

Challenges Encountered in Building a University-High School Collaboration: A Case Study

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Abstract

In this paper, we describe the second year of a multi-year project that we developed to foster collaboration between high school teachers and university undergraduates. The project incorporates specific tools that help partners find an approach to collaboration that is right for them, allowing it to offer more flexibility than traditional collaborations (e.g., cooperating teacher-student teacher relationships). We analyze the partnerships that developed through the theoretical lens of communities of practice and find that they did not exhibit many of the characteristics desirable in such communities. We discuss the factors that contributed to this and suggest changes and offer guidelines for those interested in facilitating similar projects.

“Collaboration in education is not a frill: it is an essential component of our practice” (Speer, 2012, p. ix). As indicated by the opening quote, collaboration is a critical part of education that has the potential to “counter teacher isolation, improve teacher practice and student learning, build a common vision for schooling, and foster collective action around school reform” (Achinstein, 2002, p. 421). Collaboration between teachers is an alternative to a traditional, top-down approach to professional development. Instead of receiving information from an external expert in a single session, teachers co-construct knowledge through sustained activities grounded in their practice (Clausen, Aquino, & Wideman, 2009; Musanti & Pence, 2010; Parks, 2009).

In addition to collaboration between colleagues within a school or district, there is also an ongoing movement toward collaboration between institutes of higher education and K–12 schools as a means to bridge the gap between research and practice (Buysse, Sparkman, & Wesley, 2003; Ravid & Handler, 2001; Sim, 2010; The Holmes Group, 1990). The National Council of Teachers of Mathematics (NCTM) (Arbaugh et al., 2010) issued a report in this regard stating that “research and practice communities have much to contribute to each other’s work; it is only through working in tandem that we can make a concerted effort to improve mathematics teaching and learning in the United States” (p. 6). We can see further evidence of this effort in granting agencies’ requirements for collaboration with practitioners (Buysse et al., 2003; Ravid & Handler, 2001; Sim, 2010). However, there can be difficulties in building and sustaining such partnerships, stemming from the different norms and demands in universities and in K–12 schools; distinct perspectives and knowledge bases of the various stakeholders; power relations; conflicting reasons for involvement; and failure to establish trust among participants (Adamson & Walker, 2011; Barnett, Higginbotham, & Anderson, 2006; Buysse et al., 2003; Sim 2010).

Therefore, identifying characteristics that contribute to the successful navigation of these challenges in a way that can lead to lasting and productive partnerships is crucial (Parks, 2009).

In this paper, we study the formation of collaborations guided by the concept of *communities of practice* (Wenger, McDermott, & Snyder, 2002). Prior efforts concerning communities of practice have involved practitioner professional development (e.g., Musanti & Pence, 2010; Palinscar, Magnusson, Marana, Ford, & Brown, 1998); preservice teacher field placements (e.g., Sim, 2006); collaborations between universities and K–12 schools (e.g., Sim, 2010); and studies conducted in partnership with university and school personnel (e.g., Buysse et al., 2003). The collaborative effort described here is the second iteration of a multiyear project designed to bring together university faculty, undergraduate students, and high school teachers; the first year was described in Spice and Quebec Fuentes (2011). The project integrated professional development with respect to the teaching and learning of mathematics, preservice teacher field experience, and research with the purpose of examining how partnerships between undergraduates and teachers developed.

In what follows, we describe the theory underlying the establishment of the collaborations as well as their development. This time, the partners did *not* develop successful collaborations leading to professional growth. We examine the characteristics of the partnerships that did form through analysis of the data gathered in the course of the study. We close with observations derived from these data about characteristics that are critical for the development of communities of practice and recommendations for how best to foster them.

Literature Review

Wenger et al. (2002) define communities of practice as “groups of people who share a concern, set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (p. 4). Such communities represent a fundamental change in the learning process, moving the focus from the thoughts of an isolated individual to the interactions of a group (Buysse et al., 2003), so that “learning is viewed as distributed among many participants within the community in which people with diverse expertise (i.e., experts, novices, and those in between) are transformed through their own actions and those of other participants” (Buysse et al., 2003, p. 266). This emphasis on *distributed expertise* (Pugach, 1999) marks a shift from an environment in which one group (e.g., university faculty) produces and disseminates knowledge and another (e.g., practitioners) consumes it, to an environment in which knowledge is *co-constructed*, with different groups offering contributions from their varying perspectives (Palinscar et al., 1998). Pugach remarks that a critical function of communities of practice is to involve parties with a variety of experiences and expertise, which can result in multiple layers of learning (e.g., university faculty learning from practitioners and *vice versa*, practitioners learning from pre-service teachers and *vice versa*).

Although communities of practice vary in function and form, each involves the interaction of three essential components: “a *domain* of knowledge, which defines a set of issues; a *community* of people who care about this domain; and the shared *practice* they are developing to be effective in their domain” (Wenger et al., 2002, p. 27). The *domain* provides a common purpose that supports the participation and learning of the members within the social context of the *community*. A sense of respect and trust must be established so that members feel comfortable sharing their ideas and listening to those of others (Palinscar et al., 1998). In the pursuit of learning within the established domain, the

shared *practice* represents the jointly generated knowledge and the means for co-constructing it—for instance, a common pedagogical language for discussing and sharing ideas.

