Students Teaching Teachers: Rethinking Professional Development for Technology

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With the vast majority of teachers possessing inadequate technological know-how, educators are looking for new forms of professional development. This problem is compounded when situated within a remote rural community. The following investigation looks at one rural communities' novel approach to technology professional development using high school students as technology experts in K-6 classrooms.

Teachers are often encouraged to integrate new technologies into their classrooms. Integrating technology within the current system is easier said then done. Research has indicated that there is a significant gap between the resources invested in these new technologies and the extent to which teachers integrate them into their practice (Cuban, 2001). Even those who do receive the necessary training often times lack the further support needed to consistently teach the technology (Daloz, 2000; Harcombe, 2001; Louks-Horsley, Hewson, Love, & Stiles, 1998; Rebora, 2004). In turn, schools are forced to find new and inventive ways to provide teachers with on-going support in the form of on-sight professional development.

Compounding the dilemma of finding new ways to provide on-sight professional development is the lack of feedback showing that the technology standards to which schools are asked to teach will yield positive student learning gains. Teachers' belief regarding the efficacy of technology standards they are asked to implement plays an important role in how they integrate technology into everyday classroom practice (Hew & Brush, 2006; Lawson & Comber, 1999). Rural communities are further hampered due to their geographic isolation. Expertise and other potential resources for professional development become limited simply because of their location (NCES, 2000; Poliakoff, 2002). No significant progress has been reported to address this issue. Faced with the pressure to integrate technology, one small rural community is tackling the challenges by keeping the professional development process close to home.

The purpose of this study is to explore how one rural community is rethinking teacher technology professional development with respect to the use of technology in their K-6 science classrooms. Using a model employed at all levels of education, this rural community is combating the problem by using in-house technological experts; the students. In a reversal of the

[1] In order to protect the confidentiality of others in this community, the name of the town is a pseudonym as are all other names in this paper. Confidentiality remains an issue for us, however, in that we feel it is important to include k-12 educators in research and writing, and give them due credit.

typical hierarchical transfer of knowledge from older to younger individuals, using students as technological resources is an interesting and cost-efficient way to supply teachers with technological professional development. Such an approach has been employed in higher education using both graduate and undergraduate students as mentors for higher education professors (Beisser, Kurth, & Reinhart, 1997; Browne, Maeers, & Cooper, 2000; Gonzales et al., 1997; Miligan & Robinson, 2000; S. J. Smith & O'Bannon, 1999; Sprague, Kopfman, & Dorsey, 1998) and K-12 teachers (Franklin, Turner, Kariuki, & Duran, 2001; MacAuther et al., 1995). Programs have also been established using secondary school students as mentors for their teachers (Carberry & Chruch, in press; Harper, Conor, & Course, 1999). As described by Carberry and Church, high school students become experts in the use of technology in order to learn physics content related to scientific and mathematical processes. They then enter elementary school classrooms ranging from third to sixth grade mentoring teachers (and students) in the use of physics related technologies including computer aided data collection, LEGO® robotics, and animated model making. At the end of the year, this rural community employs a novel, almost entirely local professional development model weaving the four essential elements of professional development - context, professional development program, facilitators, and teachers (Boroko, 2004).

Context

Located in an isolated mountain region, Granite (a pseudonym), population 6000, is home to three schools: Granite High School (GHS), Granite Middle School (GMS), and Granite Elementary School (GES). Although the town has repeatedly elected not to regionalize its school district, several of the surrounding communities have regionalized their schools in an effort to provide comprehensive educational services in an economically efficient manner. Together, these seven schools are the educational resources in the region, serving approximately 1600 students.

