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# Implementing a science-based interdisciplinary curriculum in the second grade: A community of practice in action*

**Meredith PARK ROGERS****
*Indiana University, Bloomington Indiana, United States*

**Abstract**

The purpose of this study was to explore the role that a collaborative teaching approach, referred to as a community of practice (CoP), had on a team of four second grade teachers' implementation of a science-based interdisciplinary curriculum. Data was collected in the form of extensive observation notes gathered over 10-weeks of twice weekly team meetings and two 45 minute interviews with each participant. From the field notes developed two vignettes for the purpose of illustrating the members CoP in action. Combining my analysis of the vignettes and the interviews resulted in three emergent themes: 1) benefits, 2) contributions, and 3) their commitment to professional development. From this study I learned that establishing a CoP was viewed as a necessary component of the team's implementation of their science-based interdisciplinary curriculum. Implications for encouraging preservice and inservice elementary teachers to develop CoPs to support science teaching, specifically interdisciplinary teaching, are discussed.

**Keywords:** elementary education; science; community of practice; interdisciplinary teaching

## Introduction

Elementary teachers' avoiding the teaching of science is not a new issue. Tilgner (1990) commented that the situation had not changed in 20 years, and in the decade since, there have been continuing reports along similar lines across the world" (as cited in Appleton, 2007, p. 496). Reports such as *Taking Science to school: Learning and teaching science in grades K-8*

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** Correspondence: Dr. Meredith Park Rogers, W. W. Wright Education Building 201 North Rose Avenue Bloomington, Indiana 47405-1006 812-856-8168 Email: mparkrog@indiana.edu

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(Duschl, Schweingruber & Shouse, 2007) and several Project 2061 publications American Association for the Advancement of Science, 1993) (Rutherford & Ahlgren, 1990; describe the need for consistent science learning in the elementary grades to begin develop students' scientific literacy. Yet, the problem remains, science is considered a second class subject in most elementary classrooms (Roden, 2000).

Some researchers have suggested that to promote the importance of elementary science, studies need to be conducted that examine different approaches elementary teachers use to teach science, such as an integrated curriculum (Raizen & Michelsohn, 1994; Roden, 2000; Tilgner, 1990) or collaborative teaching (Silva, 2000; Supovitz, 2002). It is both of these approaches that serve as the rationale for this study. Through extensive observations and discussions with a team of four second grade teachers, I have developed vignettes to illustrate their community of practice (Lave & Wenger, 1991; Wenger, 1998) and to understand the role their community served them in using science as an organizer for achieving a coherent curriculum. To explore this phenomenon further, the following four questions guided my research process:

1. What does this team's community of practice look like?
2. What role does the community of practice have in implementing their science-based interdisciplinary curriculum?
3. What does the community of practice offer each member with regards to their own professional growth?
4. What are the contributions of each member to the community of practice?

## Conceptual Framework

Lave and Wenger's notion of communities of practice (Wenger, 1998) guided my understanding of what it means when groups of people work collaboratively toward a common goal. In this case the goal was to achieve a coherent curriculum using science as an organizer (Park Rogers & Abell, 2006) and what I examined for this study was the inner workings of the team's CoP with respect to how it supported their enactment of this process.

The term "community of practice" (CoP) is grounded in social learning theory, but as Palincsar, Magnusson, Marano, Ford, and Brown (1998) pointed out Lave and Wenger never made any claims about the implications of their studies for constituting communities of practice; in fact they are probably bewildered by the ways in which we and others in education have appropriated their ideas in the service of implementing or developing such communities. However, regardless of Lave and Wenger's intention for introducing the notion of CoP there is a clear connection between its relevance in studying collaborative practices in educational settings in order to better understand teachers' instructional decisions and curricular implementation (Silva, 2000; Palincsar et al., 1998).

As Supovitz (2002) indicated, there are three key components to establishing a successful CoP in an education setting. “First, communities of practice mutually engage on the task at hand. Second, they communally negotiate the contours and focus of their joint enterprise. And third, they develop a set of shared repertoires to effectively address their work” (Supovitz, 2002, p. 1598). Regardless of the amount of time a CoP has been developed or the experience the members of a CoP have, these three components constantly are being refined and honed because each new situation presents new challenges.

Throughout our daily lives we move in and out of various communities that follow specific practices. These CoPs provide the “ideal situated contexts through which implicit and explicit meanings are appropriated and negotiated by members of the community” (Hung, Chee, Hedberg, & Seng, 2005, p. 160). The social networks of a CoP “[form] naturally and are informally bound by the work that people engage in together; they are self-organized, and memberships are based on participation rather than on official status” (Wenger as cited in Foulger, 2005, p. 3). When needed, meanings are negotiated among members based on the assumed understandings of the culture. Therefore, within the structure of a CoP, knowledge is constructed according to the group’s explicit and tacit understandings.