In her review of the literature, Sim (2010) identified four underlying features of communities of practice: (1) knowledge generation is a collaborative process, (2) understanding interacts with practical experiences, (3) sharing of this emerging understanding transpires in the practice environs, and (4) critical reflection occurs through communication. Clausen et al. (2009) similarly reviewed the literature but expanded their examination to incorporate the different types of learning communities, including communities of practice. Clausen et al.'s analysis resulted in the identification of 10 common features of learning communities:

(1) there exists within the community a constructed understanding of reality and learning; (2) the community is driven by a shared goal or purpose; (3) informal power is shared amongst community stakeholders; (4) flexibility is created within the organizational structure; (5) through a balance of support and pressure, formal leaders show long-term commitment; (6) there is an open communication channel; (7) there is a group memory; (8) in-servicing becomes ongoing and internal; (9) teachers begin to think in collegial terms; and (10) a culture of trust and respect exists among stakeholders. (p. 445)

Clausen et al. (2009) evaluated the development of a learning community in light of the aforementioned 10 characteristics, noting whether each was evident at the outset or developed later. Some characteristics that were present at the beginning also developed further throughout the collaboration. For example, a constructed understanding of reality and learning and a shared goal or purpose were originally a response only to top-down directives from the principal but later evolved to the point that the participant teachers took shared ownership of their goals and learning. Overall, Clausen et al. found that not all of the characteristics needed to be present at the beginning of the collaboration; some could develop during the collaboration or possibly be absent entirely (e.g., the viable learning community that they observed *never* developed a group memory).

Fullan (2000) claims that there is not a lot of research about “how learning communities are *established and maintained*” (Clausen et al., 2009, p. 451). Clausen et al. examined a learning community that successfully developed. In contrast, the nascent community of practice described herein *failed* to thrive. Therefore, the purpose of the present paper is to examine this attempt at building a community of practice in light of the features of learning communities identified by Clausen et al. and Sim (2010). In particular, we address the following overarching question: Which features are essential for the development of a community of practice? Or, from the perspective of our limited success: Which features were missing at the beginning and/or were *not* satisfactorily developed in the course of the partnership?

Methods

We led and studied a program guided by the concept of communities of practice that paired university undergraduates with mathematics teachers from a local public high school. A central component of the successful development of a community of practice is the establishment of shared goals and purposes. We set up the program to provide an open-ended environment in which we hoped a high school teacher and college undergraduate could discover areas of need that they could

addressed *jointly*, combining a real-world, practical perspective with a thoroughly up-to-date academic perspective. This requires constant, open communication, both internally (through participants' reflection on their own and their partners' practices) and externally. Built-in tools simultaneously allowed us to foster this communication and to gather data for our ongoing study.

Setting and Participants

The program involves collaborations between multiple stakeholders. The researchers (one mathematician and one mathematics educator) are faculty members at a private university in a large urban area in the Southwest United States and represent two different colleges within the university. The university has long had close ties with the local public high school and recently formalized this relationship through the development of an educational partnership. The partner high school prides itself on being academically rigorous. For instance, the mathematics course offerings range from traditional high school mathematics courses (e.g., Algebra I) to typical college mathematics major courses (e.g., Linear Algebra). For the traditional high school mathematics courses, teachers are expected to closely follow district-wide curriculum frameworks. Students take common course assessments, coordinated with the frameworks, every six weeks.

The focus of the present study is the partnerships between the university undergraduates (Valerie and Wendy) and the high school mathematics teachers (Sam and Ted). (All names are pseudonyms.) We provide here a brief description of each of the participants. In the findings section, we will further explore the nature of the collaborations that developed and will offer an in-depth look at the influence that the participants' backgrounds had on those collaborations.

Sam and Ted both came from industry. Sam received an undergraduate degree in mathematics and found his knowledge of geometry particularly useful while working in the oil field. After about a year in this position, he pursued alternative teaching certification. He joined the faculty of the partner high school and, at the time of the program, was in his fourth year there. During these four years, he had always taught on-level or honors geometry. He also taught summer preparation courses for college entrance exams.

Ted received a doctorate in electrical and computer engineering, originally intending to teach at the university level. However, as he put it, "industry lures you away," and he wound up working on circuit design for two high-tech companies. While in industry, he continued teaching and planned to turn this experience into a full-time career upon retirement. After leaving his second industry position, he decided he was "just going to go ahead [and teach]." Since he did not "want to fight a five-year tenure battle at [his] age" and felt that "there was zero money in teaching" at a small college, he decided to teach at the high-school level. He joined the faculty of the partner high school and, at the time of the program, was in his third year there. During these three years, he had taught on-level and honors algebra, honors pre-calculus, multi-variable calculus, and linear algebra, as well as AP physics.

At the time of the program, Valerie was a sophomore middle-school mathematics major, and Wendy, who planned to teach high school mathematics, was a senior mathematics major and educational studies minor. Since the College of Education admits students in their junior year, Valerie was not officially a student in the college even though she had already declared her major. Therefore, at the beginning of the program, she had only taken two introductory education courses.

Program Structure and Procedures

Since the data gathering was an integral part of the nature of the program, the data sources and their means of collection are embedded in the program structure and procedures. The program began with two separate recruitment phases. First, we compiled a list of all mathematics education majors and all mathematics majors with a known interest in education. From this list, we contacted those students who would not be taking one of our classes by email to invite them to participate in the program. Once we recruited Valerie and Wendy, we met with the head of the mathematics department at the partner high school. She suggested Sam and Ted as a good fit for the program.

We then conducted pre-interviews with each participant, focusing on his or her background with prior collaborative experience, identified interests with regard to professional development, and goals and expectations for participation in the program (Appendix A). As a result of these interviews, we realized that Valerie, as a future middle-school teacher, would be more likely to work with a geometry class than upper-level courses, and that Wendy's mathematics major and extra years of schooling prepared her for more advanced content. Therefore, we paired Sam with Valerie and Ted with Wendy.

We also used the data from the pre-interviews to plan an introductory professional development workshop tailored to the needs of the participants. This workshop, which met for two days, six hours each, served several purposes:

- The teacher-undergraduate pairs met, exchanged administrative information, and generated initial ideas about how they planned to collaborate.
- Participants were introduced to potentially new pedagogical approaches and mathematical content, much of it suitable for direct inclusion in the classroom.
- The sessions modelled the new pedagogical approaches and encouraged exploration of the new content.

The onsite collaboration began immediately after the professional development. For 10 weeks, the undergraduate participants were paid for up to six hours per week of program-related activities, including in-classroom observation or assistance, one-on-one work with students, out-of-classroom planning or grading, and teaching or co-teaching lessons.