As the largest of a number of surrounding towns, Granite is the economic epicenter of the region. Like many rural regions, the Granite area faces a continuous struggle to sustain itself economically, environmentally, and socially (Gruenewald, 2003; Theobald, 1997). Sustainability is further stressed with Granite’s high value of maintaining local control. In an effort to maximize local control of its schools, the town voted in 2006 to form its own school administrative unit, leaving a previous partnership with four neighboring towns. Granite’s desire for local control translates into its efforts to capitalize on the resources that already exist in the community. Granite has the potential for educators to capitalize on the social relationships that exist there simply by virtue of its size. As Putnam (2000) argues, social capital, or our connections with other people, is an integral part of living and participating in a democratic society. Building and maintaining these relationships are essential to the lively-hood of rural communities (G. Smith, 2002; Theobald, 1997). In rural education, there is a growing interest among educational experts to create curriculum that builds on these small community relationships. Some educators see young people as knowledgable community resources and hope students will find greater opportunities in rural areas to become active community participants. The result is teachers and students beginning to rethink how they learn and teach science.

In 2003, a physics teacher at Granite High School took the initial step to advance his classes by forming a partnership with a research center located at a distant urban university. The university had developed an outreach model to utilize the expertise of university engineering students in professional development outreach efforts. This outreach model, called the Student Teacher Outreach Mentor Program (STOMP) (Portsmore, Rogers, & Pickering, 2003), had been in operation in the Boston area since 2001. Granite wanted to become involved, but direct access between the university outreach center and the Granite region was difficult due to geographical distance. The Granite School District instead decided to adapt the university STOMP outreach model for use in their district. Thus, in 2005, in collaboration with university professors, graduate students, and a team of educators and students from Granite and surrounding school districts, the Granite School district began using the STOMP model in high school classrooms (HS-STOMP). The model simply established that high school students first learn the animation and robotics technologies in their own classes, and then model this use for students and teachers in elementary and middle school classes (Carberry & Chruch, in press).

This unique partnership allows students in the Granite region to utilize a university partnership via technologies such as webchats and email, as well as have on-going support from the people actually developing the technological tools. In addition, high school students, in a sense, become the professional developers teaching other teachers (sometimes their former teachers) by modeling activities with students. Without bringing in outside experts or utilizing an outside of school workshop model, which are both costly and not always effective (Boroko, 2004; Wilson & Berne, 1999), the teachers of Granite are using their own students from within their own system as technology experts to serve as their technology instructors.

Literature Support

In a review of faculty technology mentoring programs, Chuang, Thompson, & Schmidt (2003) identify that no matter the education level, there are themes consistent in technology mentoring models that drive the success of such programs. These themes include providing visions for the use of technology integration, individualizing technology support, breaking down hierarchical relationships between teachers and students, providing mutual benefits for mentors and mentees, and establishing open dialogue, collaborative relationships, and learning communities. The following sections elaborate upon the importance of each theme and how each is present in HS-STOMP.

Technology Integration

In his 1986 historical study, Cuban posed the question: “Will computers in schools have as much impact on what happens as these technological inventions have had in creating new patterns of living?” (p. 73) Since then, technology has drastically shifted how people relate to each other in the postmodern world (Tsing, 2000). In the classroom, however, the impact of technology on curriculum remains relatively minimal (Cuban, 1986). The major limiting factor rests in teacher beliefs about their ability to implement technology (Schuttloffel, 2000). Effecting such beliefs are the teachers’ own personal views on education based on their own model of learning. Simply introducing technology in schools does not ensure its use, nor does it ensure these tools will be integrated into curriculum in meaningful ways (Cuban, 2001). Teachers need to be both introduced to the technology and supported to ensure use within the classroom. The use of students as expert support is one way to help alleviate teacher inhibitions by providing teachers an opportunity to envision how to use technology in their teaching and in students' learning.

Individualizing Technology Support

Teachers come in all shapes and sizes with various degrees of technological knowledge. As such, mentorship of teachers should be personalized to accommodate the individual teachers' personal knowledge as well as what their personal interest is in understanding technology. According to Rogers (1995), support for technology should be based on a teacher's individual determination in five categories: 1) their view of the relative advantage of technology; 2) the compatibility of the technology with personal values, experience, and needs; 3) their view of the complexity of use for the specific tools; 4) the availability for experimentation (chance to fail); and 5) the observable results for others. Mentorship, as opposed to other forms of professional development, identifies these personal determinations through an individualized one-to-one interaction. Teachers can try the technology in the comfort of their own classroom with a mentor present to provide support. Teachers then receive enough time, access, support, and encouragement to become comfortable with the technology.