Wesley’s and Buysse’s (2001) comparison of a CoP to that of a learning organization provides support for how the concept of a CoP could be used within a classroom setting. Wesley and Buysse explained that a learning organization “emerges from a common desire among its members to achieve change (i.e., improve existing practices) [and] it provides regular opportunities for collaborative reflection and inquiry through dialogue” (p. 118). Because ongoing reflection and inquiry are also common practices of CoPs it can be said that CoPs can often naturally form within educational settings.

Wenger (1998) referred to participation as the process in which identities are constructed in relation to the community. Thus, the notion of a CoP provided me with a framework to understand each team member’s identity for participation and how their role contributed to the overall dynamics of the team in implementing an inquiry-based curriculum; an approach that was grounded in their beliefs and knowledge of teaching science as inquiry.

## Literature Review

There is a growing interest across many education disciplines with using the construct of CoP] (Lave &Wenger, 1991; Wenger, 1998) as a means to study the nature of establishing collaborative experiences in various teaching and learning situations. However, for the most part studies examining CoPs within science education are limited to studying the learning that occurs

through the use of CoPs in research teams (e.g., science laboratories) and professional development contexts (Palincsar et al. 1998). For example, in a research team setting Feldman, Divoll, and Rogan-Klyve (2009) explored characteristics of communities of practice through an apprenticeship experience between graduate and undergraduate studies working on an interdisciplinary scientific research project. What they observed were communities where participants had designated responsibilities thus each member played a pivotal role in the success of the community's scientific practice and ultimately their learning.

Within science education professional development contexts, CoPs are generally used as a method for trying to sustain changes in ideas and practice once teachers return to the classroom (Akerson, Cullen & Hanson, 2009; Lumpe 2007). For example, Akerson et al. (2009) employed the idea of a CoP to support teachers learning about NOS and the transfer of this learning to their instructional practice. What they learned was that "while developing a CoP is not sufficient on its own to improve teachers' views and practice related to NOS, it provides key supports to allow changes in NOS to be continued beyond professional development activities" (p. 22).

In both contexts, the purpose of CoPs was to structure support for learning a new idea and applying that idea to practice (teaching or the lab). Silva (2000) explained however, that educational research needs to move beyond using CoPs simply as a design method, but studying how it can be enacted in a practical sense at the classroom level as a part of teachers' reflective practice.

Manouchehri's study (2001) investigated this idea with two pairs of middle school mathematics teachers. She was interested in understanding what contributions each member of the pair brought to the CoP and how the peers felt their partner's contributions improved their teaching practice. One pair indicated some change in their professional practice after seven months of working together, the other pair did not. Manouchehri learned that an effective CoP requires effort from all members and that perhaps there needs to be some support or guidance during its initial development from an outside source (e.g., a lead teacher or principal). She also suggested the roles participants seem to naturally take on when participating in such a professional community are critical to the CoP's success and sustainability.

Silva's study (2000), while not specifically focusing on development of CoPs in science, provides a deeper understanding of the dynamics of team planning with elementary teachers. Her study looked at three teams of elementary teachers with very different demographics and experiences with designing an integrated language arts and social studies curriculum while under the leadership of a curriculum specialist. The purpose of Silva's study was to share the experiences these teachers encountered and describe how

each team made sense of the new integrated curriculum. Evidence from Silva's (2000) study suggests that "teams do not enact curriculum…Instead, teams become vehicles for curriculum decision making" (p. 292). Therefore, to develop a better understanding of team teaching at the elementary level, Silva suggested the need for gaining a deeper appreciation of the essence of teachers' experiences as part of a team, their beliefs, and their actions; in other words, their community of practice.

From this review of the literature one could conclude that when teachers are afforded the opportunity to work with colleagues, the quality of their teaching improves (Lumpe, 2007). Through the use of a CoP, teachers reflect with one another and are more willing to take risks in their teaching (Foulger, 2005). However, it is clear that further exploration is needed into the design and implementation of elementary CoPs at the classroom level. Therefore, studying the design and use of CoPs at the elementary level where science plays a critical role in the overall curriculum design would not only contribute to a scant literature base but may also help to address Roden's (2000) claim that change must occur at the elementary level to make science a first-class subject.

My study approaches this issue from much the same perspective as Silva's (2000) study – to gain the essence of this team's CoP experience through observing their interactions, and eliciting their own thoughts about their collaborative process. Therefore, the objective of this study was to record, interpret and share the experiences of four second grade teachers CoP; and in particular, the role of their CoP in helping them to achieve curricular coherency that is rooted in their knowledge and beliefs about teaching science as inquiry.

## Research Design

This study employs both a case study approach and method of analyze. According to Creswell (1998), "some case studies generate theory, some are simply descriptions of cases, and other are more analytical in nature and display cross-case or inter-site comparisons" (p. 186). For the purpose of this study, a descriptive case study was adopted as the goal was to discuss the four participants as a collective whole in order to understand the dynamics of the team's community of practice with regards to supporting their use of science for designing curriculum coherency.