The teachers filled out a weekly online survey, which had an administrative question about their collaborative activities in the past week, five Likert-style questions on the development of their collaboration and their satisfaction with it, and several open-ended questions (Appendix B). The undergraduates spent one paid hour per week on free-form journaling. The teacher reports and undergraduate journals were shared with us weekly; however, we avoided responding directly to this feedback and instead encouraged participants to talk to their partners when necessary.

Approximately halfway through the program, we held a follow-up, two-hour professional development workshop at the partner high school. Each pair gave a brief presentation on the development of their collaboration so far. This gave a big-picture overview of the work that they had been doing and allowed the other pair to see and evaluate possible alternative approaches to collaboration. This was the only time that the two pairs had any significant interaction with one another. We also asked the participants to bring a plan for an upcoming, traditional lesson. After the presentations, each pair redesigned their lesson in a more inquiry-based fashion. Although it was not required, both undergraduates created significantly new lessons, which they later taught themselves.

A few weeks after the workshop, we each observed one pair of participants for one class period. The timing was chosen so that the undergraduate partners had time to become fully integrated in the classroom culture. At the end of the 10 weeks, we conducted post-interviews with each participant. In addition to gathering data about the development of the collaboration, we solicited feedback for future rounds of the program (Appendix C).

Methodology, Data, and Data Analysis

We used a multicase study methodology (Bogdan & Biklen, 2007) to examine closely the collaboration, or lack thereof, between the two undergraduate-teacher pairs. The data sources that contributed to the analysis were built into the program structure and included the aforementioned transcribed pre-interviews of the four participants; teacher weekly surveys; undergraduate weekly journal reflections; field notes from one classroom observation of each undergraduate-teacher pair; and transcribed post-interviews of the four participants. We purposefully conducted the observation of each pair during the last two weeks of the program as a means of providing a picture of the collaborations in action that would complement the other data sources.

We analyzed all data sources using the constant comparative method (Glaser & Strauss, 1967). In particular, each of us coded the data for one of the undergraduate-teacher pairs. We shared and discussed these initial codes stemming from the separate analyses in the context of both of the undergraduate-teaching pairs. We first noted the codes that were common. For the codes that emerged from only one pair, we determined whether they applied to the other pair as well. These conversations resulted in a combined list of codes categorized under three themes: influence of background (e.g., influence of industry and prior experiences collaborating), thinking about teaching and learning (e.g., means of assessing student learning, relationships with students, and instructional approaches), and initiative (e.g., lack of initiative and initiator). We then used the refined list of codes to re-analyze the data. In the following sections, we describe the nature of each collaboration and the three themes that our analysis revealed. The themes provide insight into the factors that contributed to the resulting partnerships.

Findings

Our findings rely heavily on a detailed understanding of the collaborations between the two pairs of participants. Therefore, we begin with a narrative description of the development and nature of the collaborations and then examine the factors that affected this development.

Nature of Collaborations

Sam and Valerie. Valerie went to the partner school two days per week. She attended an honors geometry class before lunch, worked with Sam during the lunch period, and then attended another honors geometry class after lunch. The majority of her in-class time was spent observing. For example, during the in-class observation, Valerie sat in the front of the classroom for the entire period and did not interact with the students at all. The reason for her somewhat passive role may be related to the fact that she was never formally introduced to the class, so they did not know what role she was meant to play. As the semester progressed, Valerie did spend more time interacting with students, but as she said, "I definitely wasn't going to force myself on them." Valerie felt her role was "doing whatever [Sam] told me to do" – and indeed, she often performed tasks *for* Sam, rather than *with* him. Her duties

included creating homework assignments and quizzes, making copies, planning lessons, proofreading tests, tutoring, and grading.

Both Sam and Valerie wanted the collaboration to help Valerie evaluate her choice of career. Sam, speaking of undergraduate participants in general, said, "If they decide that [teaching] is not for them, they're able to tell that before they get too far into their major and have to change." Indeed, he wished he could have participated in such a program himself. In their specific case, Sam believed that Valerie "gained some valuable insight to what the day-to-day high school teacher has to go through." Valerie agreed, saying, "I now know more of what is expected of me and what I should be capable of doing—and what I should be comfortable doing."

Conversations with Sam and Valerie indicate that the flow of collaboration was usually unidirectional. Sam said, "I tried to show [Valerie] all aspects and the pros and cons of teaching," and Valerie said of their time together that "it was a lot of [Sam] actually showing me stuff you have to do as a teacher," and that "I don't really know what he got from me." Valerie would have liked Sam "to be more open-minded . . . he's very set on what he thinks and what he believes and how he does things." Although Sam mentioned the general possibility that Valerie "might see something that someone who's been teaching for a while . . . isn't going to see," he could not think of any examples when prompted.

Nonetheless, there were several ways in which Valerie and Sam truly collaborated. On two occasions, they planned a lesson together. The first time, Valerie could not be present when Sam taught it, but they later discussed and evaluated the results together. The second time, Valerie took the lead in designing the lesson (beginning during the mid-term professional development session). Sam taught it before Valerie did to see whether any changes were necessary. She liked this setup, saying it allowed her to "[see] if that's the way I wanted to do it or if I wanted to do it differently." Sam appreciated the opportunity to bring Valerie's new approach into the classroom. "It was nice to give them . . . an inquiry-based activity to explore with their groups," he said.

Sam felt that the lunch periods that he and Valerie spent together were an important part of the development of their collaboration. Valerie felt instead that Sam would "do his own thing" during lunch. Indeed, she said that this typified one of the issues in their relationship. "He's very bad with communication. That was a road bump that we had," Valerie said. She mentioned several instances when Sam poorly communicated change of plans. For example, on a few occasions, he postponed lessons that Valerie was supposed to teach with little advance notice. Sam did not explain these changes, and Valerie did not have the confidence to question him. She said, "It made me feel like maybe I'm not doing it right."

