Teachers’ Engagement with Student Learning Data in a Collaborative Inquiry Cycle

Tamara Holmlund Nelson
tnelson1@vancouver.wsu.edu
Angie Deuel
David Slavit
Michele Mason
Washington State University Vancouver

NARST April 2011 Orlando, Florida

Introduction

PLC work is an intentional, collegial, and dialogue-based collaboration amongst colleagues to improve student learning. It involves a cycle of identifying a common research question or inquiry focus, examining students’ work and identifying their needs, creating and implementing lessons or instructional strategies that can scaffold student learning, and continuously examining learning goals.

This definition of the work of a professional learning community (PLC) was compiled from interviews with science and mathematics teacher leaders participating with us in a long-term professional development (PD) and associated research project (for more detail on the PRiSSM project, see Nelson, Kennedy, Deuel, & Slavit, 2009; Slavit, Nelson, & Kennedy, 2010). It highlights a cyclical process of collaborative inquiry. It also underpins our research focus on looking more deeply at the processes involved in collaborative teacher inquiry (CTI). As we designed and helped to implement the PD over three years, an inquiry cycle was presented to teachers as a guideline for their work. We also conducted research with a selection of the participating PLCs over five years, and saw that talk about and uses of student learning data (e.g., classwork, homework, oral responses or classroom discussions, quizzes and tests, laboratory reports) were central to teachers’ productive collaborative inquiry process. Through our roles as PD providers, we heard from teachers about the challenges they encountered and determined some supports and resources that could help them in their inquiries. As researchers, we were able to look more deeply at the nature of collaborative inquiry as it played out in multiple PLCs over time. We use four phases of an inquiry process as a framework for analyzing PLCs’ inquiry cycle trajectories over time. In this paper, we present an analysis of two science PLCs, during the 2008-09 school year, from the same middle school. We address the following research questions: 1) What are the patterns of engagement in the four phases of an inquiry
process for these two PLCs across one year? 2) What are the characteristics of their engagement in the four phases? 3) What contextual factors help explain both the above? In our discussion, we explore the relationships amongst these three elements and how paying attention to these can help teacher leaders, PLC facilitators, PD providers, and administrators better identify where and what kind of support is needed to make PLC work productive and worthwhile for teachers and learners.

Collaborative Teacher Inquiry

Over the past two decades, professional development has increasingly been grounded in collaborative structures and processes. Various collaborative models proliferate across the U. S. and other nations, including professional learning communities, video clubs, lesson study groups, and critical friends groups. Most of these involve some form of iterative inquiry cycle or reflective process that includes some or all of these components: creating a common vision about and focus for the work, collaboratively setting/clarifying learning goals, planning instruction, assessing student learning, analyzing student learning data, reflecting on the effectiveness of the instruction, and deriving implications for the next cycle (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Ermeling, 2010; Gallimore, Ermeling, Saunders, & Goldenberg, 2009; Love, 2002; McLaughlin & Talbert, 2006; Nelson, Kennedy, et al., 2009; Thompson, et al., 2009). Through collaborative teacher inquiry, the view of professional development as the transmission of new ideas and skills shifts to a vision of ongoing professional learning, with teachers actively involved and supported in constructing new understandings grounded in well-defined standards and analyses of teaching and learning (Fullan, Hill, & Crevola, 2006).

A growing body of research indicates specific supports and resources are needed for teachers to enact powerful and transformative collaborative inquiry. The co-construction of a vision for the purpose and potential of collaborative inquiry is essential if a group’s collaborative work is to exceed the traditional outcomes of faculty or department meetings. Closely related to this is the creation of a shared vision for teaching and learning; this occurs over time and through consequential conversations situated in evidence about what is and is not working, instructionally, for diverse students (Horn & Little, 2010). These conversations require a collegial professional context for the work. A group and school culture that supports professional risk-taking allows teachers to question the status quo and have honest and consequential conversations that surface and address instructional issues (Lieberman & Miller, 2008). As Kruse, Louis, and Bryk (2007) state:

Growth of the school-based professional community is marked by conversations that hold practice, pedagogy, and student learning under scrutiny . . . Rich and recurring discourse promotes high standards of practice, and both generate and reinforce core beliefs, norms, and values of the community. (p. 30).

These are difficult conditions to establish in most schools, where “typical” and “traditional” cultures reinforce isolated practices across classrooms; patterns of dialogic interaction that maintain congenial, not collegial, relationships; and beliefs about teaching, learning, and assessment that support the status quo (McLaughlin & Talbert, 2006). Developing new visions for their professional work and ways of interacting with colleagues is not easy nor what teachers are typically skilled in facilitating. Fundamental to supporting the development of these attributes is the support of building leaders, especially in protecting stable conditions for teacher groups to meet. These conditions include protected time, teacher accountability for the work of
the group, and job-alike configurations (Gallimore et al., 2009). The first two of these conditions play a significant role in the two cases presented in this article.

The development of a culture of collaborative inquiry that holds practice, pedagogy, and student learning under scrutiny requires far more than structural supports. The provision of support for the inquiry process is also important, and also insufficient. While structural resources and processes for engaging in collaborative inquiry are important, teachers also face intellectual and ideological challenges, and these challenges are associated with the nature of a group’s inquiry stance toward the work (Achinstein, 2002; Cochran-Smith & Lytle, 2001). We have written elsewhere (Nelson, 2009; Slavit & Nelson, 2009) of our belief that a key to the transformative potential of collaborative teacher inquiry is a group’s “willingness to wonder, to ask questions, and to seek to understand by collaborating with others” (Wells, 1999). This involves asking critical questions about teaching, learning, and goals in order to surface beliefs and values across group members. A willingness to do this reflects an inquiry stance. Wilson and Berne (1999) point out, however, that “teachers have very little experience engaging in a professional discourse that is public and critical of their work and the work of their colleagues” (p. 161). While an inquiry cycle can provide support to teachers’ collaborative processes, it does not, in itself, nurture the development of an inquiry stance. In other work, we explore and describe two dimensions of a group’s inquiry stance while engaged in the collaborative inquiry process. One dimension specifically addresses the nature of teachers’ dialogue in PLC meetings, the other considers their epistemological stance toward student learning data. While we do not have the space to elaborate on stance here, it was through our grounded development of the characteristics of each stance that led us to this analysis of teachers’ engagement in the four phases of an inquiry process.

Conceptual Framing of Teachers’ Collaborative Engagement in an Inquiry Process

In our work with PLCs over the past seven years, our interest has focused on the intersection of a group’s collaborative inquiry process (i.e., an inquiry cycle), their inquiry stance, and teachers’ professional growth over time. However, to consider the intersection of these elements, we had to first unpack the inquiry process into smaller units. Additionally, we developed a rich description of a collaborative inquiry stance along two dimensions (Nelson, Slavit, & Deuel, 2009, 2010). Given the limited space in this article, we focus on teacher groups’ engagement in the inquiry process and explore the challenges and affordances to moving through one or more cycles of inquiry across a year.

It is important to note that associated with the proliferation of PLCs and other collaborative models of inquiry is the increasing emphasis on evidence-based decision making as a means for improving teaching and student achievement. Thus, teachers are expected to identify, collect, and make sense of various forms of student learning data, and then use these analyses to inform their classroom practices (Moss & Peity, 2007). Yet teachers often lack the necessary skills and, we propose, inquiry stance, to enact data-based inquiry in a manner that informs and influences classroom practice (Krebs, 2005; Slavit & Nelson, 2010). Important to the findings presented here, the ways in which schools and districts press teachers to examine student data, or the ways in which teachers interpret what administrators want, can shape their PLC work. Hargreaves (2007) describes how a singular focus on the improvement of high-stakes test scores can cause PLCs to become “perverted inversions of what they once so inspirationally aspired to be” (p. 184). Firestone and Gonzalez (2007) distinguish school district cultures focused on accountability with those focused on organizational learning. In the former, teachers
can feel pressured to raise test scores over the short term, while the latter focuses on the use of data for long-term learning about improving instruction and student understanding. We propose that teachers themselves may bring their personal beliefs about the uses of student learning data to the group, and this can also influence the nature of their collaboration.

