Tracing the effects of teacher inquiry on classroom practice

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ARTICLE INFO
Article history:
Received 6 July 2006
Received in revised form 4 January 2009
Accepted 24 February 2009

Keywords:
Professional development
Teacher research
Educational change
Secondary school teachers
Videotape recordings

ABSTRACT
Videotape and participant observation were used to document an American high school teacher workgroup's experience with collaborative teacher inquiry and to monitor changes in practice through two cycles of instructional planning, classroom implementation, and reflective analysis. Detectable changes in practice were observed, including a substantial improvement for two of the four teachers in fidelity of implementation of an instructional innovation. Results support claim that meaningful instructional changes are more likely when teachers work in job-alike teams, are led by trained leaders, use inquiry-focused protocols, and have stable settings in which to engage in the continuous improvement of instruction.

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1. Introduction

Over the last 20 years, multiple councils and organizations have called for communities of inquiry as a central feature of high quality teacher professional development, contributing to the spread of site-based action research groups, lesson study groups, teacher inquiry groups, and learning teams (e.g., National Board for Professional Teaching Standards [NBPTS], 1987; National Commission on Teaching & America's Future [NCTAF], 1996). Collaborative, site-based, inquiry approaches offer a promising and appealing alternative to conventional professional development programs (Garet, Porter, Desimone, Birman, & Yoon, 2001). However, there is limited evidence that teacher inquiry leads to changes in teaching and learning (Saunders, Goldenberg, & Gallimore, in press; Vescio, Ross, & Adams, 2008; Whitehurst, 2002). This study documented one American high school workgroup's experience with teacher inquiry and attempted to establish a link between participation in the inquiry process and changes in teacher practice. The goal was to target a specific element of the case study group's instructional plans and trace over time the effects of collaborative teacher inquiry on its classroom deployment. Thus, the central research question for this paper is: what specific changes can be traced in classroom instruction as a result of participation in teacher inquiry? Subsequent chapters will elaborate on the findings that emerged from systematic observations and videotape analysis. This chapter begins with a review of the literature on teacher inquiry and a summary of the features that distinguish collaborative teacher inquiry models.

1.1. Background: professional development through inquiry

The origins of teacher inquiry stretch back at least as far as Dewey, 1933 who viewed inquiry as a process of progressive problem solving and believed that nurturing reflective dispositions is an essential ingredient for improving teaching practice over time (Crockett, 2004; Glassman, 2001; Rodgers, 2002). Collaborative, site-based, inquiry approaches offer a promising and appealing alternative to conventional professional development programs (Garet, Porter, Desimone, Birman, & Yoon, 2001). However, there is limited evidence that teacher inquiry leads to changes in teaching and learning (Saunders, Goldenberg, & Gallimore, in press; Vescio, Ross, & Adams, 2008; Whitehurst, 2002). This study documented one American high school workgroup's experience with teacher inquiry and attempted to establish a link between participation in the inquiry process and changes in teacher practice. The goal was to target a specific element of the case study group's instructional plans and trace over time the effects of collaborative teacher inquiry on its classroom deployment. Thus, the central research question for this paper is: what specific changes can be traced in classroom instruction as a result of participation in teacher inquiry? Subsequent chapters will elaborate on the findings that emerged from systematic observations and videotape analysis. This chapter begins with a review of the literature on teacher inquiry and a summary of the features that distinguish collaborative teacher inquiry models.
1986), Communities of inquiry take a variety of names and forms, such as action research (Carr & Kemmis, 1986), teacher research (Cochran-Smith & Lytle, 1993), Japanese lesson study (Fernandez, Cannon, & Chokshi, 2003; Lewis, 2006; Stigler & Hiebert, 1999), inquiry groups (Crockett, 2004), and learning teams (Gallimore, Ermeling, Saunders, & Goldenberg, 2009), among others. The trend is also apparent in the evolving standards for professional development that include school-based opportunities for teachers to jointly learn, plan, and systematically examine practice (National Staff Development Council [NSDC], 2001; NCTAF, 1996; NBPTS, 1987).

These emergent forms of collaborative inquiry also represent a wide range of options in terms of duration, complexity, rigour processes employed, and types of data emphasized for reflection and analysis. Some models, such as action research, also range in emphasis from more general school problems and educational issues to the more explicit emphasis on the study and improvement of instruction (Ferrance, 2000). This paper focuses exclusively on the latter—collaborative teacher inquiry aimed at solving instructional problems in the classroom, or as Elmore (2000) calls it: "the technical core" of education (p. 4).

1.2. Distinct features of collaborative teacher inquiry

Despite the range and diversity of options represented in various forms of teacher inquiry, most of the instructionally-oriented models adhere to a common definition of teacher inquiry as the search for knowledge and solutions through the "systematic, intentional" study of practice (Cochran-Smith & Lytle, 1993, pp. 23–24). Additionally, when implemented with fidelity, these models share at least several important features, outlined below, which stand in contrast to other popular site-based teacher collaboration activities such as book clubs, curriculum mapping, student concern committees, and best practice discussions. Based on a review of three thoroughly documented models—Japanese lesson study (Fernandez et al., 2003; Lewis, 2002), action research (Carr & Kemmis, 1986; Ferrance, 2000; Mertler, 2009), and the getting results model (Getting Results Network, 2004; McDougall, Saunders, & Goldenberg, 2007; Saunders et al., in press)—teacher inquiry processes that are focused on improving classroom instruction involve at least four important features.

1.2.1. Identifying and defining important and recursive instructional problems specific to the local context of the participating teachers

All three models of teacher inquiry reviewed emphasize local context. Teacher inquiry is about solving problems that are job-embedded and relevant—a pressing area of need that the collaborating group finds challenging to teach and difficult for students to learn (Mertler, 2009; Getting Results Network, 2004; Lewis, 2002). Additionally, to maximize continuity and productively sustain the inquiry process, most examples of teacher inquiry involve an instructional problem or area of need that threads through the curriculum and can be studied recursively over time (e.g., reading comprehension, using data to write conclusions as part of lab reports, understanding the relationship between structure and function in living organisms, understanding equivalence; Gallimore et al., 2009; Ferrance, 2000). Some Japanese lesson study groups, choose problems that are even broader, such as "[using] higher-order thinking and critical thinking skills" and then narrow in on more specific instructional topics during the planning process (Lewis, 2002; Puchner & Taylor, 2006, p. 925). Although not focused on teacher inquiry as a process, a recent review of PLCs (professional learning communities) concluded that the few PLC variations reporting significant effects on achievement all focused on addressing the learning needs of students (Vescio et al., 2008). Regardless of the breadth or scope of the problem, available evidence appears to suggest that a critical feature is to collectively work toward identifying a pressing and relevant student need, defining it well, and considering what evidence the group might collect to evaluate progress over time.