Ted and Wendy. At the beginning of the semester, Wendy went to the partner school three days a week, attending two periods of pre-calculus and one of linear algebra. She appreciated the opportunities this schedule offered "to see [the students] more often . . . [and for] them to see me." However, she eventually switched to going just once a week for a full school day. This offered her a chance to see "what a full day feels like, and it's tiring." Nonetheless, she appreciated the experience, saying "it felt more realistic."

Ted said, "I wanted her to see extracurricular stuff, grading stuff, prep stuff, classroom stuff, tutoring stuff," but given the demands on both of their time "we didn't do as much together as I thought that we would . . . when she was here, we were doing stuff together, but we didn't really do much in between." There was no explicit collaboration plan as Ted explained: "I don't have any

particular expectations, so I'm willing to be led." Whereas Sam and Valerie's collaboration put Sam in a position of sole authority, Wendy said that Ted "was very supportive ... anything I wanted to do, he was there. I would have an idea, and he would [say], 'Go for it. Do it.' That felt good because he allowed me to do what I wanted to do." Referring to a change Wendy wanted to implement in a lesson, Ted said that he "just let her run with it."

Another difference between Sam and Valerie's collaboration is that Ted introduced Wendy to each class, telling the students that she would be assisting but not explaining why she was present. Wendy felt welcomed in the classroom and on an equal footing. "It wasn't just [Ted]," she said. "It was me *and* [Ted]." Like Valerie, Wendy began as just an observer but took on a more active role in the pre-calculus classes as the semester progressed. (On the other hand, referring to Ted's more traditional, lecture-style linear-algebra classes, she said: "I don't usually do anything . . . I just kind of sit there.") The students became more comfortable with her and asked her questions about her background and experiences. In fact, during the in-class observation, two of them asked one of the researchers about Wendy's work and about the nature and goals of the program. During the mid-term professional-development workshop, Ted and Wendy planned a lesson together, with Ted providing resources and Wendy suggesting her own modifications. Wendy taught the resulting lesson in two back-to-back periods.

Ted agreed with Sam about the importance of having out-of-class time to plan, saying, "If I could have put it together, I'd have made sure that we had an hour a day that we could just plan what was going on." He advised future participants to "be religious about setting aside . . . an hour a week, where [you] are going to call, to meet, whatever." Most communication with Wendy was squeezed between classes. Wendy said that "after all the classes . . . he would ask me, what do you think?" At first, she worried about offending him, but by the end, she "would just vent toward him . . . I would tell him how I felt toward the kids and what I liked during the class and what I didn't like and what frustrated me."

One of the main benefits Ted saw in Wendy's presence in the classroom was her ability to answer student questions—as he put it, "it's the ratio [of students to teachers]." However, the classroom culture remained roughly the same. Ted said, "I don't think students acted one way when [Wendy] was here . . . I don't think it changed the dynamic." Ted also appreciated the ability to learn from Wendy's use of technology during the lesson that she planned, saying, "I designed this stuff; I don't use it."

Factors Contributing to the Nature of the Collaborations

Influence of Background. Sam and Ted began their post-college careers in industry before pursuing alternative certification as teachers. Both had an early affinity for mathematics, which shaped, and was shaped by, the careers that they pursued. Sam said, "I like geometry because I also used to be a machinist, and I was doing geometry even before I went to high school geometry." Ted said, "Math and physics always came easy to me, and [that's] why I decided to go into engineering."

Their backgrounds in industry shaped Sam's and Ted's views of the importance of various aspects of a teacher's career, including professional development and collaboration. Both mentioned time and efficiency repeatedly. Ted summarized this perspective by saying, "I work for an incredible school, and [yet] the inefficiencies astound me." When asked what was one thing he would like to see more, he unhesitatingly answered, "time." This also featured in Sam's discussion of inquiry-based lessons:

There are a lot of lessons out there where it might be a fun activity for the students, and it might take two or three days . . . however, the amount of information [the lessons] contain or [the students] are able to get through within those three days is usually very limited, and I know that I can teach twice [the material] in that time, doing it differently.

Both teachers expressed a lack of enthusiasm for many district-mandated professional development experiences. Sam preferred outside professional development focused on graphing calculators, because it was “a better use of [his] time.” Ted said, “If you just let me sit in a corner and do what I do, I would make much more use of my time . . . not everybody makes good use of time . . . but that’s why, in industry, you’d fire people.” Sam said of our program’s associated professional development, “I loved it, it was fun, and it didn’t take up too much time.” However, when asked, he did not have examples of what he learned or how it affected his practice.

Ted had a resigned attitude toward addressing inefficiencies. For instance, when expressing his frustration with professional development, he said “the law’s the law, and you’ve got to do what you’ve got to do.” He also described the effort required to arrange chairs to facilitate group work. He said, “I could teach the students how to do that, but I guess I pick my battles.” Nonetheless, he said, “I have no reason to ever go back to high-tech . . . [which] was a pleasant surprise.” By contrast, despite a generally positive impression of teaching, Sam was considering other career pursuits. In the pre-interview, he mentioned the possibility of taking university classes in Education Administration. In the post-interview, he said: “I have been thinking about possibly looking for another type of career . . . My brother has been very successful doing what he does [in industry].”

The teachers’ backgrounds also affected their perspectives on collaboration. Ted said, “I really don’t know anything about formal student teaching, because I never did any myself and never had anybody do it with me.” When he joined the partner high school, Ted was paired with a mentor teacher, but found the experience useful mainly for sorting out administrative issues. Sam also had a mentor teacher with whom he met daily during his first year. He received support in many ways, but he said that after that first year he felt “comfortable enough on my own to go through it.” Sam considers his mentor to be a good friend, but he seldom seeks his professional guidance. Both Sam and Ted placed the most value on collaborative work with others teaching the same classes.