The use of student learning data is inherent in a collaborative inquiry cycle and its role in influencing teacher change is well documented (Ermeling, 2010; Gallimore, et al., 2009; Kazemi & Franke, 2004; Talbert & Scharff, 2008). However, decisions about what data to collect and how to make sense of it have been shown to be difficult for teachers in collaborative inquiry groups. They are too often left to struggle with these decisions with little more than technical support or vague instructions to examine state test results and to show pre- and post-unit test gains. As Hargreaves and Fullan (1998) have argued, teachers need to become “assessment literate” in order to properly make data-based instructional decisions. Little, Gearhart, and Kafka (2003) agree that while strong evidence exists regarding the benefits of looking at student work, “the available research gives little sense of how any demonstrated benefits might in fact be achieved” (p. 186). To better understand this, we examined teachers’ engagement in an inquiry cycle, and propose that looking at the inquiry process/cycle in terms of four distinct data phases aids in understanding teachers’ efforts to use and learn from student data.

These data phases are: data exploration, data collection, data analysis, and implications derived from the data. Each phase does not necessarily occur in a linear fashion, nor is any one phase exclusive to any one step in a cycle. Table 1 provides an overview of the characteristics of each phase; we describe the characteristics of each phase more fully here.

**Data exploration** involves activity and discussion related to potential assessments of student learning. This includes introductory discussion about the development of new assessments and the modification of existing tools. In this phase, teachers may explore relationships between an assessment and their expectations for students’ learning or their instructional practices. Data exploration can also involve consideration of logistical possibilities or issues, such as timing, selection of students, integration with the established curriculum, as well as discussion of the benefits and limitations of each assessment choice.

Second, **data collection** involves activity and discussion related to the selection, development, and implementation of specific data collection tools. The creation or modification of assessment tasks, scoring criteria, implementation timelines, and sampling strategies are specific activities inside this phase. Often there are multiple rounds of activity associated with data collection that involve reflective conversations about past implementation or revisions of the assessment tool. Dialogue about data collection often involves teachers’ content knowledge, classroom practices, and curricular goals. However, to be considered part of the data collection phase, the dialogue must have some connection to the selection, development, revision, or implementation of an assessment tool. Note that while the name of this phase implies the activity of administering a data collection instrument, the teachers’ activities within this phase are largely associated with what happens before it is administered.

Third, **data analysis** occurs when the collected student data is the focal point of teachers’ dialogue and they are attempting to make meaning of student responses. We found that data analysis, for the teachers in our research, involved two different categories. Examining student work for specific ways of thinking or looking for trends in students’ responses is one aspect of data analysis. Another involves the clarification of analytic methods, such as clarifying expectations for student responses or determining the meaning or purpose of the assessment item.
Fourth, *implications* involve teachers making use of what they have learned from their analyses of student learning data for the explicit purpose of making changes to, or confirming they are not going to make changes to, future classroom practices or learning goals. Drawing implications invokes teachers’ knowledge of content, pedagogy, and learners. The extent to which these implications are enacted may not be made explicit in teachers’ talk, but their intentions are clear.

Figure A shows possible pathways of teachers’ interactions around these four phases. Their movements are not linear, and may or may not be recursive within the phases of data collection, analysis, implications, and back to data collection.

The Study

Cedar Grove Middle School is located in a suburban setting in the Pacific Northwest region of the United States. There were 985 students in three grades (6th-8th), 69% White, 18% Asian, 5% Hispanic, and 4% Black. Twenty-two percent of the school population was eligible for free and reduced lunch, 7.6% were in special education, and 2.1% were bilingual. The school also offers a program for autistic children, who come from across the district. In 2007-08, the year prior to this study, the number of Cedar Grove students’ who met standard on the state tests for reading, mathematics, and science was higher than state averages; in science, where there were tests at the 5th, 8th, and 10th grades, 48.2% of eight-graders state-wide met standards and at Cedar Grove 68.6% of students met standards.

Lead teachers from Cedar Grove had participated in the PRiSSM PD project since its inception in 2004-05, although none of the 2008-09 members of the CG6 nor CG7 PLCs were involved at that time. The school district was committed to PLCs and many schools used a weekly late start time for students to provide teachers with approximately fifty minutes for PLC meetings. This time was also used for staff and department meetings, however. There was an established May Showcase where each PLC presented their work and its impacts on student learning to all faculty.

Participants

**CG6.** In 2008-2009, the core members of the CG6 PLC were the four sixth-grade science teachers at Cedar Grove Middle School: Kevin, Bridget, Holly, and Danica. Their principal, Elaine, attended three of their eighteen meetings. A student teacher, Leslie, attended five and Deanna, a former elementary teacher with one science class, attended three meetings. Danica was a 3rd year teacher, new to the school in 2008-09, and formerly a biologist. Kevin had participated in a PLC for four years (since 2005-06); the first 2 years in a mixed grade (6th & 7th) and disciplinary (science & mathematics) PLC led by PD project teacher leader skilled in facilitating collaborative inquiry, and the latter two years in this 6th grade science PLC. Kevin, in his 11th year of teaching, had a degree in marine biology, was a member of the Building Leadership Team and the 6th-8th grade science department head. Holly and Bridget, just beginning their 5th and 7th years, respectively, had participated in the CG6 PLC for two years, as well. Neither had a degree in science. Due to his longer participation in PLCs and his other leadership roles, Kevin was initially looked to as the group leader. However, group dynamics were such that by October they decided to assign and rotate different roles for all members, including meeting facilitator, recorder, time-keeper, and protocol-keeper. Despite these assignments, Kevin continued to be the person responsible for the group’s momentum.
CG7. The core members of the CG7 PLC were the four seventh-grade science teachers at Cedar Grove Middle School: Logan, Rhett, Kyle, and Bart. Logan, Rhett, and Kyle had been members of this PLC in the previous year, and the same PD project lead teacher who had worked with Kevin for two years was also a member of CG7 in 2007-08. Bart was a new member and a new teacher. Logan was the clear leader of the group, although group tasks and responsibilities were evenly distributed. Early in the year they explicitly defined and rotated meeting roles: process observer, facilitator, recorder, and time-keeper. Logan, with a Bachelor’s degree in ecology, was in his 7th year of teaching. He previously taught 6th grade science with Keith (CG6), and they talked frequently about PLC work. Logan was also the 7th grade department chair and a member of the school Instructional Leadership Team (ILT). Kyle was in his 8th year of teaching, with a degree in integrated science. Rhett, in his 15th year of teaching, had been a member of the ILT and the Building Leadership Team for a total of eight years. Bart was in his 2nd year of teaching. Neither Rhett nor Bart had a science-related undergraduate degree. All members were involved in and intentional about their collaborative work and they were considered a high-functioning, exemplary PLC by the principal. The principal attended eight of the seventeen recorded meetings, typically staying for only a portion of the meeting but playing an integral role in posing questions to the group.

Data Sources & Collection

The data used for this analysis is a sub-set of a larger corpus collected over five years across seven schools and three districts. The main data sources used here are records of PLC meetings, including audio recordings, transcripts, participant-observer field notes, and artifacts from PLC meetings including assessment instruments, student work, and meeting minutes. Interviews were conducted with three of the CG6 teachers and with Logan, the lead teacher for CG7; these were recorded and transcribed.

In CG6, PLC meetings occurred on Wednesday afternoons. This time was used on alternate weeks for other types of business, such as disciplinary, grade level, or staff meetings. When the time was designated as a PLC meeting, teachers audio-recorded these, although we do not have the audio for one meeting for which we have field notes. Across the school year, we have records for 19 meetings, and 58% were attended by one of the co-authors, who was a participant observer.

The CG7 PLC met weekly for approximately 50 minutes each Thursday morning. Around the holidays and after January, the pattern of PLC meetings was disrupted by other demands and the number of meetings per month tapered off through May. Most PLC meetings were audio-recorded, although we did not get audio records for one known PLC meeting in March and one in April. Again, we have records for 19 meetings and 58% were attended by one of the co-authors as a participant observer.

Data Analysis

All PLC meeting transcripts were coded. We first analyzed each meeting transcript for the content of their talk; as such, we identified sequences within each meeting that were directly related to the PLC’s identified inquiry focus (or multiple foci) and sequences that were about other types of business. Talk about specific science lessons or lab procedures unrelated to a group’s focus of inquiry, about schedules or other department or school business, or personal stories were coded as “no data talk.” All dialogic sequences related to a PLC’s inquiry foci were identified as “data talk” and then coded for the four data phases: exploration, collection, analysis,
Using Student Learning Data

The analysis presented here for two PLCs is part of a similar analysis for seven groups. We established inter-rater reliability first by all four researchers coding five transcripts. Ratings were compared and differences discussed. Reliability on coding for data phases was based on the portion of transcripts first coded as data talk. This measure was calculated by dividing number of lines of agreement within these portions by the total number of lines within these portions. Inter-rater reliability for coding of data phases was reached at 78.2% across all raters, with a pair-wise average rating of 71.9%. After establishing reliability, all transcripts for each PLC were coded by the researcher who served as a participant-observer for that PLC. At least 25% of the transcripts for each group were also coded by at least one other member of the research team. Results of each meeting were put into Excel spreadsheets and circle graphs were generated.