1.2.2. Connecting theory to action: planning and implementing instructional solutions

Each of the teacher inquiry models reviewed emphasize the importance of putting plans into action (Mertler, 2009; Getting Results Network, 2004; Lewis, 2002). Once a compelling problem has been identified and defined, teachers work to develop and implement instructional plans which act as working hypotheses for addressing the area of need and assisting students to learn. Each of the reviewed inquiry models approach the instructional planning process with different protocols and levels of rigour or complexity, but all can be characterized as a collective commitment to thinking through the specific details of a joint experiment and recording these details in writing (Fernandez et al., 2003; Ferrance, 2000; Getting Results Network, 2004; Lewis, 2002). Collective commitment is critical because it shifts the focus of the investigation from the individual teacher to the instructional plans developed by the group and the impact of these jointly developed plans on student learning (Chokshi & Fernandez, 2004; Getting Results Network, 2004). Thinking through specific details is critical because the details are where the complexities of teaching reside and where teachers confront the various instructional choices that will positively or negatively influence student outcomes (Fernandez et al., 2003; Gallimore et al., 2009; Stigler & Hiebert, 1999). The resulting instructional plan and corresponding details are recorded in writing as a tool to guide implementation and observations as well as a point of reference during the analysis of results (Fernandez et al., 2003; Getting Results Network, 2004; Lewis, 2002). Ultimately, the plan is put into action in the classroom so that teachers can test out their ideas as a joint experiment and gather evidence about their problem solving efforts (Ferrance, 2000; Getting Results Network, 2004; Hiebert et al., 2003; Lewis, 2002).

1.2.3. Utilizing evidence to drive reflection, analysis, next steps

Teachers participating in inquiry use a variety of forms of evidence and data to conduct their study of a problem and learn to rely on this evidence, both to better understand the problem, as well as to inform their decisions about what is working and what actions needs to be tried next. Student work, student interviews, student questionnaires, checklists, self-assessments, portfolios, systematic classroom observations, test results, audio or video recordings from the classroom, are all potential sources of data that teachers might use to inform their investigations (Fernandez et al., 2003; Ferrance, 2000; Getting Results Network, 2004; Lewis, 2002). At the same time, expectations for teacher inquiry should not be elevated to pure scientific research involving complex methodologies, experimental groups and inferential statistics. Teacher inquiry is about making the study and improvement of teaching more systematic and “less happenstance” and relying on evidence to solve local problems of practice (Dana & Silva, 2003, p. 7; Dawson, 2006; Lewis, 2002).

1.2.4. Persistently working toward detectable improvements, specific cause-effect findings about teaching and learning

Finally, each of the teacher inquiry models reviewed highlight the need for a goal-oriented persistence as teachers work over a period of time to understand/resolve a dilemma and discover specific cause-effect findings about teaching and learning. For many teachers this represents as shift toward a new emphasis on
**figuring out** an instructional solution that produces a detectable improvement in learning … not just **trying out** a variety of interesting activities or strategies and then moving on to the next area of interest (Gallimore et al., 2009; Sandoval, Deneroff, & Franke, 2002). It is not a prescribed length of time or number of strategies attempted that allows an inquiry team to solve a particular problem, but whether they persist long enough to arrive at some important findings—visible and explicit cause-effect connections between instructional decisions and student outcomes.

### 1.3. Research on teacher inquiry

A number of studies have been done involving forms of site-based teacher inquiry which have focused primarily on the requisite skills or “critical lenses” necessary for teachers to conduct inquiry (Fernandez et al., 2003, p. 173), the obstacles encountered when engaging teachers in inquiry (Campbell, 2003), and the artefacts and tools (e.g., examining student work) that might be most helpful in facilitating inquiry and reflective analysis (Crockett, 2004; Kazemi & Franke, 2004). Other studies have measured teachers self-reported sense of efficacy related to their participation in inquiry (Byrum, Jarrell, & Munox, 2002; Oakley, 2000; Puchner & Taylor, 2006) as well as the qualitative differences in the way teachers describe their meetings and work at schools participating in teacher inquiry programs (McDougall et al., 2007). At least one longitudinal study has also documented measurable gains in student outcomes directly related to the implementation of an inquiry-focused program for grade-level learning teams (Saunders et al., in press).

These studies have helped to inform the work of both researchers and practitioners and it is clear from the growing popularity that school-based teacher inquiry has intuitive appeal, but there is still limited evidence about the effects of teacher inquiry on teacher practice or student achievement, particularly at the high school level, and even less evidence of specific effects where a clearly defined version of teacher inquiry is documented in advance and a predicted theory of teacher change is tested. Most studies on teacher collaboration are complex and analyses of teacher change are post hoc leaving open the possibility that a number of processes or mechanisms are operating with a relatively broad range of non-specific effects (Vescio et al., 2008).

### 1.4. Purpose of the study

This study attempted to trace the specific effects of a clearly defined intervention on teachers’ classroom practice. In this case the intervention was a collaborative teacher inquiry process adhering to four distinct features: identifying important instructional problems, connecting theory to action, utilizing evidence to drive reflection, and persistently working toward detectable improvements. The working hypothesis was that by adhering to these four features, detectable changes in teachers’ practice would emerge over the course of the project as the group narrowed in on specific cause-effect findings about teaching and learning and persisted to implement and adjust their instruction through recursive cycles of implementation and problem solving. A case study was conducted of four high school science teachers who volunteered to participate in this collaborative teacher inquiry process. Over a 14 month period, their work and experiences were investigated by focusing on: (a) documentation and analysis of the teachers’ collective work and individual implementation efforts; and (b) a search for evidence that participation had a specific effect on classroom practice.

### 2. Method

#### 2.1. Participants and timeline

The participants for this project were a group of four high school science teachers from a private, comprehensive, urban high school in Southern California (enrollment — 1150). The group included three men and one woman, all experienced teachers, ranging from 8 to 34 years in the profession. They represented three different subject areas—chemistry, biology, and physics (see Table 1). The teachers had no previous experience with teacher inquiry or other forms of teacher collaboration and there was no regular setting in place for workgroup meetings. Their collegial interaction had been limited to brief monthly departmental meetings and sporadic conversations as needs arose throughout the year.

While they had no previous experience with teacher inquiry, they were also a unique group of teachers—highly motivated volunteers who were enthusiastic to test out a new system of professional learning. Being science teachers, they were well-suited for an inquiry-based process, since they had extensive background with the scientific method (developing hypotheses, designing experiments, collecting and analyzing data). The group also had the support of the administration who were interested in expanding this work to rest of the faculty in subsequent years. Each member received a small stipend for their participation in the project but their agreement to participate came before the monetary compensation was announced.

Since no regular setting for teacher collaboration existed on the campus, the group identified several large blocks of time on pupil free days (normally used for individual preparation or grading) and used these settings to conduct the inquiry meetings (see Table 2). In support of the project, the assistant principal also freed up time for the group to meet by reducing their responsibilities during a standardized testing day and locating substitutes to replace them as test proctors.

