Professional Learning Communities *for* Science Teaching

Lessons From Research and Practice

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Table 2.2. Shared Learning Topics for Late-Start Mondays

Academic Year	Shared Learning Topics (teachers select one)
2005–2006	Building a Positive Learning Environment Graphing Calculators 6+1 Writing Traits Reading for the Struggling Learner Strategies for Struggling Learners Beyond Reading Writing is a Process Cultural Competency 7 Keys to Reading Comprehension
2006–2007	Visualization Making Connections Determining Most Important Information Summarize and Synthesize Asking Questions Making Inferences Setting a Purpose Monitor and Clarify
2007–2008	Implementation of Reading Comprehension Strategies From 2006–2007
2008–2009	Literacy for New Teachers Beginning With the End in Mind (unit plans) Project-Based Learning

demonstrate that they were making a serious investment in establishing a learning organization with accountability and were willing to assume the responsibility for managing it to fruition.

In addition to professional development sessions, the 75 minutes on Monday were also used to provide time for departments to develop and refine common assessments, to analyze student learning based on these assessments, and to determine interventions for students who were receiving a failing grade. Ben Davis had been tracking the failure rate of students for over a year and intervening with a number of effective strategies (Reeves 2006). In 2007, the principal challenged the departments to take a closer look at the failure rate, discuss current interventions, and develop some new ideas. The results were quite impressive. The schoolwide failure rate decreased from 16% in spring 2006 to 6.5% in 2007–2008. According to teachers and administrators, some of this reduction can be traced back to focused conversations regarding individual students during the shared learning time and the prevalent use of literacy strategies. The Science Department in particular realized a decrease in the failure rate from 9.7% in 2006–2007 to 7% in 2007–2008. That decrease affected about 170 students, which means that these students turned failure into success.

Wagner and Kegan (2006) identified the seven disciplines for strengthening instruction—the first one is "urgency for instructional improvement using real data"

the prompt. The team had expected the students to write statements such as "It will light because it is a complete circuit"; "It will work because the electricity will flow in a path"; "It will light because the battery, bulb, and wires are connected to make a complete path or circuit." However, when the team examined the student work, analyzed the data, and looked for patterns and trends in student thinking, they were surprised to find that only two students used the academic vocabulary of a complete circuit and only four expressed the idea that "parts" needed to be connected. Five students said the electricity works because it goes in a circle. Seven students mentioned "parts" of the circuit rather than being specific about the battery, bulb, and wires. Five students repeated the prompt as their answer (i.e., "It will work because it will work").

The characteristics in the student work (e.g., "circle" meaning circuit; using "parts" rather than stating the specific part; no mention of anything being connected) caused the teachers to reflect on their instructional design for the student exploration with circuits. The team realized that they had given directions for the exploration but had not designed specific questions to probe student thinking as they were exploring the circuits. As part of the redesign for learning, the teachers crafted clarifying and probing questions they thought would deepen student thinking during the exploration when they taught the lesson again.

Components of a TLC/PLC: Focus on Student Learning

The teachers had focused carefully on students' answers and were reflective about what teacher "moves" would elicit deeper understanding. How did this PLC, based on a collaborative culture, come to these realizations? To answer this question, we need to retrace their steps in planning and delivering this learning sequence concept.

> As one TLC participant noted, "This experience proves [to me] the effectiveness of collaboration in teaching. When strong educational professionals put their minds together, the product becomes a tool for the advancement of student understanding. I look forward to finishing the lesson tomorrow and using the same techniques and methods in future lessons. AWESOME!"

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Shared and Supportive Leadership

From their analysis of our science immersion work, including the Studygroup, Susan B. Millar and Matthew Clifford highlighted the critical role that a few individual leaders played as *boundary crossers*. From their 2005 memorandum titled "On 'Boundary Crossing' as a Key Attribute of Partnership Coordinators," we learn about key attributes these individuals tend to possess, which can be referenced as a guide for strategically selecting and encouraging the kind of leadership that is needed for a successful partnership-based PLC (S. B. Millar and M. Clifford, personal communication). Millar and Clifford's attribute analysis is included in Table 4.3.

Table 4.3. Attributes of Boundary Crossers

Organizational/structural attributes of a "boundary crosser" include

- access to, and the confidence of, high level decision-makers within one's home institution;
- an extensive network of supportive, respectful colleagues within one's home organization;
- capacity to focus the efforts of relevant staff and other resources on partnership activity; and
- the authority or permission to devote enough time to one's partnership leader role to ensure that the boundary crosser does not act as a bottleneck that slows partnership work.