Limitations

The circle graphs that represent the percent of each meeting spent in the four data phases or occupied by “no data talk” present a general picture of teachers’ engagement rather than a one-to-one representation of time devoted to any one phase in relation to the length of the meeting. The percent of time in various phases was calculated by the total number of transcription lines associated with a specific phase divided by the total number of lines in the transcript. However, the total number of lines in a transcript does not accurately represent the full amount of time in a PLC meeting. When teachers were quietly scoring student work, or when they were talking about personal topics, there is no transcription to represent this elapsed time. If conversation was inaudible, they number of transcription lines is reduced, as well.

Also, we do not have audio recordings for a few PLC meetings for each group. We feel confident that what we do present is representative of the patterns of teachers’ engagement in data phases, and also of the characteristics of their engagement. However, these circle graphs (figures 1 and 2) do not show the entirety of their year’s work.

Finally, some transcripts were very difficult to code as the conversation was complex and involved movement across multiple data phases in short exchanges. In our further analysis of inquiry stance (not presented in this article), we look more closely at the nature of this complexity. In this more simple analysis, the complexities again complicate the seemingly straightforward presentation of teachers’ engagement in data phases as shown by the circle graphs.

Results

The Cedar Grove 6th Grade PLC

In order to understand the trajectory of the CG6 PLC inquiry process across the year, we analyzed each meeting in the context of their stated inquiry focus. The inquiry question for CG6 during the 2008-09 school year was a continuation of an inquiry begun the previous year: How will our student independently demonstrate understanding and mastery of selected key science process words? However, their work was complicated by two other mandates that imposed upon their PLC focus. Dialogue about one initiative, known as CERA (Curriculum-Embedded Reading Assessment), consumed some of the PLC meeting time, as teachers were held responsible for assessing students and reporting on student progress in relation to reading and writing skills. This initiative focused especially on students with ELL and special education designations. Additionally, in early November the teachers were required to develop a SMART
goal (Strategic, Measurable, Attainable, Realistic, Timely) as part of the school improvement plan. The development of this goal occupied a significant amount of PLC time up to and after the winter break. Directed to use results from the 5th grade state science test to shape their goal in conjunction with the CERA initiative, they stated their SMART goal as “Ten percent of ELL and Special Education students will show one level improvement on the CERA summary by the end of May.” An additional directive given in the third trimester of their year further derailed their original inquiry focus. They were directed by the principal to develop and implement an immediate plan for instructional interventions to impact students’ success on the state test. They shifted to an explicit focus on scientific investigations (a major part of the state test) and devoted all PLC time from March through May to this.

As described earlier, we are specifically interested in identifying teachers’ patterns of engagement in the four phases of the inquiry process, so every meeting transcript was first analyzed for the content of the dialogue. We distinguished dialogic interactions related to their inquiry focus on science process words (from September through February) and on scientific investigations (March through May) from their dialogic interactions about other topics. Thus, conversations about CERA, the development of the SMART goal, or other science department business (e.g., scheduling labs, ordering materials, sharing examples of activities) was coded as “no data talk.” All dialogic sequences related to their two inquiry foci were identified and coded for the four data phases. In the following, we show the nature of their engagement in various data phases and contextualize this activity in terms of the group’s interpersonal dynamics and the competing demands on their time.

The Inquiry Process in CG6

As can be seen by the circle graphs representing CG6’s engagement in the four phases of the inquiry process, (Fig. 1), 55% of their PLC conversation was devoted to topics other than their inquiry focus. We feel it is critical to provide some insight into these conversations coded as “no data” before any further discussion of their inquiry process.

CG6 teachers faced two substantial challenges in their PLC work. First, across the four teachers there was not a common vision for what a PLC might accomplish. At least one teacher viewed their time as a mandated process that took up valuable individual preparation time. Many of the tasks they engaged in during PLC time were seen as impositions and met with verbal and sometimes active resistance. Thus, significant time was spent on speculation about why they were asked to take on specific tasks, such as teaching reading in science classes and the barriers to doing so. Kevin’s participation for two years in a different, highly collaborative PLC, predisposed him to individually view PLC time as an opportunity to engage with others in an inquiry-based process to examine teaching and learning: “You see growth in the students, and that’s what makes it worthwhile.” However, others had not had the same experiences, and seemed to view the PLC work through a more traditional meeting lens: “I don’t know how the other teams are finding the time to do the level of interventions they’re doing . . . I don’t know how they fit that in, I have trouble keeping up with the curriculum just grading our stuff.”

Kevin’s efforts to guide CG6 toward the use of a cyclical inquiry process were not successful, as can be seen in the group’s lack of recursive moves through the phases of data collection, analysis, and implications. Second, the group seemed unable to either set aside the multiple district and building initiatives or integrate these into a common inquiry focus. From August through February, they devoted time to their inquiry on students’ understanding of process words
in only four of their twelve meetings. And, as can be seen by the circle graphs, the time spent on this inquiry focus was often a small part of these meetings.

Also notable from the circle graphs is that, when engaged in some phase of the inquiry process, conversation and activity associated with a data collection phase dominated; there was little collective analysis of the data or discussion of instructional implications. However, in early March, when their focus shifted to scientific investigations, their engagement in various data phases increased (Fig. 1). Thus, the circle graphs show an increased involvement in data collection, analysis, and consideration of implications for instruction during the latter part of the school year. Despite the challenges, CG6 did engage in the inquiry process in relation to their two different foci.

Initial Inquiry Focus

CG6 began, in late August, by adopting their previous year’s inquiry focus on improving students’ understandings of science process words (e.g., infer, predict, transfer, observe). The group dialogue and their activity as displayed in the circle graphs shows that while the teachers exhibited some buy-in for this focus, it was not compelling enough to hold their attention against competing demands. They used their first meeting to review and refine the pre-assessment they would use again—an activity associated with the data collection phase. On October 1st, after all teachers administered the pre-assessment, they discussed the results, explored what they might collectively do in their classrooms in response, and proposed some revisions for the post-assessment in the spring.

Importantly, our analysis reveals they spent little time on collectively making meaning about students’ understandings. Instead, they concentrated on which process words were most misunderstood by students and, finding that many words were not well understood, debated what criteria should be used to narrow their word selection.

Kevin: So what did you guys come up with for your magical words? I guess we need to come up with a criteria.
Danica: Yeah, so what percentage is going to be enough? First of all, do I put the Excel [advanced] kids aside for a moment?
Kevin: Whatever you want, they’re all included.
Holly: Lower and higher all together.
Danica: Put it all together?
Holly: If you want to compare your own classes, but we’re just grouping them all, cause you still want to see the difference between the end of the year and now. . . .
Danica: I’ve got 7% [got it correct] for “relationship.”
Kevin: I got 9 [percent] for one of the classes.
Holly: 21.
Danica: I got 17% for “infer,” those are my 2 lowest, 20% for “factor.”
Bridget: I actually got 50% on infer for one of my classes, I was really surprised.
Danica: I guess that’s what I mean what’s the criteria, because for that class it’s every word.

The instructional actions they proposed as a result of this analysis were not specific to students’ understandings of these scientific processes; instead, they shared a variety of activities for building vocabulary:

Bridget: So you’re going to do, what do we call this?
Danica: I don’t know what you call it, what do you call that where you do synonym, antonym, definition, sentence, I learned it in Step Up to Writing, you could say Step Up to Writing strategy.
Kevin: Perfect.
Bridget: . . . When we go to compile our data and what we all did to get the vocab in, this is page 12, then we have a list of all our strategies, so if you have a list of anything else, you just –
Danica: I’m considering doing the little folding thing I learned from the woman that trained me, you fold it, then you open it up and it’s like you have double the folds, it was the coolest thing I’ve ever seen, this accordion fold.
Their PLC conversations reflect traditional teacher talk, where instructional strategies from one person’s “toolkit” are shared with others, detached from any documented impact on student learning.