Redefining Teacher and Student Roles

The defining model for teacher and student roles within the classroom is Friere's (1970) "banking model", describing students as "empty vessels" needing to be "filled" with knowledge by expert teachers. For as long as this model has defined American public education, it has been criticized as ineffective (Dewey, 1938), producing unengaged and bored learners (Blumenfeld et al., 1991). Challenging this prehistoric model is the idea of integrating learning approaches establishing students as collaborators and co-learners with teachers removing the default roles of the "banking model".

Teacher-student collaboration can be initiated through the before mentioned mentorship programs, but also through pedagogical approaches such as project-based learning (PBL). PBL environments allow students to initiate their own learning with problems and questions that are meaningful to them (Krajcik, 2006), placing the teacher into the role of collaborator. The teacher still exists as an expert, but uses his or her knowledge to fuel student driven work rather than lecturing abstract information. In a study looking at a community-based PBL, Heath and Smyth (1999) point out that while collaborating with their teachers, the students begin to learn along side their teachers in a co-learning environment. In either case, the line dividing students from their teachers begins to dissipate (Kesson & Oyler, 1999) further changing the roles of both teacher and student. Fluid role responsibilities can ultimately lead to the most learning gain.

Establishing Relationships

Integration of technology through a mentorship model is highly dependent upon the relationship established between the mentor and the mentee. Good open dialogue tends to lead to an environment where both mentor and mentee are comfortable expressing feelings, knowledge, and expectations. Relationships between the mentor and mentee are just the initial step in establishing a successful integration of technology. Lave and Wenger (Lave & Wenger, 1991), through their model of situated learning, identify that learning involves engagement within a ‘community of practice’. Success, therefore, lies in both the mentor and mentee working not only with one another, but with others attempting to accomplish the same goal. Development of such a network removes teachers from being isolated from their peers into a learning community supplying support and discussion.

Mutual Benefits

An important aspect to mentorship is the reality that both mentor and mentee benefit from the interaction. The mentee benefits as a student does from interactions with a content expert. The benefit for the mentor lies in the opportunity to teach others. Teaching others provides an avenue to reflect and reformulate what we think we already know and understand. Teaching elicits in the teacher the processes of review, preparation, presentation, student assessment (through answering students questions and examinations), and reflection (Bargh, 1980; Gartner, 1971). When these processes are placed within the hands of the students, studies have shown that those who prepare to teach learn more efficiently than when they prepare to be assessed on an exam. In their study, Bargh and Schul concluded that specifically it is the preparation stage of teaching that encourages the teacher to learn how to learn. Furthermore, Annis (1983) identified three underlying factors contributing to the reason those who taught showed higher marks: 1) they paid more attention to the material to be learned, 2) the student teachers methodology to learning the material was often times to code it in a personally meaningful way so as to not convey misinformation to their students, and 3) the student teachers tended to associate the material that they were going to be required to teach with something that they already knew. Ultimately, learning by teaching supplies an active learning opportunity which intrinsically motives participants to develop a deeper understanding of the material (Benware & Deci, 1984). This not only allows for the student to learn more, but allows the teacher to teach more effectively and efficiently themselves.

Methodology

This paper represents the emergence of a collaborative project among the three authors. Our collaboration grew out of data generated while the first author was doing research for her dissertation. While she was observing in Church’s physics classroom, Carberry was involved with the university based STOMP program. Since the study was an ethnographic account of practice, Carberry became an informative participant in the study. As the three of us met, it became apparent that our distinct perspectives could offer important lenses for analyzing the data we generated together. Although observations and interviews were conducted by Tatistcheff, the collaborative process helped to shape the analysis and subsequent writing so that it reflects the unique perspectives of each of the authors. In turn, this project has become a narrative of our work together as well as an opening for additional possibilities as Carberry and Church continue their partnership.