Personal attributes of a "boundary crosser" include

- deep commitment to the vision and goals of their own organization, and to the potential value of the expertise represented by other partner organizations; and
- organizational savvy, including
  - ability to "mind the (partnership) shop"—to mind the partnership shop, a person must be able to keep the big vision for the partnership on colleagues' minds while also getting the nitty-gritty details done right and on time. It means having the creativity to secure the resources (crossing bureaucratic lines if necessary) needed to enable their organization to participate at the agreed upon level.
  - ability to be "people and process smart" (Perkins 2003)—to be people and process smart entails having insight into, and respect for, each partner organization's strengths and limitations, and the capacity to use these insights during interaction with the other partner organization.
  - ability to assess when existing organizational practices and structures are best, and when they are insufficient and must be improved;
  - ability to learn through "creative abrasion" (Brown et al. 2005)—interactions that are abrasive enough to force learning for all participants require that the participants have important differences in expertise and experience, and that the participants interact in substantive ways about issues they jointly care about.
  - ability to know when to take risks in ambiguous circumstances.

Elements of character exhibited by a "boundary crosser" include

- "can do" attitude and a thick skin.
- willingness to take risks.
- generosity in giving credit to others.
- ability and willingness to work tirelessly.

Source: Millar, S. B., and M. Clifford. November 8, 2005. On "boundary crossing" as a key attribute of partnership coordinators. (personal communication)

The Studygroup benefited from a core team of boundary crossers who dedicated themselves to doing whatever it took to get the work done. The coordination required for the Studygroup's success could have been insurmountable without the collaboration among these effective boundary crossers. For other district science leaders or "change agents" interested in establishing PLCs for professional development facilitators—particularly if it involves partners from more than one institution—we

> our comfort level allowed us to incorporate a flexibility that is hard to do with people you are not comfortable with, so that when [necessary] we could quickly alter our direction and keep the experience a positive one for the participants.
>
> —*Virginia Vandergon, associate professor in biology, CSU Northridge*

Conclusion

The Professional Development Studygroup, which developed through a partnership among universities and LAUSD, demonstrated how a K–16 learning community could be composed of a cross-institutional cadre of professional development facilitators. With this broadened view of a PLC, its vision expanded to include a goal of aligning the vision and experiences for students, preservice and inservice teachers, and professional development facilitators. Simultaneously, the Studygroup built a capable cadre of professional development providers for LAUSD. This Studygroup developed a shared vision of inquiry and the SIMPL approach to professional development, resulting in ongoing improvements in the overall professional development system to prepare teachers to teach inquiry-based science units. Because of the middle-out approach taken to establish the Studygroup, the PLC's work was grounded in classroom practice and the group's intellectual gains will remain with the region's practitioners, regardless of the administration turnover that is typical in urban districts.

During the final year of the SCALE project, the superintendent of LAUSD changed, and there were significant shifts in UW support and CSU leadership. The philosophy of centralizing the educational experience for teachers and students across the eight local districts in LAUSD shifted to each local district assuming control of the professional development and curricula to meet the needs of their district constituents. Even with this change in overall district policy, the members of the Studygroup continue to move their common vision forward through local districts with support from the academic instructors and district superintendents. This is evident as new curriculum materials come into the districts and are implemented within the framework we co-constructed. Further, Studygroup members at the local universities are structuring undergraduate classes and inservice outreach programs to reflect the PLC's vision for inquiry, and they are using the SIMPL approach to professional development. Our middle-out approach to science teaching and learning improvement appears to have created enough institutional knowledge that it is sustainable for the foreseeable future through the individual and institutional PLC partners.

From the Professional Development Studygroup's experiences as a learning community, we offer a viable example for educators who want to support holistic improvements in teacher professional learning. What the Studygroup taught us is

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practice, and student outcomes, as well as improvements in administrative support and school capacity, created significant interest in and demand for intensive content- and pedagogy-focused experiences. The new PLC members who had just begun their work with their teacher leaders were invited to a weeklong program to deepen their knowledge of findings from research on *How People Learn*, science content relevant to teaching, how students learn science, and instructional strategies that support student learning. During the program, participants also applied their new knowledge to the instructional materials they teach. Selected sessions were scheduled jointly with NCOSP teacher leaders and administrators to inform the work of their PLCs during the next academic year.