Despite their engagement in identifiable phases of an inquiry process, they exhibited little of what we have described elsewhere as an inquiry stance (Nelson, 2009; Nelson, et al., 2010). Their collection and analysis of student learning data appears to be at least as much about proving that they had impacted students’ scores as it was to help them think about relationships between their instructional practices, learning expectations, and student learning. This is reflected in the next excerpt, still in October, but similar to conversations later in the year:

Bridget: . . . So what do we want to do, all the words the same [for each teacher], or do we want to go back to the list we originally had?
Kevin: If it works best for your class –
Danica: I was thinking every class will be a little different, you want to hit harder –
Kevin: But the only problem is when we try to get the data at the end, it will be a lot more complicated to show the growth, we’d have to isolate it per class, I’m not saying we can’t do that.
Bridget: We don’t need to make this any harder than it has to be, I’m okay with us following the same thing.
Kevin: What do you want to do?
Bridget: At least our simpler ones.

Their PLC work was task-oriented in that they identified some aspect of student achievement to improve, collected baseline information, discussed instructional strategies to implement at each person’s discretion, and considered how they could show student improvement at the end of the year. Yet, this task-orientation did little to deepen their understandings about how to enrich students’ engagement in and understanding of scientific processes such as inferring or observing.

By February, their conversations continued to be similar to those in October. In a brief analysis of students’ progress in identifying the meanings of the most critical words, they again identified the percent of students who chose correct answers on an assessment. This excerpt from February 18th typifies their analytic dialogue:

Holly: I put critical words, less than 40% got it right, then I did the borderline words, but I have some critical words that less than 40% got it right.
Kevin: What are your critical words?
Holly: “Relationship,” “transfer.”
Bridget: I had my “transfers” into the 70’s.
Holly: Relationship is a hard one. . . .
This level of analysis conceivably could be the beginning of a deeper investigation as to why the lessons were not having a significant impact on many students’ ideas. To some extent, this was explained away by the number of students with reading difficulties. As one teacher frequently noted:

I noticed there were students that, they can’t even really read a sentence, so to make a choice that even makes sense, they’re just picking blindly, so maybe before when they got some of these right, when I have kids that get everything wrong but one, if they got one of them right I think it’s just random, they’re guessing.

They did not collectively move to deriving implications for instruction based on students’ needs. At best, they considered two suggestions by Kevin, but there is no evidence these were taken up in relation to their focus on process words. One suggestion at the February 18th meeting was to develop and implement common mini-lessons:

Kevin: Just brainstorming on this, do you guys want to see how people work, do you want to create one mini, mini-lesson, or 15 minutes of something for each one of these words, or do you want to keep going with the way we’re doing it? I could take “relationship,” I could create not even a big lesson but something from a book, a sample, that way we don’t have to all look at it, throw it up on the doc cam, how it’s going to be presented –

Holly: You want a lesson for every word?
Kevin: I don’t know about that . . .
Danica: What I think is interesting is we talked for how many months, the light kit, so how many times did they hear the words transfer and transmit, how many times did we cover that, so we’re talking about creating mini-lessons, I think it’s interesting we’re talking about mini-lessons from these words, yet we spent months on these words, they’re not getting it.

When the mini-lessons got little traction in the group, Kevin returned to a previous suggestion to create a poster as a visual reminder for the teachers:

Michele: Did you decide on a mini lesson?
Danica: I’m just processing it in my head now, thinking about what that would look like, I don’t know.
Kevin: Anybody interested in doing that? I know we’ve got key words, or do you just want a reminder, like a poster?
Holly: I think we should do the poster.
Kevin: Then we can see how that works.
Holly: We talked about it last year and didn’t do it.
Bridget: We talked about a lot of things last year.
Kevin: If we do the poster thing, then we do, we can see how that works, we don’t necessarily need to reassess them, but do you want to do that?
Holly: Not formally, informally, because I’ll throw one or two of these with my regular –
Kevin: So when they’re getting their regular quiz you throw out –
Holly: 1 or 2 of them, when I’m doing content I’ll throw in “infer.”
Danica: So have a poster up front that is for you to refer to, for you to be like “I’m inferring” . . .

While this seemed to be a collective decision for putting up posters of the critical process words in each teachers’ classroom, we have no evidence that this occurred. They made a decision to administer a post-assessment on process words in early May, yet did not mention any of their
activities or impacts related to this work at the May PLC Showcase. In fact, this was the last evidence we have on any engagement in a collective inquiry process about the science process words. In fact, a significant shift in their PLC activity occurred during this meeting, marked by Kevin’s comment: “We could go through and do the next little thing we’ve got to do.”

A New Inquiry Focus

The circle graphs reveal a notable change in their engagement in the four data phases from this point in February through the end of the year. Introduced to the group by Kevin’s comment about “the next little thing,” they had a new directive to increase their attention to the school-level SMART goal, “Reduce by at least 10% the number of students not meeting AYP [Annual Yearly Progress] in each group/subject.” As Kevin later explained, “We had to come up with a third plan for the year, because it had to be something new, it had to be fresh, so we had to come up with a new fresh plan, and that’s the one we ran with” (Interview, June, 2008). They abandoned the process words and concentrated on student needs as revealed by the 5th and 8th grade state science assessments from previous years. Their specific focus, as directed by the principal, was on showing improvement by students who were English Language Learners (ELLs), on an Individualized Education Plan (IEP), or were in the Social Communication Integration Program (SCIP) for children with autism. Across 7th and 8th grades, the science teachers were emphasizing students’ abilities to plan scientific investigations, and the CG6 PLC also took this up as an effort to better prepare students for 7th grade expectations and, ultimately, the 8th grade state test. They developed formal questions as a frame for presenting their findings at the May Showcase: How will our students independently demonstrate understanding and mastery of key elements of the scientific method? What tools or strategies will we provide them with to increase comprehension, retention, and utilization? Teachers were held accountable by a requirement to present findings, to the entire faculty, about the impact of the instructional intervention on students.

Because all other directives that had been competing for their attention were set aside, the CG6 PLC significantly increased their involvement in the data collection, analysis, and implications phases in six of their last seven meetings. The details of their engagement in this approximately twelve-week inquiry cycle reveal where they continued to face challenges with the inquiry process itself.

A key factor that shaped the numerous hours they spent on activities associated with this cycle was that their engagement was motivated externally. They had a deadline—the mid-May Showcase—for conducting a pre-assessment, creating and implementing interventions, conducting a post-assessment, and analyzing the pre/post-assessment results. The area they chose for this work was aligned, more or less, for different members of the PLC, with an existing instructional focus. As Kevin stated in early September:

So basically what I’m going to do for myself so I can track these kids better than previous years . . . and I’m just going to throw this out, you guys don’t have to do this at all, besides doing our process words, I’m also going to focus on the whole planned investigation with conclusion, or lab write-ups basically, I don’t know what your kit training, how many labs you actually saw that you can do that . . . but what I’m going to do is I’m going to start off with the bubble gum/chewing gum, fun stuff, you guys don’t have to do this . . .

However, this was not taken up as collaborative work by the PLC until the principal gave the directive to “do something fresh” to impact the school goal. Despite Kevin’s individual interest,
their end-of-year inquiry was mainly viewed as a mandated activity rather than a process for understanding students’ thinking in order to rethink their teaching:

Kevin: . . . we have to do an intervention for them, like what we were just doing for vocab but a new topic.

Danica: So planned investigation. Why would you, I’m just talking as a new person in the building, why do you want to plan an investigation? Is that because 7th grade teachers have told you that the kids are weak in that area? Is that one reason you want to focus on it?

Kevin: They’ve mentioned it, but that’s what they work on throughout the year, so there’s a lot of things they could be doing that could help them move up if we start introducing this a little bit more, give them more experience so when they come in, not necessarily in September but by the end of September, they might remember a lot of these things, then they can move on quicker.

Danica: But normally every year you guys teach this curriculum, they always do snail, seed, celery, they still do theirs, so what would we do differently?

The above excerpt is from February 18th, the next from March 18th, a meeting during which they scored their pre-assessment and developed a plan for intervention lessons. Despite moving forward with a plan that specifically targeted an identified area of importance for student learning, group members continued to question the time:

Danica: But I’m trying to find out what is driving something like this, an amazing number of man-hours.

Bridget: The lack of progress in the SIP [school improvement plan] is what’s driving this.

Holly: Or is it the [state test scores] scores that are driving this?

Kevin: It’s not the [test], it’s SIP, we have to meet annual yearly progress, which are the IEPs and the ELL students not passing the [state test] for this school, which is derived from the released [test] scores.

As a group, they continued to exhibit an attitude toward the work that was about compliance more than inquiry.

Informative to the above perspective, the pre-assessment they implemented was an excerpt from one of the “planning an investigation” released items from the state test. Although they spent considerable time on February 18th brainstorming what to assess and how to do this, they ultimately decided, in the next meeting, to slightly modify and use a released item with nine multiple-choice questions, a fill-in-the-blank, and one open-ended question. This was beneficial given their time constraint, as it allowed them to move on quickly with the pre-assessment. It also was a simple format that would allow them to do a straightforward pre-post comparison.