#### 2.2. Role of researcher and program design

Since the goal was to carefully document the work of this group and trace specific effects of teacher inquiry on classroom practice, I chose to insert myself into the group firsthand and serve as participant in the process. While I focused intently on my role as observer, I also served as project facilitator and coordinator. I recruited the team, introduced them to the process, and helped to coordinate a feasible timeline. I also facilitated each of the meetings and developed tools to guide the group through several clearly defined stages of inquiry work:

- identifying and defining a problem (area of student need) that could be studied over time,
- jointly planning and implementing possible instructional solutions to address the problem,
- analyzing results of instructional plans and their impact on student learning,
- re-assessing and repeating the process to persistently study the problem and identify cause-effect findings about teaching and learning.

The teachers made all decisions related to the content of the process, including the problem they would address and the instructional solutions they would plan and implement.

During the analysis stage, in addition to examining results from student work, one of the sources of data the group agreed to use was digital videotapes of the classroom lessons. The technology platform Visibility™ was employed to prepare the video materials...
and present them to the teachers for review and analysis. This multi-media software and video-based technology was made available gratis by the LessonLab Research Institute. Using this technology enabled teachers to view the lesson videos during conference periods and eliminated the need for coordinating teachers’ schedules or arranging substitutes to accommodate live observations.

Although all members implemented the instructional plans and all lessons were videotaped, due to time constraints, the team chose one classroom context as their primary “laboratory” for video analysis during each cycle of implementation (see Table 1). I then took responsibility for encoding and uploading the video to the software platform and preparing the video for analysis. Again, due to time constraints, I worked to develop time-code links for each main segment of instruction so that group members could easily navigate the video and focus on key portions related to the problem they were addressing. Along with each time-code link, I re-stated the purpose for that segment of the lesson (as recorded in the jointly developed instructional plan) and directed teachers to write down their observations of student learning related to the segment.

During each iteration of the process, teachers were asked to complete their review of the selected video after the implementation of their own lesson and prior to our face-to-face analysis meeting where we then debriefed all four lessons and the corresponding student work that was collected from each classroom. The video served as a supplement to this analysis and a mutual reference point to ground our reflective comments in evidentiary observations. The team spent a total of 28.5 h working through the inquiry process. Sixty percent of this time took place in the traditional setting of face-to-face meetings, and 40% took place on-line, using the Visibility platform (see Table 2).

### 2.3. Data collection and analysis

Throughout the teacher inquiry process, I preserved extensive notes from each face-to-face meeting and classroom lesson as well as email correspondence with group members. In addition, each meeting and classroom lesson was videotaped for later analysis as well as debriefing interviews with individual participants. Within 48 h of each event, I reviewed the entire videotape, developed an index of time-codes, and recorded specific observations. I also used member checks (Lincoln & Guba, 1985) at regular intervals to validate my interpretation of participants’ words and actions and made a deliberate effort to identify discrepant data or alternative hypotheses.

Since the goal of this data collection was to search for the effects of teacher inquiry on classroom practice, some mechanism was also needed to distinguish between ideas and strategies that directly resulted from the inquiry process and those which might have resulted from other influences or were simply part of pre-existing instructional routines. A complex intervention such as teacher inquiry is likely to set in motion many effects. This complicates the research process since it is desirable to document a specific effect rather accept post hoc any detectable change in teaching practices. Just meeting together and jointly planning lessons might have a benefit, for example, that would have occurred with a variety of professional experiences. Accepting any change that is observed post hoc risks a false positive result. This risk increases in the absence of a comparison or control group which met and discussed lessons, but did not employ teacher inquiry. Choosing in advance a specific effect that is a predicted result of the inquiry process and testing whether over time there were any detectable changes in practice, increases confidence that any outcomes might be plausibly attributable in some way to the teacher inquiry intervention (Bootzin & Bailey, 1985). In addition, choosing a specific effect also imposes focus and discipline on the collection of case study material.

To monitor for this specific effect, I planned in advance to select the equivalent of a “tracer”—a clearly defined element of the group’s instructional plan that would emerge during the initial meetings. The tracer had to be something that one could readily observe and monitor for the duration of the project. The hypothesis was that detectable changes in teachers’ practice would emerge over the course of the study as the group narrowed in on specific cause-effect findings about teaching and learning and persisted to implement and adjust their instruction through recursive cycles of planning and implementation.

### Table 1

<table>
<thead>
<tr>
<th>Participant profiles (boldface indicates lessons that the group selected for video analysis).</th>
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<tbody>
<tr>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>Vern</td>
</tr>
<tr>
<td>Ruth</td>
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<tr>
<td>Glen</td>
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<tr>
<td>Luke</td>
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### Table 2

<table>
<thead>
<tr>
<th>Timeline for teacher inquiry project (rounded to nearest quarter hour).</th>
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<tr>
<td><strong>Task description</strong></td>
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<tr>
<td>Preparation and logistics (9/26/03 – pupil free day)</td>
</tr>
<tr>
<td>Introduction to process</td>
</tr>
<tr>
<td>Identifying problem (area of student need)</td>
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<tr>
<td>(10/21/03 – half day for standardized testing)</td>
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<tr>
<td>Clarifying and defining the problem</td>
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<tr>
<td>Discussing evidence that might be collected</td>
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<tr>
<td>(11/24/03 – pupil free day)</td>
</tr>
<tr>
<td>Introduction &amp; practice with technology/video analysis</td>
</tr>
<tr>
<td>(2/03–5/04 – LessonLab Visibility platform)</td>
</tr>
<tr>
<td>Reviewing research</td>
</tr>
<tr>
<td>Identifying possible instructional solution/approach</td>
</tr>
<tr>
<td>Planning instruction (8/20/04 – pupil free day)</td>
</tr>
<tr>
<td>Additional planning (8/04–9/04 – LessonLab Visibility platform)</td>
</tr>
<tr>
<td>Analysis of selected video for implementation #1</td>
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<tr>
<td>(10/12/04 – LessonLab Visibility platform)</td>
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<tr>
<td>Debrief and analysis of implementation #1</td>
</tr>
<tr>
<td>Re-assessing the solution/approach</td>
</tr>
<tr>
<td>Planning instruction (10/13/04 – half day for standardized testing)</td>
</tr>
<tr>
<td>Additional planning (10/04–11/04 – LessonLab Visibility platform)</td>
</tr>
<tr>
<td>Analysis of selected video for implementation #2</td>
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<tr>
<td>(11/21/04 – LessonLab Visibility platform)</td>
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<tr>
<td>Debrief and analysis of implementation #2</td>
</tr>
<tr>
<td>Final debrief (11/22/04 – pupil free day)</td>
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<tr>
<td>Video presentation/report to faculty</td>
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<td><strong>Totals</strong></td>
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<tr>
<td><strong>Combined total</strong></td>
</tr>
</tbody>
</table>
3. Findings

This section will summarize each stage of the teacher inquiry project, the problem that the group selected and the instructional solutions they developed, the tracer that I identified, and the connections that were traced between teacher inquiry and classroom teaching during two cycles of implementation and analysis. Findings will be presented in six parts following the same units of investigation listed in Table 3.

3.1. Identifying and defining the problem (unit of investigation: what problem/area of student need emerges as the focus for the group’s collective inquiry?)