Teacher leaders and administrators still sought structured planning time to prepare for their roles in supporting PLCs during the academic year. A three-day program to deepen their understanding of effective science instruction and PLCs and to generate a plan for continued support of their PLCs was offered to strengthen and sustain this leadership cadre. Sessions were held jointly with PLC members to allow for collaborative planning and decision making. District administrators participated on the final day, and this provided teacher leaders and principals the opportunity to share their plans and demonstrate how they met the needs of their unique school context and supported the professional development goals of the district.

Over 350 teachers who were new to the PLCs participated in NCOSP summer experiences, and 100 participants, including teacher leaders and principals, attended the Teacher Leader-Administrator Planning program. After the summer experiences, 80% of the participants reported that their PLCs will continue to work on improving science teaching and learning during the school year (99% responded that it was "somewhat likely" or "very likely" that their PLC would continue). The most common reasons reported for the PLCs continuing were teacher buy-in and commitment, teacher motivation to improve science teaching and learning, knowledgeable and committed leaders, and the collaborative atmosphere of the PLC. Teacher leaders and administrators reported that they valued the protocols and planning resources that helped them organize and focus their work and the research presentations that helped them understand school values, beliefs, and capacities that contribute to effective teaching and learning.

Examples From Practice

There is no single ideal manifestation of successful PLCs in school buildings. Though all participating school leaders experienced the same core NCOSP program, PLC implementation varied within each school setting. Here, through the voices of participating teacher leaders, we share how two very different schools applied the knowledge and skills developed through NCOSP to support school improvement. In one example, leadership came from the top down, while in the

Chapter 6

Attributes of Content-Focused Professional Learning Communities That Lead to Meaningful Reflection and Collaboration Among Math and Science Teachers

Michael Oehrtman, Marilyn Carlson, and Jo Anne Vasquez

> "Isolation buffers mediocrity and hides high performers from those who might learn from their modeling, consultation, and coaching. When practice is deprivatized, teachers visit one another's classrooms to observe master teaching, to coach each other, to mentor, and to problem solve in the living laboratory of instructional space."
>
> —Robert Garmston and Bruce Wellman, *The Adaptive School* (1999, p.18)

Table 6.3. Categories of Belief

Category	Examples
Factors of resistance	"The pace at which I must cover material does not allow me to teach ideas deeply." "My school administrators do not value my efforts to get students to understand ideas deeply."
Beliefs about STEM learning	"Making unsuccessful attempts when working on a mathematics problem is an indication of one's weakness in mathematics." "Learning happens when students are provided opportunities to construct meaning and make connections."
Beliefs about STEM teaching	"It is important to understand what a student is thinking when s/he asks a question." "The primary goal of my exams is to assess if my students can memorize facts and carry out procedures like ones required for completing the homework."
Confidence and perceived ability in STEM disciplines	"I feel prepared to create learning opportunities for my students that promote connections between mathematics and science." "I have a clear understanding of how central ideas of my courses develop in students."

Note: STEM = science, technology, engineering, and mathematics.

that most facilitators gradually improved in both of these abilities as a result of coaching by project personnel.

To actively facilitate teachers in a PLC requires that the facilitator "place" her- or himself in the other members' shoes. Placing oneself in another's shoes is a classic example of what Piaget (1955) identified as *decentering*, or the attempt to adopt a perspective that is not one's own. Steffe and Thompson (2000) extended Piaget's idea of decentering to the case of interactions between teacher and student (or mentor and protégé) by distinguishing between ways in which one person attempts to systematically influence another. In that process, each person acts as an observer of the other, creating models of the other's ways of thinking.

The construct of decentering implies that it is important for a facilitator to both remain attentive to the fact that each member of the group has a rationality that is completely her or his own and attempt to discern that rationality. The activity of decentering is important to a PLC setting, but it is also applicable to a classroom. If one is truly concerned with student learning, it is necessary to build models of students' thinking and base further interactions on these models. Analysis of the facilitators revealed four observable manifestations of decentering, with a fifth manifestation hypothesized from our theoretical perspective (Table 6.4).

We observed that the facilitator decentering moves that had the greatest implications for the quality of the PLC discourse occurred while modeling or encouraging productive process and dispositional behaviors as outlined earlier in this chapter. Examples of the effective facilitator strategies we observed are provided in Table 6.5.