They moved to analysis of the pre-test on March 18th, but unfortunately discovered that one of the teachers had switched around some of the questions. They also realized they had not decided on how to score and compare the assessments:

Michele: So what you guys decide as a group, you’re going to do all of your periods?

Bridget: I don’t think we discussed that.

Kevin: We didn’t discuss it but I think everybody separated it out by periods, because then we can focus on that period if they did really well versus another period that missed hypothesis or whatever.

Danica: I didn’t do total percentages for these because I was trying to get individually this is an intervention, so I didn’t get a total for each question.

Bridget: This [inaudible] –
Danica: I did 2 extra questions. . . . I don’t think mine are in the same order as yours. I had hypothesis as number 4.
Bridget: So how do we plan our intervention given we each collected different kinds of data?
Thus, while they came prepared to analyze their data, they spent more time figuring out how they could reconcile their different tests. Again, their decisions were largely shaped by the requirement for a presentation.

Danica: You’re trying to get individual kids pulled out for issues, but now we’re going to do the total class percentage for each question.
Kevin: I’m assuming, because we want to show that growth, or show
Holly: You have to have a baseline
Kevin: We have to show individual growth for each kid, unless we . . .
Bridget: What kind of data are they expecting in our presentation, as a group?
Kevin: They don’t have any expectation. They just want to show growth.
Holly: Everyone is doing it different.

As they moved to planning for instructional interventions (implications phase) on March 25, they each developed and shared a “mini-lesson” on one aspect of the targeted goals for scientific procedures: writing an hypothesis, interpreting data tables, and identifying variables. Kevin had suggested this action earlier in relation to their process words focus. It became a viable suggestion at this point, as they had limited time to do targeted interventions due to spring break and state testing in early April. Each teacher implemented these lessons over the next three weeks, and gave a post-assessment in late April. The April 8th meeting (see Fig. 1) was dominated by “no data talk” as they were all in different places in implementing the mini-lessons in their classes and therefore at a holding point in the inquiry cycle.

Compilation of the post-assessment scores and comparison of the pre- and post-tests results occupied the remaining three PLC meetings. They encountered unexpected challenges in these tasks, which cost them much time, during and outside of PLC meetings, and caused much frustration in the group. They came together on April 29th to score the students’ tests. At this point, they still had not clarified if they were scoring and reporting on all student papers or just the targeted groups. They had different ideas about which students were in the targeted groups. And they had not agreed upon what level of performance would count as the cut-off score for being considered “the lower general ed kids.” This discussion was revisited multiple times across the meeting. In the next meeting, on May 6th, their attempts to compare pre- and post-test scores were muddled by the discovery that one teacher had changed the question order from pre to post.

Danica: It’s the same test in different order, that’s what I’m trying to do right now. I have this question, this is my question #11, this is my question #8, this is my question #10.
Holly: Did you rewrite any?
Danica: I made it bigger so people could see, I put the hypothesis one, 1, 2, 3 are the same, controlled, manipulated, responding, and this one is #5.
Holly: We all need to have the same one.
Danica: As I was trying to say, I sent out many, many emails because I needed to get mine done because I needed to get to print shop, and nobody responded, the next thing I know everyone had the other test, I don’t know when that happened. . . . Yeah, I changed this, because I didn’t want them to have the same, I mean, here you’re telling them that you want them to make a bar graph, and here the answer is “bar graph” –
Using Student Learning Data

Holly: But what I’m saying is if you wrote it differently it’s still not, it’s not the same. Michele, as a participant observer, helped them sort this out and created spread sheets so they could compare results from the same questions.

The next problem they encountered in their analysis occurred on May 12, just prior to the presentation day. Using the spread sheets created by Michele, the teachers were dismayed to find that most of the post-test scores were lower than the pre-test:

Kevin: We got 60, so our ELL kids didn’t gain, they lost. . . . All the way across the board, it’s just significant loss.

Bridget: SCIP is the only [category] that actually improved, but these were our targets. Given all the issues associated with their data collection, the teachers rightfully questioned these results:

Bridget: There’s no way they could have dropped in every category. . . .

Danica: There is so much going on with entering of this data, I don’t trust it, anyway, but that’s just me, there’s too many cooks in the kitchen, and too many things being typed, and too many translations. And I just know that those two questions—across the board, that we didn’t re-teach it well, and that’s it.

Kevin: But that’s only 2 out of 11.

Bridget: That doesn’t explain why there were only 4 [questions] of 11 that made gains.

Their final results underscore the multiple challenges they faced throughout their inquiry process. In all their data phases they were faced with the consequences of differing levels of experience with research design, especially as related to data collection tools and methods of analysis.

Discussion of the Patterns & Characteristics of CG6’s Engagement

Patterns. An examination of the circle graphs in Figure 1 shows that the CG6 PLC members were infrequently engaged in data phases within meetings and across the first two-thirds of the school year, when they focused on process words. There is little evidence that any of the teachers aside from Kevin had a vision of the inquiry process over time—that there would be different phases that would build on previous ones, for example. And there is no reason to expect that the teachers would, as they had little support in conceptualizing their work as an inquiry cycle. Of the four data phases, teachers are most familiar with administering assessments (part of the data collection phase) and grading these (a low level form of data analysis). This is reflected in a lack of balance across data collection, analysis, and implication phases through January 21st, with four to six times more time in a collection phase than in the other two. And there was no time in exploration, where teachers might have considered what types of information about student learning could help them better understand students’ ideas about process words. While Kevin had experienced an inquiry cycle framework indirectly through his participation in a different PLC during the PD project, neither he nor any of the other members of CG6 had been lead teacher participants in that project. This group’s trajectory from August to February reveals the importance of more explicit supporting structures for the data phases embedded in a collaborative inquiry process.

The pattern of their engagement in the data phases changed dramatically in February. At this point, they had a directive to do an explicitly focused implementation that would impact students’ learning in relation to something measured by the state test. Again, as tests are the most common experiences teachers have with collecting and evaluating student achievement (whether or not this is equivalent to learning is debatable), a pre/post-test format with an intervention in
the middle made the most sense to the group. The circle graphs very clearly map out: 1) their
discussion of what they might do (the large percent of DE on 090218), 2) their construction of an
assessment instrument (DC on 090304), 3) the analysis of the pre-assessment on 090318 (a more
complex conversation as they moved back and forth in scoring students’ work, discussing the
post-test, and considering what they should teach in the interim), 4) planning intervention lessons
(090325), and then 5) scoring the post-assessment and compiling pre/post comparison. While the
characteristics of their engagement in the data phases during this cycle may not have been as rich
and complex as can be envisioned, we hypothesize that facilitation to help them reflect on their
process during this cycle in comparison to their inquiry process during the earlier portion of the
year would move them forward in their understanding and enactment of an inquiry cycle in
subsequent years.

Characteristics. As reflected in some of the excerpts presented earlier, the teachers did
not have a common vision for the potential of engagement in an inquiry cycle. In their focus on
process words, there were few conversations where information from the pre-assessment actually
informed instructional ideas. Nor was there much conversation about gaps between how the
students interpreted various process words and the teachers’ learning goals. While comments
from individual teachers more or less reflected their own beliefs about either of the above,
seldom were these statements taken up and explored as a group. Thus, their conversations about
student learning centered on which words were frequently missed but not the nature of students’
existing ideas. This continued into the cycle on the scientific method. Despite Kevin’s year-long
individual emphasis on this with his students, their conversations about assessment were more
informed by how to get data to present at the Showcase than on how to impact students’
understandings. The meeting on March 25th that is predominantly engagement in the implications
phase was largely characterized by telling each other what his/her mini-lesson would be like.
This stands in contrast to using specific information about nuances of student understanding to
rethink or improve standard lessons. And, unfortunately, the issues they encountered with
changes in both the pre- and post-assessments caused the last three meetings, centered around
data analysis, to be characterized by extensive amounts of time determining which questions
matched across the tests. This is data analysis activity at its lowest level. It also led to a
conversation in the last meeting that centered on their lack of confidence in their pre/post
comparison rather than an opportunity to explore potential reasons for the differences.

Impact of contextual factors. Ultimately, the external motivation to have data to present
at the Showcase shaped their engagement in the inquiry process across the last eight meetings.
While it gave them a structure for inquiry, they did not have experiences that could help them
collectively shape their activity into meaningful collaboration to enrich their understandings
about connections across their students’ thinking, their learning expectations, and the lessons
they might design. Thus, the Showcase was seen as a mandate to prove they had positively
impacted student learning.