### *Context of Study*

This study took place at an Elementary situated in a growing Midwest community. At the time of data collection, the total school population for this school was 465 with 86 students split among the four 2nd grade classrooms involved in this study. The total minority population was 24.5%.

In grades K-3 at this school the classroom teacher was responsible for teaching the core content areas of communication arts (literacy),

mathematics, science, and social studies. Students went to teacher specialists for art, music, and physical education and it was during this specialist time period that the teachers scheduled their bi-weekly team meetings.

*Teacher Participants' Background*

The four second grade teachers participating in this study were given the pseudonyms of Tracy, Brenda, Heather, and Nancy. I purposively selected these four teachers because of my various past professional experiences with three of them. Although I had not had any prior interactions with Nancy, she agreed to participate because of the focus on the team approach to interdisciplinary design. In addition to the four participating teachers, the school principal also contributed to the study by providing information on the dynamics of this teaching team in comparison to other teachers in the school, and the school's overall educational objectives.

At the time of this study, Tracy was in her 16th year of teaching. Over those 16 years she taught grades K-4, with the majority of her teaching time (11 years) at the second grade level. She explained that using an integrated approach to teaching had always played a significant role in her teaching practice, especially with her curricular design experiences during Drake's early years of following the *Basic School* (Boyer, 1995) model.

During the data collection period for this study, Brenda was in her 13th year of teaching. Similar to Tracy, Brenda had experience teaching several of the primary grade levels, although the majority of her teaching was split between two different schools teaching second or third grade. Brenda explained that the key to her teaching was to use an inquiry approach across all disciplines. Although she felt science and math lent themselves most easily to this approach, she also stated that the more comfortable she became with inquiry, she also found ways to apply inquiry-based practice to her teaching of reading and writing.

Heather had 14 years of teaching experience, all of which were in the second grade at Drake Elementary. She admitted that at the beginning of her teaching career that she preferred to teach mathematics, but over the years she grew to love and appreciate teaching science.

The fourth teacher of the team, Nancy had nine years of teaching experience at the time of this study with seven years at the second grade level at a school other than Drake, and two years as a Title 1 Reading teacher at Drake. Due to a cut in funding, the Title 1 position at Drake was removed, but the principal offered her a regular classroom position on the second grade team instead. Nancy believed that her main contribution to the team was her strengths in reading and writing, which was why she was selected to run the pullout reading program for the second grade students needing additional literacy support. This meant that she did not teach any of the science, but she still contributed to the team planning sessions and

taught other disciplines that were observed (reading, writing, and mathematics).

*Data Collection*

I observed and collected field notes in two different settings: 1) during team planning sessions, and 2) in individual teachers' classrooms. The team meetings were observed for 1½ hours each week for 10 weeks. They took place on Tuesday and Thursday afternoons and served two purposes. The Tuesday meeting afforded the teaching team the opportunity to reflect on what they had taught at the end of the previous week, how they had carried the learning forward during the current week, and what considerations they needed to make in adapting their teaching for the remainder of the week. The Thursday meeting acted as a checkpoint for the teachers; they often shared anecdotes about things their students said or did that may have shifted their thinking about their lessons for that week. Copies of handouts and schedules were collected at these meetings to support my analysis of these field notes.

The second setting for observation data was the teachers' individual classrooms. The purpose of these observation periods was to gather data on how the teachers connected the ideas discussed in their team meetings and implemented them into their individual teaching practice. I observed the teachers' classrooms during the same length of time as the team meetings (10 weeks). Overall, I gathered observational data on two and a half science units, but focused the majority of her data gathering on the first 6 weeks with the *Changes* unit, which examined changes in properties of matter and changes of state. During the final three weeks I spent the majority of my time observing the teachers' classrooms during reading, writing, and mathematics lessons. It was during these last few weeks that I had the opportunity to observe Nancy teach.

Finally, I used a standardized open-ended interview protocol (Patton, 2002) as a second source of data. I conducted a single open-ended interview protocol with the principal before beginning the 10 weeks of observation for the purpose of gathering background information and to establish the context for the study. I also conducted two interviews with the teachers, one at the beginning and one at the end of the 10-week observation period. The questions in the first interview asked the teachers to describe past teaching experiences, their goals and methods for designing their curriculum, and the role of science in this design. The second interview protocol focused on how their approach to teaching science influenced their teaching of other subjects, and the role that their team teaching approach had on enacting their interdisciplinary design.

*Data Analysis*

As a result of having employed case study method for data analysis, various themes emerged in response to the response to the four research questions. An integrated mode of examining these themes across participants' stories resulted in developing a rich description of their shared experience (Patton, 2002). Using a single case study approach for data analyze afforded me the opportunity to examine and report on these teachers experiences as a unit rather than individually. The unit of analysis for this particular study was the team, with each member of the team contributing to my understanding of their community of practice. This method of data analysis assisted us in staying focused on the purpose of the study, which was to examine the role of team planning in developing the team's shared understanding (Supovitz, 2002) of what it means to teach inquiry-based science and use this understanding to design a coherent curriculum.