The undergraduates’ backgrounds were quite different from one another and from the teachers. Valerie arrived at teaching as a career by a process of elimination. “I can’t work in a cubicle, don’t want to work with chemistry or anything medical,” she said. “The only thing I can think of to do is teach.” Teaching appealed to her because of the impact she could have on students. She said, “I want to be a teacher, because I want to be available to kids.” *What* to teach was also established by a process of elimination: “I don’t want to teach English, I hate history, so I [decided on] math.” She further stated: “Math was my worst subject in high school, [but] I hope I can make [the students] realize that it’s not as terrible as they think.”

Valerie had minimal experiences in schools and working with students. Her two education courses had field components that consisted of observation. She mentored eighth graders as part of a service program and was a nanny for a sixth grader (“I help her with her homework . . . and I just kind of hang out with her”). She had no experience collaborating with someone regarding teaching in general or teaching mathematics in particular.

Wendy originally intended to work in forensics and said, “the only reason I was taking math courses is because I’m good at math.” However, after receiving effusive praise from a student she tutored, she said, “I just felt so good, like I impacted that one person, and I was like, ‘I want to be a teacher’ . . . I wanted that feeling again.” Like Valerie, she specifically relished the challenge of dealing with students with negative attitudes toward mathematics: “I want to change that idea in people’s heads . . . I want a defiant kid.” Wendy’s extensive education coursework had given her more in-classroom experience. During the pre-interview, she singled out a particularly memorable experience of doing field placement work in an outreach program that provided at-risk youth with mentors and role models.

Thinking About Teaching and Learning. Both Sam and Ted had difficulty reflecting upon their practice and its influence on student learning. When asked during the pre-interview what he would most like to improve about his practice, Sam said: “If you gave me a list I could tell you which ones I would prefer the most, but off the top of my head I can’t say, ‘Oh, I want to learn this.’” His three suggestions for possible topics—classroom management, student motivation, and the use of technology—seemed to focus on areas in which he felt comfortable rather than areas of need. For example, he already described himself as “fairly tech-savvy.”

The professional development workshops incorporated several inquiry-based activities. Sam liked the idea of student-centered activities but still had reservations, saying, “Overall, I like the [district inquiry-based activities] . . . [students] are going to learn more . . . The con is, it takes a long time. I still feel like I can do an adequate job of teaching, just stand and deliver.” Ted agreed with these reservations. When asked about the possibility of employing alternate pedagogical approaches, he said, “We lecture, and we’ll do a lab every few weeks, but there’s a lot of material we have to cover.” Both teachers took a procedures-based approach to measuring their success. For example, Sam said, “You see what you’ve done whenever the [state exam] scores get back or at the end of the six weeks [and you find out] whether or not your students know a particular topic.”

Each teacher felt that his classroom was best served by traditional methods. Sam believed that “the students aren’t used to [the teacher] just saying, okay, try to figure it out.” He also felt that inquiry-based lessons would only work for students who “are interested in mathematics, such as a higher-level student.” In contrast, Ted said:

You’ve got to teach something three or four different ways, and not necessarily at the higher level, although it’s useful there, too, but particularly in our lower-level classes . . . It really doesn’t apply much to my high-level classes, because they’re sitting there like college students.

Ted’s ability to experiment with alternate instructional approaches was limited by his lack of a degree in education. With only “a little bit of the pedagogy” covered in his alternative certification program, he had no model for what a non-traditional high-school classroom *could* be. For example, when describing his most advanced courses, he said: “I teach them the way that I was taught in college, and I taught in college, and it’s pretty well lecture.” Indeed, in the pre-interview, Ted said that one of the main advantages of his participation in our program would be “an opportunity for me to learn stuff from somebody that’s going through it the right way” (i.e., *via* a traditional teacher education program). Despite these pedagogical challenges, Sam and Ted both found that they could productively

integrate their backgrounds in industry into the classroom in a way that made the content relevant and interesting to students.

Similarly, in the pre-interview, Valerie focused mostly on the affective aspects of teaching, such as developing relationships with students. She rarely mentioned the details of her practice or of student learning. When describing an observation associated with an education class, she said: "The teacher was really, really nice, and the students seemed to be having a lot of fun." Through the professional development, she wanted to gain confidence in speaking to a classroom of students and learn about assessment and meeting diverse needs ("everyone learns different[ly], so I just need to learn how to make it all where everyone can understand what's going on"). During the pre-interview, Wendy echoed Valerie's focus, saying, "[In] my education courses here, I learned that it's all about the relationship." She also repeatedly referred to her fear, nervousness, and lack of confidence. However, she said: "Whenever I'm in front of the classroom, I feel like a completely different person." Wendy also referenced her education classes: "You learn certain things, and I just want to see if [they're] actually true." To this end, she eagerly sought out alternatives to traditional modes of instruction and content. This enthusiasm for new ideas sometimes clashed with the district's emphasis on common frameworks and assessments and Ted's comfort with his existing style of teaching.

Both undergraduates took seriously the opportunity to observe and reflect on their partner teacher's practices. For example, Wendy reflected at length on a trigonometry lesson that Ted taught in a group-oriented fashion:

I was incredibly excited about this because it wasn't the usual lecture . . . The students had their own packet, but [each group] only had to turn in one packet. I didn't like this because I knew what problem could potentially happen and it did. Usually, one student from each group did all the work, while the others watched or goofed around. I really wished [Ted] had asked the students to turn in their own packet, but also [told] them they could work on it together.

The undergraduates' reflections indicate an increasingly sophisticated view of teaching and learning. During the pre-interview, Valerie had described mathematics as "either right or wrong." However, in the post-interview, she said that she had tried to emphasize while teaching that:

There's not a right answer, it's more of how you approached it . . . [Sam's] lessons are all kind of the same . . . and [the students] just take notes in their notebook and do their homework . . . I wanted [us] to do something . . . that I could do in my classroom, because I do not want to be one of those teachers who just teaches right out of the book. I want to have fun stuff that they can do that's different.