The interpersonal dynamics were congenial at best, and complicated by evident and
differing beliefs about student learning and access to challenging science content. While Kevin
showed evidence of holding a personal vision for the power of collaborative inquiry and was the
de facto group leader, he was unable to overcome the interpersonal dynamics to facilitate the
kinds of conversations that could disrupt and transform their typical (McLaughlin & Talbert,
2006) group culture. The multiple initiatives from the building and district administration
contributed to the pressures and frustration teachers felt. Due to several directives that were
interpreted as distinct from each other, it is no surprise the group felt there was no time to go
deeply into any one of these. As Danica said, “I don’t know how the other teams are finding the time . . .” Additionally, the content knowledge of the teachers differed. This contributed both to some issues of trust as well as potentially constraining their abilities to engage in nuanced conversations about student ideas.

We see the struggles CG6 faced as a clear indication for the need for facilitation in PLC work. We strongly believe teacher leaders can do this, but need ongoing, embedded support and targeted resources to do so.

The Cedar Grove 7th Grade PLC

In our examination of the CG7 PLC’s inquiry process trajectory across the year, we consider their patterns of engagement in the four data phases, as shown in Figure 2, and use evidence from transcripts to support our characterization of their engagement.

CG7, like CG6, was required to develop SMART goals and they generated two. The first was stated, in their Showcase presentation, as: Eighty percent of 5th grade students [who did not pass the state test] will show improvement in procedure writing as measured by the Alka-Seltzer pre-test and friction post-test. This SMART goal was guided by an inquiry question: How can we improve students’ procedure writing sections of their lab reports? And, while they implemented efforts to improve all students’ abilities in this area, they identified the forty students who scored a “high 2” out of a possible 4 on the 5th grade state test as a way to measure their attainment of this SMART goal. They focused primarily on these students when doing in-depth data analyses, but quantitatively analyzed all students’ papers to inform their development of instructional interventions. Their second SMART goal was stated as: At least four major end-of-unit assessments will be shared [in the PLC] and we will provide intervention opportunities for all students prior to the final test; shared formative assessments will be used to identify areas of weakness. Across the year they developed then implemented a recursive inquiry cycle consisting of the following steps:

1. Identify priority standards for each unit: Human Body Systems; Catastrophic Events; and Energy, Machines, and Motion.
2. Create a shared formative assessment, tied to priority standards, that uncovers student thinking.
3. Use formative assessment data to form intervention groups.
4. Provide targeted instructional intervention.
5. Facilitate common summative assessments and discuss effectiveness of these interventions.

The second goal dominated their PLC work from September through the end of November, and the end of January through March. They gave some attention to the first goal again around the new year, and then from April through June they merged the recursive cycle they had developed for the second goal to focus again on goal 1, procedure writing.

As we did with CG6 data, we analyzed each meeting transcript for the content of their talk. Talk about specific science lessons or lab procedures unrelated to their inquiry cycle, schedules, materials, or other department, school business was coded as “no data talk.” All dialogic sequences related to the two inquiry goals were identified and coded for the four data phases.

The Inquiry Process in CG7
As can be seen by the circle graphs representing CG7’s engagement in the four phases of the inquiry process, (Fig. 2), in every meeting but one (September 25th) they were engaged in one or more phases of the inquiry process. We present examples of ideas and activities that shaped and characterized their engagement in these phases across the year.

This group maintained their PLC momentum from the previous year and thus spent minimal time in the data exploration phase. Only twice during the school year did they move into an exploration phase: once in October as they explored what kind of assessment they might do to inform interventions, and again in February when they considered potentially less time-consuming methods for collecting information on student needs related to upcoming instructional units.

Prior to their first recorded PLC meeting, CG7 teachers had decided upon and administered the Alka-Seltzer pre-test (designated in SMART goal 1, above) to all their students. The question posed to students was: “Is the time it takes for an Alka-Seltzer tablet to dissolve in water affected by the temperature of the water?” Students then designed an experiment to answer the question. In their first two PLC meetings, they moved directly into three phases of the inquiry process. Their data collection-related conversation involved planning for the next assessment and for sampling in relation to their focus on underperforming students. They collectively analyzed student work, one sample at a time, using a document camera and a rubric for procedure writing common across all grade levels at Cedar Grove (and common across the state). The following excerpt, which took place after Kyle read a student’s procedure for the investigation, is typical of their analytic dialogue:

Logan: . . . So let’s start with the variables first. Did this student do anything to make it a fair test, control variables? [He] talks about the amount of water.
Kyle: They don’t have the extra control in there. I don’t see the –
Logan: It says fill one 150 ml beaker, yeah, but –
Kyle: But there’s no temperature as the control.
Logan: Actually, they can get the controlled variable point. My understanding of the controlled variable point is that the only thing they have to do to get that point is to describe some way that they treated each beaker equally, or treated, uh, they just had to list anything that made it a fair test in any way. . . . They could also get the point by saying “I put the Alka-Seltzer tablets in each beaker at the exact same time.” They could get that point by saying they did anything equally, or they could even get the point if they said they made sure the tablets were exactly the same.
Kyle: Well, I think he had the manipulated variable, he has hot and cold.
Logan: Yeah, I agree, got the manipulated, I’m just not seeing any control.
Kyle: I’m not either, no control, no repeat. He said record but not—I don’t think he used that enough –
Logan: No, yeah, you get the record point, if you just say that –
Kyle: But, yeah, I don’t see the steps for logical.
Logan: No, if you don’t get one of the variables points, then you automatically don’t get logical steps.
Bart: Oh, I never knew that.
Rhett: Okay.
Kyle: Really? I thought you had to get responding, but the control you’d still –
Logan: My understanding is in order for it to be logical and repeatable you have to have all 3 variables at once, or you automatically don’t get logical steps.
Kyle: Okay, so we’d give this guy, boom boom, 6 out of 8? Is that correct? Or 5 out of 8?

They frequently shifted between phases, moving from analytic dialogue to a consideration of the implications for their upcoming lessons, for example. The principal, Elaine, influenced their data implication discussions early in the year when she suggested that they could regroup students across the four teachers based on student needs:

Elaine: Let me draw another radical idea that goes in line with PLCs and certainly what we talked about this summer. What if you all agreed and decided that we’ve got a group that needs work on hypothesis, a group that needs work on conclusions, let’s say two groups on conclusion and one on procedures and something else, what if you took a half hour period where you traded kids, this one did conclusions, you did procedures, and you did materials, teach to everybody’s kid what they need? . . . You’d each have your own monitoring notes, but when you teach, instead of each of the four of you teaching four small groups, you take a large group, you give it some intention, so what you’re doing is you’re sharing kids.

Rhett: That makes sense, I’m just wondering how you’re going to make the groups. I think it’s a great idea, that is a radical idea.

Logan: The last Thursday of every month or something, if we planned ahead far enough I could see that working.

Rhett returned to this idea in the next meeting, which led them into a deeper consideration of possible relationships between their instructional practices, how students learn, and what might be realistic expectations for 7th grade students:

Rhett: . . . Some of these fixes are easier than others, so this led me to a thought – to maybe, as we get all this data, do like Elaine was saying, to divide up students with similar needs to teach to those strengths, like on “fix your procedures Friday.” It’s just an idea.

Kyle: What I’ve noticed, this last Friday I did a paper airplane lab, they had a problem and a question, I’m sorry, a problem and a set of materials, and they had to design a lab and conduct a lab. So same thing as this but they actually had to carry out the lab. . . . and the kids did very, very well on that, they were in groups but at the same time their procedures were much better written than these procedures [on the pre-assessment] were. I think having them do the lab would make a big difference, if we let them do the lab in addition –

Logan: I agree.

Kyle: Before we even did this, I’m the one that said let’s not do it because of the price, nine tablets per group, that’s a lot of tablets, I don’t know what it costs, I’m sure it’s expensive overall. Looking back, I think that would help these scores out a lot because the kids would start thinking, and actually do the lab here, put their hands on it and see what’s going on.

Rhett: If they’re going to write the procedures as they do it, is that okay?

Kyle: Yes and no.

Elaine: Instead of planning for it?

Rhett: Right, and I’m thinking that’s what always comes to mind, are they going to make it up as they go?