Following the observations of the team meetings and the *Changes* unit, I wrote preliminary thoughts about the emerging themes observed in Tracy's, Brenda's, and Heather's instruction. This act of reflection (Wolcott, 1995) allowed me to begin bracketing my personal views about developing a community of practice and made me aware of the team's unique dynamics and the specific roles each member contribute to their community of practice.

I employed a content analysis process on both the field notes and the interviews, a technique often associated with case studies. The content analysis process was inductive in nature and involved two phases: 1) aligning the teachers' responses from what I observed and what the teachers stated in both sets of interview questions to the four research questions and 2) reviewing the teachers' responses for patterns that we could then develop into assertions to answer the research questions. Because this paper is part of a larger study, I focused my coding of interview data to comments that focused only on the role of team planning and I focused my analysis of the field notes to the team meetings mainly, using the observations of individual classroom teaching as a confirmation (through implementation) for what was discussed in the meetings. From my content analysis of the field notes and the interview data, three themes emerged: benefits, contributions, and commitment to professional development.

The vignettes described in the next section address research question one mainly, as they depict two sample team meetings illustrating the team's planning strategies and interactions with one another. Following the vignette section, in the findings and interpretations, I discuss how the theme of benefits addresses research question two and three and the theme of contributions refer to research question number four. The final theme, commitment to professional development is also discussed with respect to

how the teachers' view the role of professional development in developing their community of practice, but is not related to one specific research question.

**Setting the Stage: A Window into Team Meetings**

Brenda, Tracy, Heather and Nancy met regularly twice a week for an hour during their shared planning time on Tuesday and Thursday afternoons. The following two vignettes are representative of a typical Tuesday and Thursday meeting. They illustrate the role of each member and the kinds of conversations one could expect to hear during these meetings.

*A Tuesday Afternoon*

It is 2:30 and the second grade teachers are gathered in Nancy's classroom at her small group meeting table. They have their planning binders laid out in front of them and they are looking over what they have scheduled for the week.

Brenda initiates conversation with the question, "So tell me what you have been doing with writing?" Nancy is the first to respond, saying that she used the read-aloud book they have been discussing in class to look at the detailed style of writing the author used.

The team had participated in a book study the previous year that looked at Lucy McCormick Calkins' and Abby Oxenhorn's (2003) book *Small Moments: Personal Narrative Writing*. Each teacher was using the strategies from this book with their students. For example, their students select something they do in their daily life and write about that event. The goal is to have the students to go from a broad discussion of the daily event to a narrowed and detailed description of a brief moment within the event.

Nancy directs the conversation to publishing. For this piece of writing she wants the students to focus most of their time on revision writing rather than rushing to illustrate. So she is considering having her students complete a page that is folded in thirds instead a full booklet. She believes this will make the students focus on writing concisely and will leave less blank room. Heather says that she likes that idea because she was also thinking of making the illustrations more of a side item in order to keep the students' focus on improving their writing. However, she was thinking of having her students publish their small moment into a small booklet instead. Brenda says she is still in the brainstorming phase of writing with her students and that they have not really caught on to the significance of the detailed writing that is needed to go from a broad concept to a small moment. She has not yet thought about how they are going to publish their writing but asked to see some examples from Heather's and Nancy's students when they are finished.

As everyone else talks and shares their ideas Tracy writes in her planning binder on this week's schedule. She takes advantage of a brief

pause in the conversation to say to her colleagues that she is having similar difficulties as Brenda and that she feels better knowing she is not alone. She too wants to place less emphasis on illustrations and have the students focus more on the publication of their writing. She asks Nancy and Heather if she can photocopy the booklet formats they are considering using with their students to help her think about what she might want her students to do.

They all take a moment to write some notes down on their weekly plans. During this time the conversation starts to go off topic from planning their writing lessons to stories about their students. But Brenda brings them back on task by asking Nancy, "So what are you going to do again in writing tomorrow?" Brenda asks Heather the same question and Heather looks back and forth between Tracy and Brenda as she explains how she is helping her students to move their small moment revisions forward.

Nancy interjects with a question about the writing prompt assessment that they need to give their students next week. Tracy suggests doing it on Monday so they can get it over with at the beginning of the week and not have it interfere with the rest of their week. Brenda, Heather and Nancy all agree that this is a good idea. They block off the writing period for the assessment that day.

Tracy has to leave to pick her students up from the counselor. Nancy, Brenda and Heather stay for another 20 minutes to talk about some other lessons they have used since last Thursday and how they plan on building from those lessons for the remainder of this week.