During the 2003–2004 school year, the science team spent three meetings (approximately 4 h) learning about the teacher inquiry process, identifying a problem/area of student academic need, and reviewing student work samples to better define the need. They also began discussions about types of evidence that could be used to measure student progress on lab reports or other forms of assessment. Below is the exact phrasing that emerged from the group’s discussions about the need and the corresponding terminology that the group identified to ensure common understanding and to guide their ensuing work.

Problem (area of student need): conceptual understanding of scientific phenomena

Definition generated by the inquiry group: conceptual understanding means thinking beyond the basic facts to discover and articulate concepts about natural phenomena through multi-semiotic modes and applying and transferring those concepts in different settings.

Other definitions:

multi-semiotic = verbal, mathematical, and/or graphical modes of scientific communication (Wellington & Osborne, 2001).

Near transfer = an individual’s ability to apply previously learned scientific knowledge, skills and methods to manipulate, analyze, synthesize, create and/or evaluate a new situation which is “closely similar but not identical” (Haskell, 2001, p. 29). Example of near transfer: explaining why a company which manufactures chemical products would need to make use of balanced equations.

3.2. Planning instruction (unit of investigation: what clearly defined element of the instructional plan emerges as a possible “tracer”?)

3.2.1. Reviewing research

In August of 2004, the team met for a 1-day planning retreat prior to the new school year. The day began with a discussion of a 15 page research synopsis I had prepared on transfer of learning based on resources from Transf ord, Brown, and Cocking (2000) and Haskell (2001). Transf ord et al. emphasized the importance of making students’ thinking visible, and Haskell developed a theory called deep-context teaching which explains how students’ erroneous conceptions block their understanding of scientific phenomena. As the conversation evolved, the team noted a strong parallel between the problem of misconceptions they observed in the student work analyzed during the previous meeting and the need for exposing and addressing misconceptions, as described in the transfer research. This topic of misconceptions resurfaced several times during the discussions and a consensus emerged among the group that this was a “critical stumbling block to transfer.”

3.2.2. Developing instructional plans

As the planning process progressed, the team agreed that their common strategy or instructional focus for the inquiry project would be to expose students’ thinking about specific scientific concepts and then work to help them resolve misconceptions. They also agreed to implement a card sort activity which was one of the strategies recommended in the transfer literature as a catalyst for engaging students in a struggle and bringing misconceptions to the surface. The team then spent several hours developing detailed instructional plans that involved the following key components, which we later titled the “struggle/scaffold script.”

(1) Implementing a struggle activity (e.g., card sort strategy) to engage students with the scientific concepts and expose students’ conceptions/misconceptions.

(2) Withholding reference materials before and during the struggle stage.

(3) Suspending verbal guidance and “telling” during the struggle stage.

(4) Creating opportunities to see students’ thinking and reasoning (concept map/presentation/explanation/rationale).

(5) Noting misconceptions for future reference and/or preserving student work, conceptual organization for follow-up lessons or assignments.

(6) Tailoring instruction, assignments, activities to address misconceptions and scaffold student learning.

(7) Providing opportunities for students to privately or publicly confront and resolve erroneous thought patterns.

(8) Designing assessment activities or writing assignments which include a “transfer of learning” prompt.
Of the four members in the group, Glen had the most experience with this notion of promoting struggle and exposing misconceptions as part of his regular practice in teaching physics. Throughout our planning discussions, Glen provided numerous insights, ideas, and suggestions, which shaped our understanding of the more subtle pedagogical choices behind doing this well. One such example from these initial planning meetings is the following exchange between Glen and Ruth:

Glen: One thing that I found that might be problematic is that students don’t let go of misconceptions very easily. And I’ve seen the situation several times where you have them expose the misconceptions, but they’re not really exposing them to themselves; they’re just exposing them to you.
Ruth: That is profound.
Glen: You go ahead and teach the lesson.
Ruth: Um hmm.
Glen: And you think, “Ok, well they’re going to pick up on all these things …” and then you give a test and they give you exactly what they did originally … It takes a little bit of student work. When the student discovers they have a misconception, then they’re more ready to change that.

Each of the other three members openly acknowledged that this was a rather unfamiliar approach, but something they were eager to embrace and attempt. To guide the planning process, I prepared a four-column planning template similar to those used in Japanese lesson study programs, including steps of the lesson, anticipated student responses, teacher responses, and points to notice. We used this format to collectively plan lessons for each of the four subject areas in the group, as indicated in Table 1, and incorporated a version of a struggle/scaffold approach as well as a card sort activity for each unique context. Due to his prior experience with “promoting struggle,” the group also selected Glen’s lesson on graphical methods as the one implementation example we would study on videotape for the first iteration.

3.2.3. Identifying the tracer

After studying the videos from these initial meetings and reflecting on the instructional plans the teachers had prepared, I selected promoting struggle to expose misconceptions as the “tracer” for my continuing investigation. According to our group discussion as well as interviews with Ruth, Luke, and Vern, this approach was something entirely new to their practice and therefore unlikely to happen except as a result of our teacher inquiry work. Furthermore, while Glen had some experience with the notion of promoting struggle, the use of the card sort activity and the explicitly outlined struggle/scaffold script were new elements for all four teachers, including Glen, so I determined this would function well as a tracer for the first round of implementation.

Three primary sub-units of investigation guided my observations during subsequent stages of lesson implementation. My plan was to document: (a) teachers’ attempts to implement the struggle activity; (b) their efforts to withhold textbooks and reference materials; and (c) their efforts to suspend verbal guidance and “telling” during the struggle stage of the lesson. The specific misconceptions exposed during each implementation would also be recorded. I did not reveal the idea of a “tracer” to the participants so they had no knowledge of this term or my plans to focus in on “promoting struggle” during the ongoing data collection and observations.

3.3. First iteration of lessons (unit of investigation: what elements of the tracer are actually employed?)

During the month of September, I videotaped the first round of lessons for each teacher and looked for evidence (or lack of evidence) of the tracer in the actual delivery of instruction. As illustrated in Table 4, a moderate range of variation emerged in the implementation efforts. The paragraphs that follow provide a concise description of each lesson and the corresponding connections or discrepancies that were traced between planning and practice, starting with the lessons that displayed the most faithful representation of the strategy and proceeding to those with less consistent execution.

3.3.1. Physics: graphical methods

For the lesson on graphical methods, Glen divided his physics class into six groups and assigned each team a unique scenario involving motion. He then asked the students to sort through a set of index cards and determine how to graph that motion. The students were required to complete their graphs on small-white boards and explain their scenario to the class.