Kyle: But some kids, they start writing it, then do the lab and come back and they fix things on their procedure.
Rhett: But is that okay?
Kyle: That’s revising, I think that’s kind of okay. I think if they had nothing on there when they start that’s not okay. But I think if they start writing it . . .
Logan: Some kids, they probably just can’t picture it until they do it.
Rhett: Exactly.
Logan: We’re asking kids to picture something in their head, some kids just can’t do that.
Elaine: And realistically do scientists plan them all, or do they build them as they go?
This conversation continued as they discussed the work of famous scientists and connected their ideas about the nature of scientific inquiry to the state standards for middle school science.
Over the next few weeks, they reconsidered Elaine’s “radical” idea that they periodically exchange students based on assessed needs. Other than the meeting on September 25th, where they planned for a complex amylase lab, they continued to collectively analyze formal (the Alka-Seltzer pre-assessment) and informal (from classroom activities) student learning data. In early October (081010), Logan brought a question from the Instructional Leadership Team about “What do we do when kids can’t learn it, what do we do when they don’t do it?” This shifted their attention toward their more conceptually-oriented second SMART goal and student thinking in relation to their unit on human body systems. They decided to use the unit test to identify groups of students who could benefit from specific interventions to address conceptual misunderstandings, and students who would benefit from an extension of the unit concepts. This work encompassed all four data phases, as they explored what they might do to assess student needs, developed a common assessment, informed their assessment development with some informal analysis of students’ understandings, and considered what to do instructionally in the intervention groups. Their analysis of the implementation of intervention groups led to a question from the principal (Elaine) and a critical realization amongst the teachers:
   Elaine: So whether they chose not to or they just didn’t grasp it, is there anything we learned from this piece that we can go back and have our first time teaching next time be more efficient?
   Rhett: I think you need to have an assessment before the test to figure out these groups.
   Elaine: An assessment before the test?
   Rhett: Just a mini thing –
   Bart: Like a formative assessment.
   Logan: So you can do the intervention right after the unit test?
   Rhett: Or right before it.
   Logan: I see.
   Rhett: Because I think we’re shutting the gate after the cows get away. They demonstrate on the test, we do it again, we have no real way of measuring how effective it is—except these exit slips.
This was the point at which their recursive inquiry cycle took hold and shaped their work for the rest of the year. This involved clarifying their priority standards for each unit, creating a formative assessment to identify student needs, analyzing this data to develop intervention groups, providing targeted instruction for each group prior to the unit test, then administering and analyzing the data from the unit test.
To begin this cycle, they came up with the idea of carefully constructed exit slips to assess students’ ideas on specific sub-concepts within a unit. In early November (081106), they spent considerable time in a data collection phase constructing an exit slip for cellular respiration. The three or four questions on the exit slip would allow them to sort students into
four groups. Three of these groups were intended for students with specific misunderstandings, the fourth an “extension” group for students who already were solid in their understanding of the other three areas. This excerpt represents how they made links during the data collection phase to the learning expectations for the unit on cellular respiration:

Logan: Bart had the idea of giving the kids a four question exit clip one of these days, and each question represents that intervention category. . . .

Logan: Should we come up with this tool, this exit part, we need a question for each of these categories, or maybe just three, three questions. . . .

Bart: Do we want them to be similar to the ones on the test?

Kyle: I think similar but different. I don’t want them to be the same as that question.

Logan: Maybe for the O₂, CO₂ one – “The cell has used the O₂ and used the glucose, and it has released CO₂. Explain what happens to the CO₂ after cellular respiration.” . . . I was thinking that question would identify kids that were weak on the “trip,” not weak on cellular respiration. . . . The problem with that is we can’t give away the cellular respiration recipe for the other group, we need one question to find out if kids are weak on cellular respiration, one question to figure out who is weak on the journey –

Kyle: Why don’t we just ask them to tell us the order of the organs oxygen passes through as it gets to the cells, and tell us the order of organs it passes through when the CO₂, on the way back. Something like that.

Logan: We can mention O₂ and CO₂ in that question, I don’t think it will help the kids that don’t understand cellular respiration.

A second round of intervention groups occurred prior to the unit test in November, and they analyzed these data late that month. We do not have a record of their conversation about the results of this implementation. However, they continued this pattern of formative assessment development, analysis, intervention group, unit test, and more analysis through the end of March. The large percentage of time spent in the data collection phase in meetings in the latter half of the year (Fig 2: 090129, 090219, 090312, 090409) reflects their development of exit slip assessments. Analyses of student learning data were done subsequent to or during these meetings, and often they analyzed data from the current unit and then considered the potential assessment questions for an upcoming concept (see Fig 2, 090122). The circle graphs show how they moved across data phases as they both analyzed student learning data and considered the implications for upcoming lessons. While we do not have audio records for the meetings between February 19th and March 12th, nor for March 18th, the circle graphs from January 15th and 22nd and February 12th and 19th represent their common pattern of engagement in the data phases.

Recall that, like CG6, CG7 had multiple PLC foci. In early December, they shifted attention back to their first SMART goal on procedure writing. They had not given this explicit attention in the PLC since September: “We’ve been on this goal [two] for a while, because we’re really doing two different things this year, this is the one that’s taken a lot of our time” (Logan, December 11). In December and early January, they exhibited the same pattern of moving across data phases as they analyzed student work related to scientific procedure writing, considered how to collect the next set of data, and explored the lessons they might implement in response to the analyses. They then set this goal aside again, not to be reconsidered until April 9th, when Logan pointed out:
Logan: So we realized we’ve been doing a lot more with intervention days than we have been with writing procedures, so we thought it might be a good time pretty soon to focus on that other smart goal for a while.
Kyle: I forgot all about that.
This speaks to the challenges of pursuing more than one inquiry focus, even in a group that was highly engaged in and capable with an inquiry process and wasted little time in their PLC meetings.
In this April 9th meeting, the teachers realized that they could merge their two SMART goal foci, as the interventions they had been doing for the sub-concepts within units would also be useful in supporting students’ procedure writing. Through conversational turns like the following, they came to recognize that they could do exit slips and intervention groups related to the development of scientific investigation procedures:
Rhett: Let me ask you this, do we need to have, whatever you call those things we do, those teacher swaps, to teach to the procedures and see how they do during the lab?
Kyle: You know what, I wouldn’t be totally against doing a lab teacher swap . . .
Logan: I think we’d see some pretty rocking results on the posts if we did a teacher swap before –
Rhett: Of the procedures?
Logan: Yeah.
Rhett: But that means we’re all doing procedures? That’s what it tells me.
Logan: We could break it up, right, one of us could focus on kids who can’t write a hypothesis yet. One of us could do kids that really have a hard time with responding variable and record, those are kind of related. I guess we could just break it up by attribute. . . .
Logan: I like that idea, it’s cool we’re melding both of our goals into one, we’re focusing on both intervening and writing.
The circle graph for this date shows their efforts to construct these exit slips (data collection phase) and consider the focus for each intervention group (implications). While this was the last recorded PLC meeting, their end-of-year presentation for the faculty contained information about the impact on student learning in relation to both goals. Additionally, the CG7 teachers constructed and conducted a disposition survey to determine how their students felt about the intervention groups. Seventy-nine percent of all students agreed or strongly agreed that “teacher swap days were helpful in preparation for unit tests.” These teachers continued to implement this inquiry cycle in the following school year.

Discussion of the Patterns & Characteristics of CG7’s Engagement

Patterns. An examination of the circle graphs in Figure 1 shows that the CG7 PLC consistently engaged in multiple data phases and did so in an identifiable pattern. They were task-oriented with regard to both their inquiry foci: procedure writing (goal 1) and student thinking in relation to priority standards associated with units of instruction (goal 2). They implemented a cycle of assessment tool development, pre-assessment, analysis, derivation of implications for instruction, intervention, and post-assessment. This cycle occurred at least three times for goal 1: in the early fall (080911-080918-081002), mid-year (081211-090115), and at the end of the year (090409-090430) when goal 1 was merged into a cycle associated with goal 2 efforts related to the Energy, Machines, & Motion unit. The cycle was implemented at least four times in relation to the Human Body Systems (081010-081016-081023-081106-081113-090122)
and Catastrophic Events units (090129-090212-090219; 090312-090318). Given that we do not have records for all meetings, there may have been one or two additional cycles.

The pre- and post-assessments in each cycle served different purposes and were analyzed differently. Pre-assessments, in the form of exit slips, were developed in relation to the major ideas related to a given unit of study (e.g., cellular respiration). These were then used to identify students who had a good understanding and would benefit from an extended application of the unit concepts, and students who could benefit from an additional lesson related to one of the major ideas. Whereas the exit slips focused on student thinking, the post-assessments (unit tests) were used to assess the impact of instruction. This second analysis phase of their inquiry process provided opportunities for them to reflect on the impact of their activities in relation to student learning.