Next the teachers start talking about the strategies they are working on with their students during Making Words. This is equivalent to spelling time in traditional classrooms. These teachers pull words from the content areas that follow similar spelling patterns and that students frequently encounter in their reading, writing, and speech. Heather shares a lesson where she used the story *Bubbles Popping* as a word study about combinations of long ā sounds. She says that she selected this book because it discussed a lot of the same ideas that the students were experiencing in their science unit. In particular she described an activity with an Alka-Seltzer tablet where the students observed different ways to dissolve the tablet at different rates. She explains that the book reinforced some ideas about dissolving while also introducing students to a more extensive vocabulary they can use when recording evidence in their science journals.

This connection between science and reading leads the teachers into a conversation about predictions. They share with each other different strategies that they are using in science to help the students develop predictions. They want to extend this beyond science and find ways to help their students become more comfortable with taking risks in making predictions in other content areas as well (e.g., reading response journals

and math discussions). After a few minutes of sharing different techniques that each of them use, they pause to write some ideas down in their planning binders.

Heather asks Brenda how her science class went that morning because she remembered from their last meeting that she was having some difficulties getting her students to develop questions. Heather asks, "Did they ask any questions? I am thinking I want to do the guided inquiry on Thursday prior to the ice experiment because my kids have started asking some interesting questions and I think they ready to begin a more open inquiry approach." Brenda explains that her students' questions are starting to get better, but that she ran out of time to ask them about their questions so they will not be ready for a more student-directed inquiry on Thursday. Heather says she might go ahead and start a more open approach to inquiry with them on Thursday anyway, rather than doing the next lesson in their *Changes* science unit.

At 3:20pm they start to wrap things up because Brenda, Nancy and Heather have to go pick up their students from the specialists and get them ready to for dismissal at 3:45pm. They each make some last minute notes in their planning binders. On their way out of the room, they discuss different materials that they would like to borrow from each other for the remainder of this week.

*A Thursday Afternoon*

It is 2:40pm and once again the four second grade teachers are gathered in Nancy's classroom around a small group discussion table. The conversation begins with Brenda saying that she is planning on doing her writing prompt preparation with her students tomorrow for their assessment on Monday. Nancy chimes in, saying that they started some of this preparation today. She describes the team the mini-lesson that she did with their students. Brenda then asks Heather what she did in writing today, Heather explains that she started some prompt writing today, but she is going to focus more on it tomorrow.

Tracy directs the conversation back to the small moment writing that they were doing at the beginning of the week. She explains that she has not had a chance to start this writing with her students. She is having difficulties getting her students to think from the broad concept to the more narrowed topic of a small moment. She has been thinking about how the others are approaching this writing style and that she is going to take a slightly different approach next week. For example, Nancy had her students focus on the sequence of writing what occurs in a small moment, but Tracy does not want to separate the show and tell part of the writing from the sequencing because this may be where some of the problems are coming from. She wants to try incorporating both sequencing and show and tell writing together.

After a brief pause, Tracy changes the topic from writing to math. She explains to the others that she wants to start working with some of the ideas from Chris Confer's (1994) book *Math by All Means: Geometry, Grades 1-2* to supplement the district's text. Tracy says she really likes the hold and fold activity that Confer suggests because it helps to develop students' math vocabulary. Brenda says that one of her favorite activities is *Rocket Discovery* because it deals with shapes within a shape. Tracy concurs. Heather and Nancy like the idea of using this book. They suggest some other books that they could connect the literacy and math pieces. One of them raises the idea of using the book *Cloak for the Dreamer* (Friedman, 1995) because of the discussion about shapes in the cloak design. The math planning conversation ends with talk about using ideas from Confer's book to decorate their classroom bulletin boards with a geometry theme.

While everyone takes a moment to write in their planners, Tracy changes the topic to science. She initiates this discussion with an explanation that the *Changes* unit they have been studying in science is meshing well with their reading she is having her students look for changes in story lines.

Brenda reminds Tracy to save the water from the ice melting activity from the *Changes* unit to use for the evaporation activity next week. Tracy responds, "O.K. Are you planning on moving forward with some discussion on the water cycle for a couple of days next week?" Brenda replies that she thinks they will take all of next week to cover the water cycle.

Brenda, Tracy and Heather discuss different books they can use to connect to the water cycle ideas they are going to be studying in science. Tracy says that she wants to begin her reading with fictional books that have elements of the water cycle in them. As they progress with their study of the water cycle in science, she will draw connections between the stories and the science concepts.

At this point all four teachers examine their reading books and begin to brainstorm how they can connect the books with the remainder of the *Changes* unit. They find a couple of books that focus on character change. They talk for a few moments about how the idea of character change could be incorporated into reading and the small moments writing. This conversation carries on for about 10 minutes, until one of them realizes it is 3:30pm. They quickly pack up and go their separate ways to pick up their students to get ready for school dismissal at 3:45pm.