Throughout the card sort activity, Glen consistently suspended guidance and encouraged struggle as the students voiced their confusion with the task and looked to Glen for answers and assistance. When a student asked, “Are those supposed to be something?” Glen calmly responded with, “They all have something to do with something.” And when another student exclaimed, “I have never been this confused in my life,” Glen answered with a smile, “That’s a comfort zone, a place to grow from.” No textbooks or other materials were made available during the period and students were not told about the activity in advance. While the level of dissonance was high, the struggle was not so difficult that students completely gave up or ran out of time to complete the task. Some groups needed more encouragement than others, but all of the groups

| Table 4
prevandomorphism to expose misconceptions. |
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<tbody>
<tr>
<td>Attempted to implement struggle activity</td>
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<td>-----------------------------------------</td>
</tr>
<tr>
<td>Glen</td>
</tr>
<tr>
<td>Vern</td>
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<tr>
<td>Ruth</td>
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<td>Luke</td>
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Results of tracer investigation in lesson 1. ✓ – yes/observed in the lesson.
completed the activity and came up with a graphical explanation for their scenario. The creative tension that resulted from this struggle served as an important opportunity for scaffolding student learning and resolving misconceptions in the subsequent class periods. Glen also followed-up the lesson with a transfer prompt assignment, which required students to apply this graphing knowledge with a series of mathematical expressions.

3.3.2. AP chemistry: recognizing oxidation reduction reactions (redox)

In Vern’s AP chemistry class, the students received an envelope with 41 small slips of paper on which were written different kinds of chemicals, equations, or descriptors. The students were supposed to arrange the items on their white boards in a way that made sense to them and then secure the paper to the boards once they were finished with their organizational plan. After about 10–15 min, each group would then be asked to present their arrangement to the class. With just 5 min left in the class period, the groups were still working to complete their organization, so Vern asked them to stop at whatever point they had reached and make their presentations to the group.

As with Glen’s lesson, the students were anxious to receive additional guidance and Vern responded with similar statements of encouragement without directing them to answers. He frequently made statements such as, “You are not being graded on whether it’s accurate, so just give it your best judgment for right now.” He commented to another student, “Make it so that it’s a scheme that could be understood by someone else.” No textbooks or other resources were made available during the class period and students had not been previously exposed to the oxidation–reduction reactions. Although the card sort activity took much more time than expected, the lesson was effective in exposing a number of important misconceptions. A few days later, Vern provided the students with a list of their mistakes and asked them to repeat the task for homework while consulting their textbooks. He also followed-up the lesson with an assessment that required students to identify the various types of reactions.

3.3.3. AP biology: dissolved oxygen in water

Ruth began her AP biology lesson by distributing magazine pictures of water from a variety of natural settings, as well as sets of cards with temperatures, and sets of cards with percentages. Each group of students was supposed to create a graph with percentages and temperatures as the axes and arrange the pictures according to the various levels of oxygen content. Prior to the lesson, Ruth changed her mind from our planning meetings and decided to provide the traditional lab handouts in advance. She communicated later that she felt somewhat afraid about the amount of anxiety this would cause the students and wanted to provide a little more information to help them grapple with the task. Instead, the students came to class prepared with the answers and had very little difficulty arranging the pictures on the axes. There was still a moderate level of struggle as students worked to organize the materials, but several groups were even referencing the lab handouts during the class period to find answers about the various influences on oxygen content.

Ruth did make a deliberate effort to suspend verbal guidance and telling during the struggle stage of the lesson, but with all of the prior knowledge and reference materials available, there was less dissonance than observed in Glen and Vern’s card sort activities. When students did ask, “Is this right?” Ruth responded with, “It could be. You will want to be able to explain your answer and defend your presentation with a reason for what you think.” The struggle activity was followed by student presentations and a group lab assignment later that same day, where students experimented with dissolved oxygen and confronted similar concepts. As part of their final lab reports, Ruth assigned a transfer prompt that asked the students to analyze a graph of dissolved oxygen levels, add time values, and then provide an explanation for the values they selected as well as the corresponding events that took place at these intervals.

3.3.4. Chemistry: measurement

In Luke’s chemistry lesson, the students received a packet of cards containing units and categories of measurement. They were asked to organize the cards and then reproduce their organization on white boards for class presentations. Much like the lesson on dissolved oxygen, Luke’s students had too much information prior to the struggle activity and entered the lesson with a solid understanding of measurement from prior class periods. They had little difficulty with the card sort task and were referencing the textbooks during the class period when they were not confident about their answers. In addition, the large category headings included in the card sets created patterns for the students which limited the conceptual challenge and allowed students to quickly copy answers from other teams in the class.

Like the other teachers, Luke made a concerted effort to suspend verbal guidance and telling throughout the struggle activity and responses to questions with statements such as, “Whatever makes sense to you.” During the presentations, almost all of the groups had identical answers and there was little need for scaffolding or correction. No follow-up transfer prompt was assigned.

3.3.5. Tracing connections

All four teachers made consistent efforts to implement a card sort activity in their classes and to suspend verbal guidance and telling throughout the struggle stage. However, both Ruth and Luke deviated from the struggle/scaffold script by providing information and/or reference materials to the students before and during the struggle activity that divulged answers or gave away the basic organizational patterns. As a result, there was also a dramatic difference in both the amount and the significance of the misconceptions that were exposed during the various implementations (see Table 4). As Luke later testified about his classroom, “They didn’t completely grasp the concepts, but they were able to sort them.” For this reason, although it might seem counterintuitive, the lessons with fewer misconceptions were considered less effective for this initial stage of the activity. As Haskell (2001) explains, “To the extent that we do not know what is in their heads, is the extent to which we are probably ineffective as teachers … If these contexts are not addressed, learning may, at best, be shallow and not lead to significant transfer” (pp. 160, 220).

3.4. Debrief and analysis (unit of investigation: what connections can be traced between the analysis discoveries and the 2nd iteration of instructional plans?)

In mid-October 2005, at the conclusion of the first round of lessons, each of the team members spent approximately 90 min completing a video analysis task for the lesson on graphical methods. I taped and reviewed all four lessons for research purposes, but the teachers chose to use Glen’s lesson on graphical methods as their “laboratory” for video analysis. Of the four lessons implemented in the first iteration, this lesson, presented by Glen, was arguably the most effective example of the struggle/scaffold approach and served as an ideal opportunity for teachers to reflect on the instructional plan. The video analysis task was followed by an extensive post-lesson discussion where the teachers discussed observations from the video, examined student work, discussed the impact of their instructional approach, and began making plans and
adjustments for the second iteration. As we began this analysis process, I was interested to discover if Ruth and Luke would recognize the inconsistencies between planning and practice and adjust their plans accordingly for the second round of lessons.

3.4.2. Ruth: insights gained during analysis activities

In their analysis/commentary for the physics video as well as the face-to-face debrief discussions, both Luke and Ruth openly acknowledged the lack of struggle in their respective lessons and reiterated the need to withhold reference materials both during and before the struggle stage. Throughout the discussion, Luke wrote down notes on his copy of the struggle/scaffold script and later shared some reflections on his own implementation efforts:

I would do my lesson differently the next time I did it. I would do the timing differently ... I did it after we had gone over the information, so that's a good thing—that they were able to work through and get it right, but I would have liked to have had a little more struggle, because as you were discussing, I think that is necessary for learning ... I gave them too much guidance, or too much opportunity for guidance.

