationality behind the other person's claim that the data is growing exponentially. As can be gleaned from this example, the observer must have a deep and connected understanding of the idea in order to make sense of and interact with the other person in such a way that he/she advances his/her thinking in a de-centered way.

Outcomes of Data Analysis

We used the construct of decentering described above to classify the effectiveness of a Professional Learning Community in promoting quality discourse among members of a PLC. In analyzing videos of 9 PLCs over a two year period we identified five different levels of facilitator decentering, progressing from the facilitator showing no interest in understanding the thinking or perspective of other members of the PLC to the facilitator acting as a second-order observer.

The five decentering moves we identified are:

FDM1: The facilitator shows no interest in understanding the thinking or perspective of a PLC member with which he/she is interacting.

FDM2: The facilitator takes actions to model a PLC member's thinking, but does not use that model in communication with the PLC member.

FDM3: The facilitator builds a model of a PLC member's thinking and recognizes that it is different from his/her own. The facilitator then acts in ways to move the PLC member to his/her way of thinking, but does so in a manner that does not build on the rationale of the other member.

FDM4: The facilitator builds a model of a PLC member's thinking and acts in ways that respect and build on the rationality of this member's thinking for the purpose of advancing the PLC member's thinking and/or understanding.

FDM5: The facilitator builds a model of a PLC member's thinking and respects that it has a rationality of its own. Through interactions, the facilitator also builds a model of how he/she is being interpreted by the PLC member. He/she then adjusts his/her actions (question, drawing, statements) to take into account both the PLC member's thinking and how the facilitator might be interpreted by that PLC member.

Identification of these five decentering moves has been critical for advancing our PLC facilitator-coaching model and in creating workshops to support the ongoing development of the PLC facilitators. The artifacts of the research are videos that illustrate specific moves of PLC facilitators (when interacting with other PLC members) that are effective in promoting deep reflection and connections about learning and teaching content that is specific to the course that is the focus of the PLC.

Results: Student Improvements

We administered the Precalculus Concept Assessment (PCA) (Carlson, Oehrtman, Engelke, 2010) to students of teachers who participated in Pathways PLCs (as described above), including PLC facilitators who were trained to decenter when interacting with other PLC members. PCA scores of students' with teachers who participated in Pathways PLC scored significantly higher on PCA. We found that efforts to decenter by the facilitator were enacted by other PLC members and eventually were established as a PLC norm. This resulted in the PLCs achieving higher-level mathematical discourse (Clark, Moore, Carlson, 2008). We also detected using the Reform Teaching Observation Protocol that teachers who participate in *Pathways* PLCs were more attentive to their students' thinking and that they posed more conceptually oriented questions to their students. Our results support that the investment of intense and focused efforts to support PLC facilitators in acting and mentoring his/her PLC members in decentered ways affects teacher effectiveness in engaging her/his students in more meaningful conversations that translate to greater student learning.