Observations

For six months, Tatistcheff actively participated in Church's physics and robotics class. Together, they discussed practice and at times brainstormed activities collaboratively. Both spent time with students, collaborating teachers, and the university partner. In turn, those observations were encoded into field notes that were subsequently shared with Church. During the analysis process, field notes provided an important way of reading the dynamic relationships among the university partnership, collaborating teachers, and the whole of Mr. Church's classroom.

Semi-structured Interviews

In addition to daily conversations, that took place during on-going observations, Tatistcheff and Church engaged in a series of more semi-structured interviews to discuss teaching philosophy, curricular approach, and the HS-STOMP project. In addition to Church, other teachers were important in shaping our understanding of HS-STOMP. Two elementary school teachers provided additional perspectives through semi-structured interviews, and informal conversations, while Carberry helped to shape our understanding of the university partnership. Informal conversations with students that were then encoded into field notes also provided meaningful ways of understanding their role in the program as well.

Data Analysis

The initial analysis was conducted while Tatistcheff was a participant observer at GHS. This was done through on-going conversations in which Church and Tatistcheff discussed his work and emerging themes. These conversations often acted as member checks. A second layer of analysis took place when the three of us met together during a university event and again during STOMP showcase near Granite. These meetings were particularly useful for framing our understandings of the relationships among the multiple actors involved in the program. As a result, we framed our analysis in this paper in terms of the roles each of the partners play in the program. After our initial meetings, Tatistcheff did more extensive analysis and coding based on the themes constructed in our conversations. That data was then analyzed by all three authors separately and used to construct the findings section of this paper. Thus, our collaborative analysis shapes our reading of the data and subsequent discussion of the findings.

Findings and Discussion

In Granite, the interconnection of the university partner, physics teacher, collaborating K-6 teachers, and high school students was a particularly important component of the HS-STOMP program. Although the four actors rarely met with each other directly, their relationships are significant for understanding how this model played out in Granite. The following two composite vignettes help illustrate these dynamic relationships.

Vignette 1: Third Grade

> When they arrive at the elementary school, the three female students from Mr. Church's class go into a third grade classroom. There are laptops already out and students who

arrive are put straight to work. Winter boots and coats pulled off, the third graders find "a safe place" to tape the long piece of paper Mrs. Sherman gives them. There is a white board at the front of the room and a sink in the back; the linoleum floor is filled with desks and chairs all sporting tennis ball feet designed to minimize excess noise. The room feels cluttered at times as students search for their "safe place", but it feels like a useful clutter.

The young students ask the high school students for help as they circulate among the groups. Today, students are looking for the relationship between circumference and diameter using robots and different sized wheels. Last week, one of the high school students explained that the difficulty was trying to program the robot to go one revolution. Their group spent time during class trying to find a solution to this dilemma and today, Mrs. Sherman has decided to solve that problem by giving each third grader a bit of paint tape. As the wheel revolves, the paint will leave a dot on the paper. The students can measure the circumference by measuring between the dots.

The high school students circulate among the third grade groups along with the teacher. They work parallel each other. Jill, a high school senior, offers a group of students tape and paint. It seems obvious that she has worked with younger children before because her voice changes as she explains explicitly what the group needs to do. Mimicking Mrs. Sherman's words, Jill asks the group that is beginning to "find a safe place to put your paper so you can run your robot, maybe over here," she points to a location behind a group of desks that is clear and will give the group room to run their robotic car.

After about twenty minutes, some groups are ready to measure the distance between their paint marks; however, some groups are still struggling with programming or building. Mrs. Sherman works with one group, but seems to struggle with troubleshooting their problem. Later she says, "with the robotics, there are so many key elements that we don't have time as a teacher [to learn] because you're learning so many other things when you're teaching elementary school that I needed that support [of the high school students]. They are the key to it because they understood the little nuances of using the robotic cars that we didn't. For example, if a wire was placed backwards instead of forwards, it might take us like 15 minutes as the teacher to figure that out, but they would instantly know it."

Jill tells me later that she is still learning and that "it's good to have Mr. Church here because he knows how to fix these things and I don't know much about computers." On the other hand, Mr. Church notes that he is not sure if it is good to have him there all the time because then the students take more ownership if he's not there. Mrs. Sherman does not always seek help when she is struggling, but she continues to value the input of Jill and her peers asking them to return again.