3.4.3. Re-assessing and planning

During the ensuing planning discussion all four teachers demonstrated a renewed commitment to implement the struggle/scaffold script and once again worked to develop instructional plans for each content area following the same basic steps of this script. This time the teachers revised their approach by replacing the card sort strategy with unique struggle activities specifically tailored for each classroom context. The group also chose Ruth's AP biology lesson as the one implementation example they would study on videotape for the second round of lessons. As the team worked to develop Ruth's discovery lab on osmosis and diffusion, she emphasized her plans to promote struggle:

(Holding up a copy of the lab packet) Here is the classic American way of teaching. They give you all the answers in the background information. Here is everything that the kids are supposed to know. That was my fatal flaw in the last lesson ... and the thing that I have to avoid because I directly exposed them to the right answers the day before ... So one thing that I'm definitely not going to do is give this to them.

3.5. Second iteration of lessons (unit of investigation: what elements of the tracer are actually employed?)

In the second iteration, there was a more consistent translation between planning and practice, as all four teachers implemented the strategy with fidelity (see Table 5). The paragraphs below present a concise overview of Ruth and Luke's lessons, the two which demonstrated the most significant change between the first and second implementation.

3.5.1. AP Biology: osmosis and diffusion

In Ruth's lesson, the students struggled with the concepts of osmosis and diffusion as they worked to design their own procedures and conduct an experiment for placing dialysis bags into five unknown concentrations of sugar water. The objective was to discover the relative concentrations of sugar water in their dialysis bags to the concentrations of the sugar water in their cups. Each of the groups had a different concentration in their dialysis bags, so they were all working on different variations of the same experiment.

Unlike Ruth's first lesson, the students had absolutely no prior knowledge about the lab and no reference materials to rely on. There was significant distress in many groups as they struggled to understand the concepts without any assistance from other resources. Ruth circulated to provide support and encouragement throughout the experiment, but completely suspended verbal guidance, even as students playfully accused her of trying to "lower their grades." Her response was, "You just have to live with a little dissonance. It's going to be okay." When a student asked if they were on the right track, Ruth smiled and responded with, "It's the joy of discovery, don't you think?" On several occasions, she even pretended to take careful notes on her notebook, so as to avoid eye contact with students and encourage them to work on their own. The group struggled through the lab for several days as they prepared their white board presentations. Ruth provided extensive scaffolding at critical stages in each of the presentations and used a culminating illustration on the board to summarize the experiment. She then assigned the class a series of transfer prompts as part of their final lab report.

3.5.2. Chemistry: atomic structure

In Luke's chemistry lesson, he used a struggle activity with bags containing three different colours of beans that represented the three subatomic particles. Each group of students received several bags and began to circulate throughout the room to trade with other groups and to find bags that represented isotopes of an element.

In stark contrast to Luke's first lesson, this second struggle activity was quite challenging for the class. They were not given any information for the activity prior to the lesson and did not have access to any reference materials during the class period. One student voiced her frustration with the new approach by exclaiming, "I can't believe you're making us do this. I don't understand this." Luke calmly encouraged her to keep working on the task but continued to suspend verbal guidance or telling. He also effectively implemented the activity so that the groups were all working on different aspects of a larger problem and could not simply copy the answers from other groups. At the end of class, they were asked to use the information to calculate the average atomic mass for the given elements. In a subsequent lesson, Luke discussed the activity with the class, worked through some of their misconceptions, and later assigned a transfer prompt that required the students to explain how these bags and beans were an accurate or inaccurate representation of the concepts.

3.5.3. Tracing connections

As planned, all four teachers implemented a struggle activity in their lessons and fostered an environment of reasonable dissonance by suspending guidance and telling but also encouraging students to persevere through the confusion. Unwavering from their stated intentions during the analysis and planning meetings, both Ruth and Luke were successful in withholding background information and reference materials both before and during the activity. As a result of this universal effort to promote struggle in the lessons, there was a detectable increase in both the number and
significance of misconceptions exposed in each of the four class-
rooms (see Table 5). This provided teachers with concrete in-
formation about student thinking and established a deep-context
where careful scaffolding might help students begin to grasp the
scientific concepts (Haskell, 2001).

3.6. Final debrief and report (unit of investigation: what are
teachers’ perceptions of the process and its impact on teaching
and learning?)

On November 22nd, the science team gathered for the final
reflection and debriefing meeting. Prior to the meeting, the team
had once again completed a video analysis task—this time for the
biology lesson on osmosis and diffusion. The purpose of
the meeting was to examine evidence of student learning from the
second round of lessons, discuss the strengths and weaknesses of
the struggle/scaffold script in light of this evidence, and reflect on
the overall teacher inquiry experience. Consistent with my obser-
vations, the teachers noted an explicit connection between the
adjustments they made in this second iteration and the increase in
both the number and significance of misconceptions that were
identified. The group also discussed some initial indicators of
positive student outcomes. Ruth shared convincing evidence from
the transfer prompt she had assigned, explaining that within one
class of AP biology students, there were 10 different approaches to
the same transfer question, and all but one student demonstrated
an advanced conceptual understanding of osmosis and diffusion.
Some members shared anecdotal evidence from informal inter-
views with students who indicated that they “learned things better
this way,” “had a better understanding,” or “enjoyed having the
chance to solve problems.”

As we discussed the successes and failures of the struggle/
scaffold efforts, all members indicated that they were looking
forward to further refining this script in their ongoing practice and
hoped to continue the inquiry work. Luke suggested that it might
be interesting to strategically schedule struggle/scaffold lessons at
critical points in the curriculum. Vern talked about designing
similar lessons in the future and watching for improvements in the
students’ approach to planning scientific procedures. Glen sug-
gested the possibility of including a journaling component during
the struggle stage to help students reflect more meaningfully on
their own thought processes. Ruth proposed a related idea of
creating assignments where students are graded for the process
and not for their results. Several group members discussed how the
inquiry work had enlightened their understanding of their role as
teachers in helping students learn science. Toward the end of the
meeting, the teachers shared these final thoughts on the experi-
ence in comparison to more traditional models of professional
development.

<table>
<thead>
<tr>
<th>Attempted to</th>
<th>Withheld reference materials before and during the activity</th>
<th>Suspended verbal guidance and “telling” during the struggle stage</th>
<th>Nature of misconceptions revealed in the lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glen</td>
<td>√</td>
<td>√</td>
<td>Substantial (e.g., struggled to conceptualize acceleration and non-acceleration on the same graph when there are two parts to an object’s motion)</td>
</tr>
<tr>
<td>Vern</td>
<td>√</td>
<td>√</td>
<td>Substantial (e.g., struggled to conceptualize that the amount of water formed in the net reaction is what is used for ‘mass’ in the heat flow)</td>
</tr>
<tr>
<td>Ruth</td>
<td>√</td>
<td>√</td>
<td>Substantial (e.g., struggled to conceptualize that water was moving in osmosis, not sugar)</td>
</tr>
<tr>
<td>Luke</td>
<td>√</td>
<td>√</td>
<td>Substantial (e.g., struggled to conceptualize that ions are electrically charged atoms which have either lost or gained electrons and are seeking neutrality)</td>
</tr>
</tbody>
</table>

Ruth: It’s really what professional development is in my mind. It’s the best kind of inservice that anybody could have. It’s what really changes teaching.
Vern: We’re not just getting general principles from education or science.
Glen: And you try them and analyze them. It’s not just like, “Do this” and you forget and you might do it … You follow-up.
Ruth: And it doesn’t matter that … you teach chemistry, and that you teach physics, and I teach biology. We have very common ground to talk.