Similarly, Wendy critiqued Ted's lessons: "I felt like [he] was doing most of the talking, and that's just not my style . . . He would lead the whole thing, and I wish the *students* could take the lead." In contrast, she described her own teaching: "Even though I felt like I lost some control, I didn't mind because the students were the ones engaged, and they were talking about math."

Valerie and Wendy also focused on student learning. For instance, Valerie wrote about one of Sam's lessons using graphing calculators: "I do think technology is a good way to get things across, [but] I feel like the students should understand the things they are creating and why they are making them." Wendy lamented opportunities she saw missing in a traditional classroom: "Whenever I go to a math

classroom—not just [Ted]’s, but any math classroom—I feel like something has them lost. I feel like they’re not as excited . . . I want students to discover what they’re learning.”

Some of Valerie’s comments demonstrated the influence of Sam’s views on teaching and learning. When asked to compare her style of teaching to Sam’s, she said that she would mix direct and student-centered instruction, because “there’s some stuff that you can blow right through and . . . other stuff that you want to spend more time on and have them where they’re going to understand it and remember it.” She further explained that “what they’re learning and . . . how long I have to do something [will determine] if they get to do something fun, or if they just get to learn it and do their homework and take a test.” Wendy’s ideas about classroom practice showed less influence from Ted, but his attitude of resignation regarding administrative issues had its effect on her. For example, in one of her weekly reports, she echoed a phrase that he often used: “I . . . learned that I have to pick my battles with students.”

Initiative. Valerie often waited for Sam’s permission or explicit invitation before talking to students: “I tried not to be bothersome in the class . . . it’s his classroom, and I don’t want to impede . . . I just tried not to do anything that he wasn’t okay with or hadn’t asked me to do.” Sam agreed, saying that, “in the beginning, even if I asked her . . . there was that hesitation, like, ‘I’m scared.’” He added that “she definitely got more comfortable with jumping up and getting involved.” Wendy also said she was initially an observer: “I didn’t know how to approach [the students], because I’m older and they’re high schoolers.” Ted confirmed that “there wasn’t a ton of interaction . . . but . . . as they got more comfortable with her . . . they’d ask her for help, and that became more and more common.”

When Valerie could not answer a student’s question, she said, “that was hard . . . I feel like [the students] look up to me and I didn’t like telling them I didn’t know. But I think in the long run that made me more approachable.” Wendy felt more confident, saying in the pre-interview, “I would love to do calculus, because I think it would be the most challenging.”

On several occasions, plans for Valerie to teach a lesson were delayed. For example, in one weekly report, she wrote:

I was supposed to teach, and I was down when Sam told me I wouldn’t be teaching, but relieved because I know that will give me more time to prepare . . . I am still looking forward to teaching but am getting more and more nervous as I know it will come before I am ready.

Although the midterm professional development activity only required the participants to revise an existing lesson, Valerie overcame her nervousness and took the initiative to create and plan (with feedback from Sam) an original lesson. She then told Sam, “I’m teaching. I’m doing this lesson.” Her nervousness returned when she first stood in front of the class, and the students commented on it. She hoped that Sam would offer support, but instead, he “egged the kids on . . . he was just laughing and not really helping at all.” This is a marked contrast to Sam’s experience with his own mentor, of which he said, “Whenever he observed me . . . it was all about positive reinforcement, with the idea to make it better.”

In the pre-interview, Ted said that an open-ended approach to collaboration “fits my mold better” than a more traditional, rigidly described approach. He reiterated this idea in the post-interview: “The freedom works for me.” However, he also contradicted these sentiments: “I never really knew what the goal of the collaboration was . . . If you’ve got something that you want me to do, you need to tell

me what that is.” The teachers did not construct a shared goal with their undergraduate partners, but rather tried to discover the goal that they believed we had determined in advance.

Before she taught, Ted warned Wendy, “You’re going to say something the first time you give a lesson, and then . . . you’re going to go, ‘oh, I’m going to do that differently next time.’” In fact, Wendy commented on differences between two implementations of the same lesson. During the first lesson, “there was . . . discussion as they tried to convince each other . . . I couldn’t stop smiling, because this is what I wanted.” In contrast, during the second lesson, “the students did not want to talk or participate . . . I’ve never seen them that quiet before.” However, other than his initial advice, Ted took a *laissez faire* approach to the collaboration. When Wendy tried to model or implement changes in the classroom, she felt that he “didn’t say anything negative or positive.” Ted acknowledged this lack of feedback. For example, he described his response to Wendy when she proposed changes to a lesson plan: “I just said, ‘fine’ . . . I probably didn’t say much of anything.”

The way that the partnerships developed meant that the lesson taught by each undergraduate partner was the capstone of her collaborative work. Valerie believed that, despite a rough start, her lesson was successful: “When I was walking around and watching the kids working on the worksheet that I actually made . . . I felt proud of myself, because I didn’t think I would actually teach as it’s gone through this whole semester.” Wendy felt that “the whole semester really prepared me to teach that lesson.” Ted and Wendy both wished that Wendy’s teaching could have been a more regular part of their collaboration.

During the post-interview, when asked how the program could be improved, Valerie said: “I would definitely try to get [future participants] out of their comfort zone. Because I think [Sam] . . . let me be in my comfort zone and [did] not put me on the spot and make me do stuff.” Wendy said that, rather than having a dialogue about teaching, “I felt like it was more me talking . . . [Ted] would answer my questions, but I don’t think he would really go any more beyond that.” She later elaborated: “I just felt like he wouldn’t change . . . I never saw him once try to step outside of his box.” In general, she said, “If I had ideas, I would do it. *He* wouldn’t do it.” If she were in Ted’s position, she said: “I [would] want to hear [my partner’s] ideas. I’m not going to discourage them . . . I want to hear what they’re expecting from me and what they expect from the classroom, and everything.”