Another group that the high school students do work with is having difficulty building their robot and programming. When they load the program onto the brick it does not seem to run. It turns out two things are happening; first it is an issue with the wires, and

> second with the speed. As we fix the problem, the teacher says, “See this is why I like to have help here.”

In another instance, two senior males worked in a fifth grade classroom with Mrs. Count. The following vignette describes their experience.

Vignette 2: Fifth Grade

> David, a twelfth grader, sits at a laptop in Mrs. Count’s room. This is the second week David and Brian have been working with this group of fifth graders. Colorful posters line the bulletin boards along the walls and a neatly organized chart reads “everyone lends a hand” with cut outs of hands marking the jobs on the chart. Unlike Mrs. Sherman’s room, this room has a sense of orderliness to it.
> David and Brian facilitate the class, explaining the activity is to “find the hidden letter.” They are having difficulty calibrating the light detectors on the robots. David calls Mr. Church to help solve the situation more quickly.
>
> After two minutes, David hangs up the phone and returns to his computer. He motions to Brian to shift a setting and they test the new parameters using one group’s robot. They are ready to begin class. Mrs. Count commands students to listen in their seats. Taking the cue, David stands in front of the class and changes his voice to project over the hum of the fifth grade. “Ok, I want to see everyone sitting here quiet and the first group I see is the one that will get to go first. Ten, nine, eight, seven, six,…” he begins counting down until everyone is in their seats. I smile to myself because this is the type of thing we do as teachers and David is mimicking the classroom management strategies he too may have experienced. Mrs. Counts and I set up the letter in the hallway. She brings our several pieces of oak tag to cover the letter. We make the letter X because I think it is one of the easiest letters for student to find in our limited time. Mrs. Counts and I do this together while David and Brian are working with two laptops and individual groups. They sit with each group individually and help them to graph the data. Once each group has collected their data, the groups work to graph the data and determine the letter “hidden” in the hallway. Mrs. Counts takes pictures of the students engaging in the activity and helps to manage students’ activities when they are not working with David and Brian. As she does, she notes “I don’t think I could do this at all without the high school students here.”

Interdependent Roles and Relationships

It is clear from these vignettes that the roles and relationships of each of the individual players in this program are intertwined in important ways. The following section examines how each of these actors (physics teacher, high school student, collaborating teacher, and university partner) is situated within the complex enactment of HS-STOMP.

Physics Teacher

Although Mr. Church did not always attend the sessions with high school students, his presence was palpable in each of the classes. Jill references his support when she notes that it is helpful for him to attend classes in case there are problems beyond the scope of the students' knowledge. In addition, David and Brian call Mr. Church to assist in a technological dilemma. Although Mr. Church provided students in his physics class with the opportunity to build and work with new technology prior to entering classrooms, they continue to be active learners while engaging in the HS-STOMP experience. In this way, students may be seen as collaborative colleagues, calling on Mr. Church as a resource to help them problem solve.

The teacher also plays an active role as an intermediary between the university partner, high school students, and collaborating teachers. Although interactions with high school students is the majority of the active role, Church comments on the importance of being able to, "go to the folks at [the university] and get solutions to technical problems that we can't fix here. I can also get help from them on how to run the whole program itself. Talking with people at [the university] helps me see how STOMP fits into the bigger picture." Mr. Church's personal relationships with each of the teachers also helped pave the way for students to enter their classrooms. As Mrs. Sherman noted after she retired from the elementary school, "that brainstorming is what I miss because that's what I used to do with [Mr. Church] all the time. So he's a wonderful person in that area." This collaborative relationship provided a space for reflection and curriculum development for both teachers. Thus, Church's role as both physics teacher and resource become important to understanding how high school students work with the collaborating teachers.