As we closed the debriefing meeting, the group agreed to share a final report of our work and experience with the entire faculty and staff. Over the next 2 weeks, I spent approximately 50 h editing video and compiling a 25 min documentary of the teacher inquiry project. At the next faculty inservice (monthly pupil-free day set aside for faculty meetings) in December, the team presented the report, integrating video clips with compelling testimonials about the inquiry process, their own professional growth, and the new insights gained for helping students “think beyond the basic facts.” The report was well-received by both faculty and administration, generating significant momentum and interest for expanding the project to other departments.

4. Discussion

Over the course of 14 months, a group of high school science teachers worked through a process of collaborative teacher inquiry adhering to four distinct features: identifying important instructional problems, connecting theory to action, utilizing evidence to drive reflection, and persistently working toward detectable improvements. Through participant observation and extensive review of videotapes from each meeting and classroom lesson, I worked to see if I could trace an explicit connection from teachers’ participation in the inquiry process to changes in their classroom practice.

Specifically, the group chose to tackle the challenge of fostering students’ conceptual understanding of scientific phenomena by adopting an approach called the “struggle/scaffold” script and working through two iterations of collective planning, implementa-
tion and analysis to investigate the impact of this approach on student learning. Over the course of the project, detectable changes in practice were observed as all four teachers implemented the approach in their classrooms, and two of the teachers made substantial improvements in their efforts to promote an environ-
ment of struggle, dissonance, and scientific inquiry. Using evidence from their own local implementation efforts, the teachers came to new understandings about how their instructional choices (sus-
pending verbal guidance, withholding reference materials,
providing small groups with different variations of the same experiment) influence students’ opportunities to explore and understand scientific concepts.

Having traced this connection between teacher inquiry and classroom practice through systematic observations, I also corroborated these findings with member checks and debriefing interviews, particularly with Ruth and Luke. Both teachers unmistakably attributed changes in their practice to their participation in the inquiry process and the persistent effort the group made to construct and analyze lessons that genuinely engaged students in scientific exploration. A few months after the study, I also received the email below, from Ruth, which provided additional self-reported (but unsolicited) evidence of these connections between inquiry and teaching.

I have to share with you my good news … I just got my AP scores back. Eighteen/20 passes = 90%, the highest in the school! Seven students received a 5, six received a 4, which is so much higher than any class ever before. I am so happy for my students, I just sat down, closed the door of my office and cried and cried and gave thanks. I have to believe I changed the way I taught, that making them struggle really bridged the gap. This was my most enjoyable year of teaching in my 28 years …

Of course, not every journey through the process of teacher inquiry will end with this kind of dramatic result. These findings from one small group of science teachers at one private high school are by no means conclusive. The challenges faced in large public schools with multiple district initiatives, high stakes testing, and other accountability pressures present additional complexities not encountered by this project. In addition, while this report uses a rich description of one group’s inquiry experience to help establish the conditions in which the changes took place, the data from this project alone are insufficient to claim that these particular features of teacher inquiry uniquely contributed to the results. More research is needed to test these hypotheses with larger sample sizes and more complex designs.

At that same time, it is hoped that this detailed account of one inquiry team might serve as a modest proof of concept and a starting point for other investigations about the effects of collaborative teacher inquiry on teacher learning, classroom practice and student achievement. It is also hoped that this study might help to elevate the standard by which we measure changes in practice related to professional development interventions, moving away from imprecise post hoc analyses to systematic investigations of specific, predicted effects.

4.1. Implications for going to scale

Over the last 4 years since the time this study was completed, I have helped to coordinate an ambitious research and development effort to expand this model both at the study high school and in several large public school districts. Beginning in the fall of 2005, the entire faculty at the case study high school was organized into 16 teacher workgroups that now meet every Wednesday morning—their fourth year of school-wide implementation and had established an administrative position dedicated to sustaining the work and connecting the inquiry process to the overall campus vision for improving student learning. In addition, a version of teacher inquiry inspired by the model in this paper is now being implemented at over 100 secondary schools in Southern California and other parts of the United States, primarily in large urban public schools.

Efforts to replicate and scale this inquiry model have led to important insights and hypotheses about some of the conditions that enabled this case study group (and other subsequent teacher inquiry groups) to be successful. No doubt there are other important factors, but a growing body of experience suggests that the following conditions or core components are necessary for establishing and sustaining the kind of systematic, intentional, and instructionally focused teacher inquiry described in this study:

4.1.1. Job-alike teams

The teachers in this case study made regular comments about the value of a job-alike team—collaborating with colleagues who have “common ground to talk” about science. It was that common ground and shared sense of urgency about fostering conceptual understanding that helped teachers sustain the work and assist each other to adopt and learn a new instructional approach that was immediately applicable to their classrooms.

The importance of job-alike teams has played out with other inquiry projects as well. In elementary programs, grade-level teams fulfil this function. In secondary, schools have been successful when teachers are organized into course-level or subject area teams. Tharp and Gallimore (1988) characterize effective collaboration as joint productive activity where participants assist each other to solve a common problem or produce a common product. Absent a common task immediately relevant to each teacher’s own classroom, it is difficult to create and sustain the kind of inquiry described in this study. Joint productive activity around a shared context breeds commitment to the group as well as commitment to repeating the process (Wenger, 1998).

4.1.2. Distributed leadership

Job-alike teams are one important ingredient, but this study suggested that even motivated and productive teams also need facilitation to maximize the teacher inquiry experience. Having a trained leader dedicated to the work of guiding the process, moderating discussion, probing for deeper understanding, and providing a balance of support and pressure, helped create a safe and productive environment where participants could focus on the work of improving instruction. As Glen emphasized in our debriefing meeting:

There’s also an element to the way that this worked that I think is an important element … that you provided us with structure but also you gave us an incredible amount of freedom. And you treated us with respect as professionals and you looked to us to be developers. There’s a critical element that you get when that’s the case and I think that’s a critical element … If something like this is planned as an extension or continuation, that part cannot be ignored.