Discussion

Regarding the 10 features of learning communities (Clausen et al., 2009), we found that there was a lack of a shared goal (item 2) and of a willingness to share power (item 3) at the beginning of the program. Since we did not satisfactorily address these issues, they prevented other features from developing. We view this situation through a theoretical lens and relate it to concrete evidence described in the findings section.

Collaboration is a deep process that is viewed as a necessary part of modern approaches to education, but Dooner, Mandzuk, and Clifton (2008) point out that “teachers often do not understand the nature of the interdependence required in effective learning communities” (p. 565). Indeed, Musanti and Pence (2010) were surprised to find that “building a community of practice required a long process of *learning to collaborate* [emphasis added]” (p. 79). The teacher participants had a relatively superficial view of the nature of collaboration, regarding it as essentially synonymous with simply working together. For example, Ted described his experience with collaboration as “stay[ing] synchronised and keep[ing] in touch” with other teachers covering the same material and mentoring

younger colleagues in industry. Both of these are valuable and important activities, but neither typifies the give-and-take experience of mutual development that our program tried to foster. The undergraduate participants had a deeper view of the nature of collaboration, and it evolved over the course of the program. However, without the teachers' commitment, and because of the uneven distribution of power in the collaborations, they were not able to implement their ideas.

One of the most important ingredients in a successful community of practice is a shared goal. Unfortunately, the program did not successfully lead the participants to discover such a goal. In what may have been a slip of the tongue, Ted summarized the resulting feeling of aimlessness when he said: "I don't like to spend time not doing things, but [the program] was useful and I enjoyed it." In place of the passionate pursuit of change, the partner interactions mirrored what MacDonald (2011) described as the *culture of nice*, an environment in which participants "rarely question each other's and their own practice, assumptions, and beliefs" and "recommend strategies for [others] to apply, but don't critically reflect and apply them to their own institutions" (p. 46). Parks (2009) observed that "a big challenge for facilitators [of collaborations] may be helping participants to question shared beliefs and assumptions that rely on simplistic or easily summarized explanations" (p. 94). Despite positive impressions of the program, no participant reported a significant change in his or her attitude toward the practice of teaching and learning. Wendy, who was most enthusiastic in her praise, said instead that the program "really reinforced what I believe in . . . I'm really confident about everything I'm thinking."

An environment in which participants are not challenged to examine and evolve their beliefs exhibits undesirable characteristics such as "feigned politeness" (Hargreaves, 2001), "superficial effort" (Barnett, Higginbotham, & Anderson, 2006), and "contrived collegiality" (Hargreaves, 1994). While talking with us, the teachers often referred to what they had learned, but these comments about learning did not seem to be reflected in changes in practice. This indirectly indicates two major trouble spots for collaboration, namely, teachers' differing levels of commitment (Sam, White, & Mon, 2005) and their lack of confidence (Walker, 2007).

A successful community of practice involves the establishment of a shared language, which the practitioners use to talk about the practices and ideas they have investigated together (Eckert & McConnell-Ginet, 1992; Sim, 2006, 2010). This language serves as the cornerstone of critical reflection, another essential component of a learning community. Stein (1998) emphasizes the reflexive relationship between the development of a collaboration and shared language: "It is the process of interaction with others that produces and establishes meaning systems among learners" (p. 4). The participants in the program neither had, nor developed, such a language, and so could not engage in true, joint reflection. For example, both undergraduates expressed dissatisfaction with aspects of their collaboration in their weekly journals but did not seem to have raised these issues with their teacher partners. This indicates that, not only did the nascent community of practice not develop a deep, shared language (Wenger et al., 2002), but the participants could not even communicate freely and openly. Such communication is possible only with a deep sense of trust (Barnett et al., 2006; Palinscar et al., 1998), which was not established in this program. For example, during the lesson that she taught, Valerie felt that Sam sided with the students, joining them in poking fun at her nervousness. Wendy reported in a weekly journal that Ted "sometimes refers to me as 'the pretty one' or 'the attractive one' in class in front of the students," adding, "I never know what to say when he says that."

Backgrounds may also have been a contributing factor to the difficulty in constructing a shared language. Valerie had taken only two education classes, and the effect of this limited experience on her

thinking about teaching and learning can be seen in her tendency to prioritize students having fun over learning. This is similar to the experiences of a student teacher described by Feiman-Nemser and Buchmann (1985), who had “a view of teaching as filling time [and] keeping children busy” (p. 61). We hoped that Valerie would benefit from Sam’s mentorship. However, Sam himself preferred to rely on quantitative, summative assessment rather than formative assessment to measure student learning. He also replaced concerns about student learning with concerns about efficiency. One possible cause is the district’s strong emphasis on preparing students for state exams. Lave (1991) notes that institutional mandates, such as the district curriculum frameworks and benchmark assessments at our partner school, stifles authentic participation in communities of practice. In addition, Sam’s limited professional relationship with his own mentor, which had mostly concluded once he was sufficiently familiar with the ‘ins and outs’ of work at the partner high school, had not prepared him to play the role of mentor himself. Although “[c]lassroom experience alone ... cannot justify what teachers do, nor teach teachers to think about their work” (Feiman-Nemser & Buchmann, 1985, p. 61), Sam felt that professional development was a poor substitute for on-the-job experience. He said: “You can’t teach someone how to teach. You have to experience [it].” In the other collaboration, Ted repeatedly described himself as both willing and eager to learn. However, Wendy felt that, even when exposed to different models of teaching, he preferred to stay faithful to his familiar techniques. Although all participants discussed alternate pedagogical approaches, they spent little time reflecting on the effect that their instructional decisions would have on student learning.

These two collaborations show different approaches to allocating power in a professional relationship. Sam and Valerie adopted a more traditional model. As the teacher, Sam had most of the power and frequently made unilateral decisions without conferring with Valerie. Ted and Wendy, on the other hand, found that their main goals did not overlap significantly. Ted’s approach to teaching was comfortable for him and challenged his best students; he felt no need to change it. Whereas Wendy was eager to try out academic ideas in the field that she had previously only heard about in her coursework. While Ted readily gave Wendy the authority to try out her own ideas, he did not adopt these ideas himself. Where they conflicted with his existing approach, he implemented them only occasionally and with resistance. Neither pair found a true power-sharing structure, in which issues of common interest were explored by both partners acting on an equal footing (Clausen et al., 2009).