High School Students and Collaborating Teachers

The relationships between the high school students and collaborating teachers are not always clearly defined. In Mrs. Sherman's class, Jill and her peers were assistants; they helped Mrs. Sherman and her students troubleshoot problems and guided students when they could. It is hard to tell how the activity itself influences their involvement. Unlike in other classes, Jill and her friends had not done the experiment with circumference prior to helping in Mrs. Sherman's class. As Jill acknowledges, the high school students were simultaneously learning this new technology in their physics class and Mrs. Sherman's class was the first classroom they visited. As the high school students worked with Mrs. Sherman to solve problems as they arose throughout the lesson, such as, figuring out how to use the robot to measure a linear distance equal to the circumference, both students and teacher brought their ideas to the activity. While Mrs. Sherman actively designed the learning experience, Jill and her classmates were co-authors of that experience in the ways that they supported Mrs. Sherman's ideas.

In contrast to Mrs. Sherman's classroom, David and Brian's experience in Mrs. Count's class provides a different view of the respective roles of high school students and collaborating teachers. For David and Brian, the experience melded what they already knew about the activity with the newness of managing that activity for a group of young students. Having done the activity in their physics class, the two were already technologically familiar with the procedure and desired outcome of the activity. Thus, their role in Mrs. Counts' class was to lead the activity for her students while she acted primarily as an observer. For Mrs. Counts this role was helping her learn both the technology and activity simultaneously. Instead of needing to be an active decision maker in the lesson, the high school students and researcher were able to support students' as Mrs. Counts observed the activity.

Despite these two different enactments of HS-STOMP, each scenario elicited observed mutual benefits to the participants. Mrs. Sherman reported being more comfortable with the technology when the high school students were there to help her problem solve. Furthermore, she noted that for some of her students, "to have that senior boy or girl with him was fabulous. It was just one of those things that made him feel like wow, I'm a worthwhile person. This junior or senior wants to spend time with me and teach me." For the high school students who visit her classroom, Mrs. Sherman noted, "most of the kids who came into my room, having taught in L for so long, were former students and it was wonderful to reconnect and to see how far they went with it." She speculates that, "they loved knowing they made an impact on our students." Jill and her friends indicated similar enthusiasm, though Jill is more focused on content, she notes, "I am very excited to continue to watch this discovery." For Mrs. Counts, the benefits may be on-going. Nearly a year after this experience, she was still apprehensive about being able to integrate technology without the support of the high school students. Thus, for Mrs. Counts, this program may be integral to her willingness to even use technology in her classroom. We need to investigate this scenario more closely in order to understand teachers who continue to need the daily support of HS-STOMP.

University Partnership

It is clear from each of these vignettes that the role of the university partnership has little presence in the actual interaction of high school students with each of these teachers. There is an invisible presence that helps to support Mr. Church's work as well as technology integration. This becomes apparent during an interview with Church when he discusses how he justifies a program like STOMP within a physics class. He notes, "having people question this] forces me to think through and check with some other folks you know is this on the right track. And that's where for me having a place to discuss with university faculty and so having the green light from them, you know this is on the right track," helps him to continue pursing the program.

In addition to supporting Church's pedagogical choices, the university supports STOMP through funding. For example, when Mrs. Sherman was facilitating a summer program, she notes that because of Church's connection with the university "we were able to pick up five more LEGO kits and more webcams and every student in the summer program was able to go home with a webcam and Tufts actually allowed them to have the software so they could run it on their home computer. So that was exciting because then the learning actually goes beyond [school]." For Granite schools, like many rural areas, funding and resources remain a particularly important factor in technology integration. Thus, the university partnership, though perhaps silent in the actual enactment, plays an important role in supporting technology integration.

Thoughts for Future Research

The intertwined relationships present in Granite, are important to our beginning understandings of how programs such as HS-STOMP employ multiple people in technology integration. This preliminary study explored how each actor in the program played an important role in enacting HS-STOMP. For rural communities in particular, these relationships seem particularly important because there is a need to establish lasting tools for technology integration with few resources. In addition, this ethnographic study raises questions to pursue in subsequent research. Perhaps we need to know more about the potential benefits to each of the actors in order to understand the potential for long term sustainability. Perhaps we also need to explore what students are learning in order to support HS-STOMP beyond one community. This study acts as a catalyst for exploring these questions and investigating ways to support technology integration in rural communities.

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