## Findings and Interpretations

According to these teachers, regular team planning sessions were a necessary part of their teaching practice. Based on our analysis of the data, we assert the following three claims as critical pieces to this team's vision and development of their community of practice. First, the teachers believed the benefits of team planning outweighed the time spent; second, they

valued the unique skills each member contributed to the group and as a result felt their teaching was stronger as a collective unit rather than individually; and third, each of them was committed to the idea that teachers need to be continually involved in professional development. For this team of teachers the bi-weekly team meetings were one way of ensuring they met this need for continuous professional growth. These three assertions are elaborated on below with embedded data provided to support each claim.

*Benefits*

For some teachers having only a couple of planning periods a week is not enough time to do all they have to do, so using the little planning time that they have to meet with other teachers may seem counterproductive. However, the members of this teaching team said just the opposite. For example, Tracy (Interview 1) explained that "without the team our approach to teaching would look very different, because I would be responsible for pulling everything together myself". Tracy seemed to suggest that the team approach actually saved her time and helped her to implement the inquiry-based curriculum she felt fit her teaching philosophy. The team meetings were not a burden on these teachers' time, but the most efficient way for them to gather new ideas and resources for their teaching.

Besides the time factor, these teachers described the support they give each other as another benefit of their twice weekly team planning sessions. They described the purpose of the planning sessions as a constant check-in for them to make sure that they were staying true to their curriculum, meeting their objectives, and addressing the needs of their students. According to Brenda, having the opportunity to meet regularly with her grade level colleagues ensured that she was reflective in her teaching practice.

> It is very beneficial whenever you can sit down together and brainstorm and figure out – O.K., this is working but this is not working out. Ask each other "Did this happen to you when you were doing this?" "Think about trying this whenever you are doing this lesson". Just having the time to talk things out is important. (Brenda, Interview 1)

In addition to encouraging reflection on their practice, the regular meeting times gave teachers the support they needed to take risks in their teaching and refine their ideas before putting them into practice. Heather commented on this when she said, "Having the team support allows you to try different things and take risks in our teaching. If you are alone you want to feel safe and secure, so instead of branching off with different ideas you may resort back to the manual more often". Brenda (Interview 1) noted, "Teachers get better at teaching when they work as a team. Learning goes up when you are asking questions, talking and problem-solving with others".

In summary, these teachers felt that their weekly Tuesday and Thursday meetings provided them with benefits that they could not get on their own. The meetings encouraged them to be reflective about their teaching practice, they provided an outlet to talk through problems and share strategies that worked, and increased their accessibility to resources (e.g., materials and teaching ideas). Overall, these teachers viewed their scheduled time together as a benefit rather than a detriment to their teaching practice.

*Contributions*

As the newest member of the team, Nancy described the collaborative atmosphere of the second grade teachers as a vital part of her success in returning to the classroom after several years as a reading specialist. Nancy acknowledged that, "Without this team I'd be struggling more and would feel isolated. I wouldn't be as reflective with my teaching nor would I be as willing to experiment with different teaching practices". She went on to say, "This team is rare. We are well matched with respect to skills, we value each other's strengths, and our personalities get along; we believe in each other professionally and personally" (Nancy, Interview 1).

I asked each teacher to describe her contribution to the team. In each case they identified a different attribute. However, each of them explained that the reason they valued their planning time together was not because of what they offered but because of what they gained. As Brenda (Interview 1) noted, "Just having the time to sit with three other experts that will help me plan things out is invaluable."

Because of the respect they showed for each others' expertise, I asked them to describe the contributions they felt each of their teammates offered. I learned that each person plays a specific role on the team. For example, Brenda's teammates described her as a manager, because she often initiated the discussion at the team meetings, kept the conversation on task, and was the first to provide suggestions when a teammate had an instructional question or problem. Tracy was identified as the person who made curricular connections across the content areas. Yet similar to Brenda, she often would initiate the team's conversation with curriculum questions. Serving a slightly different role, Heather was acknowledged as the organizer of the group, because she often took notes about their discussions and reminded them of special dates they needed to mark in their calendars (e.g., test dates and Grandparents Day). Under Heather's title as organizer, she was also a resource person for different lesson ideas, especially those that integrated the disciplines. Nancy's expertise was undoubtedly her experience as a Title 1 Reading Specialist. Therefore, Brenda, Tracy, and Heather all agreed that since science and mathematics were their strengths, Nancy's literacy background was a much-welcomed addition to the team.

Looking back at the two vignettes, one can see why these teachers identified each other with those particular characteristics. For example, in both vignettes Brenda initiated the conversation and managed the conversation to ensure that everyone had an opportunity to share what they were doing, ask questions, or simply comment on someone else's story. From time to time she also took responsibility for bringing the conversation back on task. For example, in the Tuesday Vignette, when the team started to go off task about planning their writing, Brenda redirected the conversation with a question to Nancy. Brenda asked, "So what are you going to do again in writing tomorrow?"