Conclusion

In the first iteration of the program (Spice & Quebec Fuentes, 2011), the participants developed genuine collaborations with minimal interference from the investigators. During the second iteration, the collaborations were only rudimentary. We use the current research to make recommendations about how others hoping to facilitate collaboration may avoid such setbacks.

The culture in which the collaboration will develop is already being established during the initial professional development workshop, and many of the issues observed in this study have their roots in that workshop. We did not provide sufficient background for the pedagogical and content ideas that we presented. So the teacher participants were not sure how to relate them directly to their classrooms. Participants need to establish a common language for discussing collaboration and reflection and put it to immediate use by investigating shared questions and goals. The goals may be both broad and tentative, but they must be present in some form, as they will be the lynchpin of what follows. The

goals can be matched to new concepts encountered during professional development and the language used to explore how these concepts fit in the classroom.

We assumed that communication between teachers and their undergraduate partners would develop on its own once the goals were articulated and the language was in place. Therefore, we focused only on fostering communication between them and us. Our data-gathering tools were comprehensive but light weight. They required a minimal time investment from the participants and doubled as instruments of reflection. We encourage future facilitators to make use of these or similar tools but *also* to emphasize the equal importance of communication between partners.

Another challenge is for more experienced practitioners to view novices as equals. For example, Pugach (1999) describes, “[a] highly experienced group of teachers . . . explicitly rejected the notion of newcomers,” and “the preservice group also was not open to newer members or masters” (p. 270). The shared creation of goals and of a language for investigating them will help to mitigate this potential imbalance, giving both partners full ownership of the framework that they use to build their collaboration. This will place them on equal footing and allow them to share power fluidly as necessary.

With these changes in place—explicitly guiding the participants to define their collaboration and take steps to quickly establish their “ways of doing, ways of talking, beliefs, values, power relations” (Eckert & McConnell-Ginnet, 1992, p. 464)—the existing structure of the program is well suited to future implementations. It offers great flexibility and fluidity, encouraging participants to explore new goals, or approach existing goals in new ways, as circumstances suggest. The professional development workshops help participants explore their different perspectives, from the theoretical to the practical, and blend them to serve their unique needs. Immediate and extensive in-classroom experience allows undergraduate partners to become a thoroughly integrated part of the high-school classroom culture, so that they can work easily with students and feel comfortable implementing new ideas. Finally, data-gathering tools allow non-intrusive observation by, and communication with, facilitators. At the same time, these tools encourage constant critical reflection by the participants, an essential aspect for establishing and maintaining a community of practice.

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Appendix A

Pre-interview Protocols

Teacher

1. Describe your teaching experience (e.g., number of years taught, schools, courses).
2. Tell us about yourself as a teacher. What are your strengths and weaknesses? What are the areas in which you would like to improve your practice?
3. How do you maintain your professional development?
4. What types of professional development are most helpful to you? Why?
5. What types of professional development are least helpful to you? Why?
6. What are some areas in which you would like to receive professional development?
7. Do you read any research literature? If yes, what do you read?
8. If you had the opportunity to collaborate with an undergraduate, how do you envision the role of the undergraduate?
9. How do you imagine developing a productive collaboration with an undergraduate? What role do you think the undergraduate could play?
10. Describe any positive or negative experiences you have had collaborating with an undergraduate. Describe any positive or negative experiences you have had collaborating when you were a student teacher.
11. What do you think would be some of the benefits for you in participating in this project?

Undergraduate

1. How did your interest in teaching come about?
 2. Describe your teaching education course work.
 3. Describe any positive or negative experiences you have had in the field.
 4. Describe any professional development experiences you have had.
 5. Do you read any research literature? If yes, what do you read?
-

6. What are some areas in which you would like to receive professional development?
 7. If you had the opportunity to collaborate with a teacher, how do you envision your role?
 8. How do you imagine developing a productive collaboration with a teacher?
 9. What do you think would be some of the benefits for you of participating in this project?
 10. What is your course placement preference at the high school?
 11. What was/is your favorite mathematics course(s)?
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Appendix B
Teacher Weekly Progress Report

1. This week, my undergraduate partner participated in the following tasks:

2. Please mark your agreement with each of the following statements. In case you are not able to agree or strongly agree with a statement, it will be helpful for you to give additional comments below.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am fully involved in our collaboration.					
My undergraduate partner is fully involved in our collaboration.					
My undergraduate partner is integrating well into the school culture.					
I am satisfied with the development of the collaboration.					
I am utilizing what I learned in the professional development.					

3. Please discuss briefly the lessons that you have learned from your undergraduate partner and that she has learned from you.

4. How has your collaboration developed? Please address specifically what has, and what has not, changed.

5. Any additional comments are valuable, but not required.

Appendix C Post-interview Protocols

Teacher

1. How did you collaborate with the undergraduate?
2. How did the collaboration develop?
3. What were the positive and negative aspects of your experience in the project?
4. Did you utilize what you learned in the professional development? Explain.
5. How have your views about mathematics and mathematics education changed?
6. What are your suggestions for future implementations of the project?
7. Would you be interested in participating in the project again?

Undergraduate

1. How did you collaborate with the teacher?
2. How did the collaboration develop?
3. What were the positive and negative aspects of your experience in the project?
4. Did you utilize what you learned in the professional development? Explain.
5. How have your views about mathematics and mathematics education changed?
6. How have your ideas about the role of a classroom teacher changed?
7. When you are a teacher, how would you utilize an undergraduate partner?
8. What are your suggestions for future implementations of the project?
9. Would you be interested in participating in the project again?