**Characteristics.** CG7 teachers were focused on student thinking and procedural skills from the onset of their first inquiry cycle. In their analytic conversations related to both goals, they used a document camera to share and discuss the nuances of specific student responses. This allowed them to negotiate meaning in student work and to make their learning expectations more explicit. Their pre-assessments, in relation to goal 2, consisted of exit slips specifically tailored to surface students’ understandings in relation to the priority standards, or sub-concepts, of a unit. They devoted time to defining and clarifying these sub-concepts, and to crafting prompts that would allow them a picture of student thinking as opposed to a simple sorting based on points earned from right answers. In search of efficiency, however, the assessments reflected their pre-determination of three specific learning expectations rather than a more open-ended assessment of students’ conceptual understanding. This constrained the potential for revealing other aspects of students’ thinking that might be problematic.

Their nature of their inquiry process as laid out in the five steps presented at the beginning of the CG7 section emerged as a result of their continuous and collaborative examination of the learning goals and students’ understandings, and a consideration of how to efficiently address student needs. The development of their pattern of inquiry was facilitated by dialogic interactions that were collegial rather than merely congenial (Nelson, Deuel, Slavit, & Kennedy, 2010), and characterized by an acceptance of experimentation and tentativeness. Their dialogue also shows an acceptance of the principal as a member of the group and her ideas received the same consideration as ideas ventured by other members. This collegial stance allowed them to question each others’ ideas, practices, and student outcomes in a non-defensive fashion, learning from their intervention group experiment and making changes based upon reflective discussion.

**Impact of contextual factors.** CG7 teachers faced the same school and district directives that confounded the inquiry process for CG6, yet were able to substantively and productively pursue their inquiry questions. They spent little time, if any, puzzling over CERA or SMART goals. In fact, they formulated two inquiry questions that simultaneously addressed the SMART goal parameters and incorporated the authentic interests of the group. We suspect that the previous year’s experience of three members with a strong leader experienced in facilitating thoughtful analysis of student learning data contributed to their capacity to stay focused.

The press from the school and district administration to show an impact on student learning did shape some of the characteristics of their analyses and implications. Seeking efficiency in addressing areas of underachievement narrowed their analyses considerably. We hypothesize that a more explicit focus on teacher learning and transformation of practice
grounded in analyses of student learning data would allow teachers to conduct a more nuanced and conceptual examination of students’ ideas.

Cross-Case Discussion and Implications

Given the current intersecting emphases on data-driven decision making in schools and collaborative teacher inquiry, understanding teachers’ engagement with student learning data to improve instruction is critical. The distinctly different patterns of the CG6 and CG7 PLCs’ engagement in data phases provide a clear indication that teachers’ understandings of and abilities to collaboratively gather, find meaning in, and make use of these data are variable. As such, the supports and resources that could benefit any given group need to be tailored to a group’s needs. While this seems as obvious as the need for differentiated classroom instruction, the professional learning experiences provided to teachers are too often in the form of general guidelines that teachers are left to adapt by themselves. We strongly believe that teacher leaders can guide and support their own PLCs in a productive inquiry process, given frameworks and ongoing opportunities to reflect on the problems and possibilities with other leaders.

The two PLCs in this study demonstrate the need for differentiated support. CG6 teachers’ activities from March through May show they knew the steps of an inquiry process, from data exploration through derivation of implications. Yet the nature of their engagement in data phases reveals little benefit to their understandings of students’ needs or to informing their instructional practices. The differences in the characteristics of each PLC’s engagement in the data phases are also notable. In their analyses of learning data, CG7 teachers shared students’ written responses across the group, and discussed details of students’ thinking. They explored ideas in relation to their own expectations and to their understandings of science content and goals. CG6 teachers infrequently looked at student learning data together. When they did, their dialogue was characterized by generating percentages of right and wrong responses per item. This is consistent with their stance of compliance toward external directives. It may also reveal unfamiliarity with how to analyze student learning data any differently. Teachers most commonly work with test scores, and use these mainly for summative purposes.

We have seen that teachers in PLCs often resist making student work physically available to all group members. The CG6 and CG7 PLCs help us understand other complications in the specifics of engagement in the data phases associated with an inquiry process. Moving through the steps of an inquiry process is qualitatively different than engaging in inquiry as “a way of being” (Jaworski, 2006, p. 197). CG6’s engagement was more the former, CG7 the latter. The patterns of each group’s engagement in data phases provide a useful contrast. CG7 frequently linked students’ thinking to past and future instruction, a new round of formative assessment, and learning expectations. Their movement through multiple inquiry cycles across the year and through multiple data phases within one meeting reveals how complex the interactions around student learning data can be. Their process gives us a picture of what is possible. However, when they derived implications from their analysis of student learning data, their ideas often were shaped by pre-determined ideas of where students needed further instruction rather than emergent from students’ responses. More importantly, the CG6 patterns and characteristics of engagement in the inquiry process provide an opportunity to consider the nuances of support that collaborative inquiry groups might require. There was no evidence that CG6 teachers were any less committed to collaborative work than CG7 teachers. The evidence does show that they were unsuccessful in negotiating a compelling inquiry focus grounded in their collective interests, buffeted as they were by directives upon which they were unable to build. When they did engage
in data phases, it was to accumulate the data needed for compliance with an accountability measure. Each group could have benefited from reflection upon the limitations and successes of their engagement in different phases of the inquiry process; the differences in their needs calls for differentiated facilitation or other supports that could push their inquiry to deeper levels.

The contextual factors at Cedar Grove show us that Hargreaves’ (2007) warning that the transformative potential of PLCs could become perverted by a focus on improving high stakes test scores is not unfounded. While we do not imply that the pattern of the CG6 PLC’s inquiry process was solely due to this, it is possible to see that their interpretation, at least, of district and school directives created pressures that paralyzed their inquiry process. They interpreted, and maybe rightly so, the environment in which they worked to be one of accountability rather than of learning (Firestone & Gonzalez, 2007). They sought ways to comply with directives that did not align with their own driving interest. As these same directives did not derail the CG7 PLC’s inquiry focus, we hypothesize that mitigating factors internal to the group existed. CG7’s relationship with the principal, their previous work with a lead teacher highly skilled in the collaborative inquiry process, and their more collegial interpersonal relationships may all be contributing factors.

We return to the definition of PLC work, compiled from lead teachers, presented at the beginning of this article:

*PLC work is an intentional, collegial, and dialogue-based collaboration amongst colleagues to improve student learning. It involves a cycle of identifying a common research question or inquiry focus, examining students’ work and identifying their needs, creating and implementing lessons or instructional strategies that can scaffold student learning, and continuously examining learning goals.*

What we have learned from CG6 and CG7 underscores the need to more explicitly provide guidance, resources, and support to PLCs about many of the concepts embodied by this definition. Characteristics such as intentional and collegial speak to how teachers interact when engaged in an inquiry process. Other components of this definition reflect processes that are complex, interwoven, and often outside a teacher’s realm of experience. Much of what teachers experience and do through collaborative inquiry goes against traditional school practices. We respect the efforts of the CG6 and CG7 teachers and hope our analysis of their work contributes to an understanding of the varied types of support that will make collaborative teacher inquiry professionally stimulating and potentially transformative for all involved.
References


<table>
<thead>
<tr>
<th>Data Phase</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Exploration (DE)</em></td>
<td>Brainstorming, wondering, proposing ideas for assessing student learning; may link to learning expectations, teachers’ content knowledge, prior experiences with instruction on specific topic.</td>
</tr>
<tr>
<td><em>Collection (DC)</em></td>
<td>Selecting, developing, or modifying tools for assessing students’ thinking; logistics for implementing, scoring, sampling; developing common assessment criteria; links to instruction, learning expectations, and content are directly related to the assessment tool.</td>
</tr>
<tr>
<td><em>Analysis (DA)</em></td>
<td>Occurs after data collected; making meaning about student responses; re-examining the assessment items or scoring criteria with respect to student responses and learning expectations; links to instruction, learning expectations, and content are directly related to students’ responses.</td>
</tr>
<tr>
<td><em>Implications (I)</em></td>
<td>Focused on future lessons/practices; informed by discussions in analysis phase</td>
</tr>
</tbody>
</table>

Table 1. Four phases of a collaborative inquiry process.
Figure A. Relationship amongst the four phases.
Figure 1. CG6 PLC’s engagement in data phases
Figure 2. CG7 PLC's engagement in data phases