Tracy's role as curriculum connector was illustrated in the Thursday Vignette when she shared the connection between idea of changes they were studying in science and how she was having her students look for changes in storylines in reading. In this case, Tracy drew from two different experiences to share with her teammates how her students were grasping the concept of change because of the connections she made in both disciplines.

During the first vignette, Heather's role as team organizer focused more on her position as a resource provider. For example, Heather shared a lesson with her teammates in which she used the book *Bubbles Popping*. Throughout her description of this lesson, she explained how she used that book to connect to experiences the students had with the Alka-Seltzer activity in science, as well as how students used the vocabulary from that story in their science journals. A little later on in the Tuesday vignette, Heather's organization skills were revealed once again when she referred back to a previous meeting and asked Brenda if her students were starting to develop any of their own inquiry questions. This question served two purposes for Heather: 1) she wanted to check back in with Brenda to see how she was progressing with her students, and 2) Heather planned ahead for her own lessons and wondered about division of materials with Brenda's and Tracy's classes.

Not only did Nancy's teammates view her expertise in literacy as a valuable contribution to the team, but Nancy explained that it gave her a different perspective with which to consider how an inquiry-based approach to teaching meshed with disciplines other than science. She said,

> Because I am not a scientist when I think of inquiry I see it through the lens as a reader or a writer. I see the same [inquiry] skills used in science also used in literacy, but I look at it from a writer's perspective. So for example with poetry, what does inquiry look like in poetry? So bringing out a question for the [students] and then having them go investigate what things they are noticing as a writer. Then having them come back and collaborate and talk about it as a group, what things they are noticing and sharing these…So I guess my perspective is a little bit different from the others. (Nancy, Interview 2)

Because of this different perspective, most of Nancy's participation during the team meetings involved asking questions. Also, since she did not teach the science curriculum, she focused much of her discussion on reading, writing, and mathematics. She contributed to the geometry discussion in the Thursday Vignette when she and Heather suggested using the book *Cloak for a Dreamer* (Friedman , 1995) in reading at the same time they were doing the geometry unit in mathematics.

I observed these teachers portray consistent roles throughout the 10 weeks that I visited their team meetings. When they discussed classroom and curriculum issues, Brenda usually initiated the conversation, Tracy made curricular connections, Heather organized their plans for action with taking notes and distributing resources, and Nancy probed her teammates for their ideas and suggestions, as well as offered her assistance with literacy connections. Although their time together was informal and fun, it was also productive because each member came to the table prepared to ask questions and share ideas.

*Commitment to Professional Development*

This team's dedication to professional growth was something that was evident throughout each team meeting. There was several times throughout my 10 weeks at Drake Elementary that I heard these teachers refer to strategies they had read about in a professional book study or learned about in a workshop they had attended. For example, the team used writing strategies described in the Calkins and Oxenhorn book (2003) *Small Moments: Personal Narrative Writing* when they were planning for their next writing lesson. All four teachers were familiar with this book because they had studied it in their school's professional book club the previous year. The principal explained that participation in book clubs was voluntary, but often all four members of the second grade team took part. This reflects their orientation toward teaching as one of continuous learning.

For these teachers, professional development was an integral part of their teaching practice. According to both Tracy and Brenda, it was important for all teachers to think of their own learning as much as their students'. For example, Brenda (Interview 2) said,

> I think that it is really helpful [for teachers] if [they] are doing some kind of, not necessarily coursework, but something where [they] are reading, and have a group of people that [they] can talk with. For me it was coursework because that is what I love, but you know a book study or something like that [also works].

In these teachers' minds, the time they spent together was just another form of professional development. The twice weekly meetings gave them the opportunity to gather ideas and resources just as in any other professional development program outside of their school. Because of their like-minded

commitment to professional development, they viewed each other as professional resources for their teaching.

**Discussion and Conclusions**

For this team of teachers, team planning was not a requirement mandated from the outside; they deemed it necessary for successful implementation of their inquiry-based approach to a connected and coherent curriculum. They viewed second grade at Drake Elementary School not as four separate classrooms, but as a single unit which they facilitated as a teaching team. Their team approach served an important role in their instructional approach and offered several benefits to their teaching practice. Their community was defined by their individual contributions to the team's collaborative practice, which Manouchehri (2001) also noted in her study is a critical component to any CoP's success and sustainability. The third finding from this study, each member's commitment to professional development, provided some explanation as to how the team's understanding of inquiry-based science developed and was mutually agreed upon by each member of the community as the foundation for designing a coherent curriculum.

The conceptual framework informing this study was Wenger's (1998) notion of communities of practice (CoP). Wenger's description of a CoP was comprised of four components: community, meaning, practice, and identity. For the purpose of this study we do not discuss all these aspects of CoP. Instead we have chosen to elaborate two of these components – the teaching team's *practice* and how they generate *meaning* within their community. These two components were most clearly illustrated through the findings of this case study.