To replicate this effect beyond one case study teams requires an important shift from an external provider stepping in to lead one group, to a campus-wide distributed leadership model where teacher–leaders are identified, trained, and compensated to perform this role. This has benefits for teachers, administrators, and content experts. First, teacher facilitators are uniquely positioned to build rapport with colleagues and guide the inquiry process as a full participant, trying out in their classrooms the same lessons as the rest of the group members. They also help to ensure the work is relevant and assist the group in remaining focused and persistent during the inevitable ebb-and-flow of the school year where a myriad of other responsibilities and initiatives compete for teachers’ time and attention (Saunders & Goldenberg, 2005). Second, the use of teacher–facilitators frees up coaches and content experts (when available) to play the role of knowledgeable resource rather than
team leader, and lessens the chances the setting is converted from inquiry-focused to a more conventional PD “presentation” structure that puts teachers in a passive rather than active role. Finally, raising up teacher-facilitators also means assisting administrators to adopt new roles as instructional leaders where their primary focus is on holding the process together and assisting the performance of other leaders. As Elmore (2000) notes:

Distributed leadership does not mean that no one is responsible for the overall performance of the organization. It means, rather, that the job of administrating leaders is primarily about enhancing the skills and knowledge of people in the organization, creating a common culture of expectations around the use of those skills and knowledge, holding the various pieces of the organization together in a productive relationship with each other, and holding individuals accountable for their contributions to the collective result (p. 13).

Good principals and assistant principals are central to the success of this work but they cannot do it alone. Organizing a campus into teams, identifying and training teacher–leaders, and working to support these leaders through a careful balance of support and pressure, helps make possible the otherwise daunting task of sustaining a long-term teacher inquiry effort (Goldenberg, 2004; Saunders & Goldenberg, 2005).

4.1.3. Inquiry-focused protocols

In the early stages of the case study reported here, it quickly became apparent that both the group members and I needed an explicit process to follow—something we could all rely on for a sense of direction and continuity as we navigated the inquiry cycle. Not a prescription for what problem to work on or what solution to attempt, but a protocol for conducting teacher inquiry. This notion of a protocol became even more important as I began to anticipate the need for other facilitators (teacher–leaders) at the site to reasonably step in and perform a similar leadership role in the future. For each stage of inquiry (e.g., identifying and defining a problem, planning instructional solutions, etc.) I began to develop tools and articulate processes that might help to scaffold each task and then continually refined these processes after testing them out with the case study team.

For the facilitation of this group as well other inquiry workgroups in subsequent projects, protocols have consistently provided several important benefits. First of all, protocols help provide just enough structure to ensure that each group’s work adheres to the essential features of teacher inquiry, while at the same time providing schools and teachers with a flexible process which they can directly apply to their local context and immediate instructional needs (Saunders & Goldenberg, 2005). Secondly, for members within a single group, but also for school-wide or district-wide implementation efforts, protocols help to build coherence by establishing a common process and shared language of inquiry. Third, when carefully tested and derived from an authentic context, protocols can help to nurture inquiry skills and reflective dispositions (e.g., identifying and defining problems, anticipating student responses during lesson planning, using evidence to inform solutions, persisting with a problem long enough to uncover cause-effect connections between teaching and learning). Researchers hypothesize and anecdotal evidence suggests that systematically working on these skills in the context of inquiry-focused protocols may have broader benefits that begin to permeate teachers’ daily practice (Gallimore et al., 2009; Lewis, 2002; Stigler & Hiebert, 1999). Finally, protocols help to provide much needed focus and continuity typically absent in site-based collaborative settings which often are riddled with distractions. They equip the facilitator with simple tools for maintaining joint productive activity, keeping the emphasis on instruction, and holding the group accountable to collect feedback on the effects of their teaching (McDougal et al., 2007; Saunders & Goldenberg, 2005). As Glen commented in this case study: “And you try them and analyze them. It's not just like, ‘Do this’ and you forget and you might do it ... You follow-up.”

4.1.4. Stable settings

Stable settings are dedicated and protected times where teachers meet on a regular basis to get important work done. The idea of settings comes from Sarason (1972) as well as Tharp and Gallimore (1988) who draw attention to the fundamental challenge of making schools places of learning for adults as well as students. Saunders and Goldenberg (2005) also write about the significant contribution of settings to school improvement and school change efforts and emphasize the importance of establishing settings, not only for teacher workgroups, but also dedicated settings for the ongoing training and support of the teachers and administrators who facilitate and support these groups.

In the case study reported here, the initial effort to establish settings was simply a matter of locating available times and arranging a series of regular meetings for a small group of four teachers. However, the task becomes more complicated when faced with the challenge of creating new settings for a school-wide inquiry program, including a dedicated time for individual workgroups to meet three or four times a month, as well as a monthly meeting for administrators and facilitators. Since this case study school was already in the midst of changing the bell schedule for a move to block periods, they were able accommodate these settings by carving out a weekly late-start for students on Wednesday mornings and dedicating 75 min to teacher inquiry work. The teacher workgroups now meet three times a month to conduct inquiry and the facilitators meet on the fourth Wednesday to receive ongoing training and support. When groups choose to analyze video they also use one of their regular Wednesday meetings to gather in the computer lab and conduct this analysis, so that all meetings take place within the context of their regular settings and routines. In subsequent projects, most schools and districts have been unable to devote the time and fiscal resources needed to incorporate video, but have successfully established inquiry workgroups by relying on student work, live observations, and other readily accessible data sources.

The task of establishing these settings plays out differently in various schools and districts. For some schools, it is a matter of re-purposing settings that already exist and for others the task is about carving out new settings within the school day dedicated to teacher inquiry and instructional improvement. In either case, creating and protecting settings for teacher inquiry is a substantial challenge, and should not be done in isolation from the other core components. Inquiry cannot take place without stable settings, but stable settings will not result in joint productive activity without carefully arranged job-alike teams, a distributed leadership model that provides ongoing support and pressure, and well-articulated protocols for conducting the study of teaching and learning.

5. Conclusions

This case study suggests that collaborative teacher inquiry-systematically investigating shared problems to discover cause-effect connections between instructional plans and student outcomes—can lead to detectable changes in teachers’ practice. These results are more likely when schools establish stable settings dedicated to the continuous improvement of teaching and infused these settings with job-alike teams, trained leaders, and inquiry-focused protocols. If teacher inquiry is to succeed as a lasting mechanism for change in the current climate of short-lived reforms,
it will require a sustained commitment to creating and protecting these conditions and building site–level capacity to maximize them. Emerging examples of learning communities, lesson study, and action research around the world (e.g., United Kingdom, Netherlands, Japan, Australia) make evident that such programs and their corresponding challenges are not unique to the United States (Bolam, McMahon, Stoll, Thomas, & Wallace, 2005; Visscher & Witziers, 2004; Stigler & Hiebert, 1999; Kemmis & McTaggart, 1990). Insights gained through the Third International Mathematics and Science Video Studies suggest that in many parts of the world, from Asia to Europe, the way classroom instruction occurs would lend itself to similar structures and processes for collaborative teacher inquiry and systematic improvement of practice (Hiebert et al., 2003; Roth et al., 2006). More research is needed to deepen our understanding of these structures, to broaden our knowledge base of teacher inquiry models, and to investigate the effects of specific inquiry features on teacher discourse, classroom practice, and student achievement.

**References**