First, we focus on Wenger's description of practice in a CoP. Wenger stated that as "we interact with each other and with the world and we tune our relations with each other and with the world accordingly. In other words, we learn" (p. 45). Wenger explained that a CoP cannot withstand time if it is solely developed because a job requires it. Brenda, Tracy, Heather, and Nancy came together to learn from one another, and therefore formed their own CoP. For them teaching was not only a way to earn a living, but a passion. It was this team's sense of passion for teaching that constituted their community of practice.

The teachers' concept of practice was an experience that included both explicit and tacit meaning. Their views of *how* to design inquiry-based lessons was something they explicitly discussed at their twice weekly meetings, but their shared view of *what* constitutes inquiry-based instruction was implied within their community of practice.

Wenger (1998) stated, "Practice is about meaning as an experience of everyday life" (p. 52). To elaborate on this statement he argued that 1) meaning is located in a process called the *negotiation of meaning*, and 2) this

negotiation involves the interaction of two processes called *participation* and *reification*, which form a duality fundamental to the nature of practice. The teachers in this study were engaged in the process of negotiating meaning each time they met, whether it was during their scheduled team meetings or impromptu conversations over lunch. Any given school day, these teachers were faced with various questions or problems requiring a negotiation of meaning based on both the explicit and tacit understandings of their CoP.

Wenger's second argument about participation and reification looked at the process of how a CoP negotiates meaning. He described participation as sharing an experience with others in an activity or enterprise; therefore suggesting participation requires "both action and connection" (p. 55). Reification is a process that Wenger claimed is central to every CoP. He defined reifying as taking something (e.g., an experience) that is abstract and making it into something (e.g., a meaning) that is concrete. Using a wide range of reification processes (e.g., making, designing, representing, describing, perceiving, and interpreting) "human experience and practice are congealed into fixed forms and given the status of object" (p. 59). Wenger described the participation and reification as a duality rather than opposites.

With respect to this study, the teachers' participation and processes of reification played an integral part in the negotiation of meaning for their CoP. For example, based on their participation (action and connection with one another) and reification of such abstract concepts as inquiry and curricular connections, they developed a set of practices unique to their community.

Regarding Silva's (2000) findings on team teaching, the duality between participation and reification in the negotiation of meaning for a CoP plays an important role in how a curriculum is implemented. With regards to the team in this study, the characteristics of their CoP (e.g., commitment to professional development and individual expertise) guided their processes of participation and reification. In turn this led to both explicit and tacit negotiation of meaning about designing and implementing an inquiry-based coherent curriculum.

## Implications

The findings from this study have implications for educators working with both preservice and inservice elementary teachers. From this study we have learned that regardless of the number of years of teaching experience, all teachers need to seek ways to develop professional collaborative relationships as they can play a critical role in their own reflective practice. This can be especially important for elementary preservice teachers just learning to teach science as they often do not feel confident teaching science. Requiring them to establish these kinds of relationships as students in their science methods classes may encourage them to look for similar

relationships with colleagues during their induction years and onwards. The development of a CoP that includes both new and experienced teachers may help to foster a more consistent inquiry-based science program throughout an elementary school. With regards to inservice teachers, many of the benefits discussed by the teachers in this study may benefit any experienced teacher. It is always important for teachers to challenge their own learning, and this is especially true for teaching science. The National Science Education Standards (National Research Council, 2000) refers to quality science teaching as being inquiry-based. This kind of curriculum requires teachers to think beyond the cookbook steps of a textbook and engaging in questioning and exploration with their students. As the teachers in this study explained, a CoP offers a safety net for teachers to question, debrief, and reflect with colleagues so they will be more willing to take the risks that an inquiry-based approach to teaching science sometimes requires. Finally, there are also implications from this study for school administrators. For science to be valued in elementary classrooms, administrators need to learn first-hand the instructional strategies teachers are learning in professional development so they will give them the support (e.g., time to meet collaboratively) that they need to design and implement quality curricula that includes science.

This case study contributes to the current body of literature on improving the quality of elementary science instruction. According to Roden's (2000) statement that science is viewed as a second-class core subject in elementary classrooms, it is clear that there is a need for providing classroom teachers with practical solutions for incorporating more science into their curriculum by drawing from the resources around them. The CoP these four teachers had developed demonstrates the possibility for quality science in elementary classrooms when planning and implementing instruction for all subject areas that mirrors inquiry-based science teaching.

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**Biographical Statement**

**Meredith Park Rogers** received her Ph.D. in Curriculum and Instruction, with an emphasis in Elementary Science Education, from the University of Missouri in 2006. She is currently an assistant professor of science education at Indiana University and oversees the elementary science education program. Her research interests include teacher knowledge, pedagogical content knowledge specific for teaching elementary science, and approaches to improving teacher professional development.

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