Describing the "Supported Collaborative Teaching Model": A Designed Setting to Enhance Teacher Education

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ABSTRACT: In this article we detail ongoing work designed to understand and improve our practice and that of the future teachers with whom we work. This work centers on helping elementary teacher candidates learn to implement instruction that supports student learning. We have developed and implemented a model—the *Supported, Collaborative Teaching Model* (SCTM)—to help teacher candidates make the transition from student to teacher and encourage them to implement content-rich science teaching. In designing this model we made a series of principled decisions to address specific challenges. Here we outline challenges associated with teacher education and explain how the SCTM helps us address those challenges. We also describe how the SCTM is made possible by our relationship with our Professional Development School (PDS) partnership school. There is reciprocity built into SCTM in terms of teacher candidates being able to work with elementary students and teachers seeing examples of inquiry-based science instruction.

NAPDS Essential(s) Addressed: #2/A school–university culture committed to the preparation of future educators that embraces their active engagement in the school community; #3/Ongoing and reciprocal professional development for all participants guided by need; #4/A shared commitment to innovative and reflective practice by all participants

Introduction

The public education system in the United States is under close scrutiny from all sides of the political spectrum and all elements of our society. Concerns about the education system generally focus on the idea that U.S. students are not performing as well as students in other countries and that there are substantial gaps in performance between different sub-groups within our country. Because there is also widespread agreement that the quality of teachers has a significant impact on student success, policy makers, academicians, and professional associations have become concerned with the improvement of teacher education. A recent report by the American Association of Colleges for Teacher Education (AACTE, 2011) stated, "Properly preparing new teachers is essential if we are to increase

student learning and close the achievement gap for disadvantaged children. All new teachers must be prepared to implement high-impact instruction designed to realize attainment of demanding objectives for all learners" (pp. 2–3). In light of these concerns, we are engaged in ongoing work designed to answer the following grand question: How can teacher educators help elementary teacher candidates learn to implement instruction that supports students' learning?

As we have explored this question in depth we have come to realize that there are two fundamental challenges facing elementary teacher educators. The first difficulty involves helping new teachers make the transition from campus to school, from the world of books and theories to the world of broken pencils and fire drills. The second challenge involves helping teacher candidates learn to implement content-rich teaching and, in so doing, facilitate meaningful learning for their students. In the examination of content-based teaching on which we report here, we focus on science teaching.

We teach methods courses ("Science for Early Childhood Education" and "Early Childhood Methods") for elementary teacher candidates and have been involved with our college's Professional Development School (PDS) partnership since its inception. In these roles we have become intensely aware of the challenges that confront our students as they prepare to become teachers and the difficulties we face as we attempt to support their growth and development. In response to these concerns, we have developed and implemented a model we believe helps teacher candidates make the transition from university student to professional teacher and encourages them to implement content-rich science teaching. This model was made possible through our relationship with our PDS partnership elementary school. In this article we catalogue challenges associated with elementary teacher education, describe how our model—which is rooted in a practice-based theory of knowledge for teaching—helps us address these challenges, and describe how the model is made possible by our PDS partnership.

Challenges Inherent in Teacher Education

The connection, or lack thereof, between most university campuses and the elementary schools where future teachers are trained and will one day work and between the theory and practice of education has been a topic of concern in education circles for many years. Teacher education programs have been criticized for being overly theoretical and having too few connections to practice (Darling-Hammond, Hammerness, Grossman, Rust, & Shulman, 2005). As a result, recent scholarship on the pedagogy of teacher education has highlighted both the importance and difficulty of integrating theory and practice (Bransford, Darling-Hammond, & LePage, 2005; Darling-Hammond, 2000; Darling-Hammond et al., 2005; Feiman-Nemser, 2001; Zeichner, 2010).

This "split" between theory and practice is considered problematic precisely because clinical practice is believed to be central to the enterprise of learning to teach. Leading scholars in the field of teacher education have gone so far as to say that the essential elements of learning to teach are garnered primarily within the context of practice (Ball & Cohen, 1999; Hammerness, Darling-Hammond, Bransford, Berliner, Cochran-Smith, McDonald, & Zeichner, 2005). Not only must learning theories and actual teaching practices be connected in the education of teacher candidates, but experience in real schools and classrooms must be the hallmark of the entire teacher education enterprise. In this view, daily teaching practice is seen as the location in which the elusive theory/practice connection can best be made (National Council for Accreditation of Teacher Education [NCATE], 2010).

Having sufficient opportunities to participate in a variety of "real world" settings is critical to creating a teacher education program

that meets the requirement of integrating the theory and practice of teaching (Hammerness et al., 2005). More difficult perhaps, is the need to reach an understanding, if not a consensus, about what is meant by practice. As Ball and Cohen (1999) point out, the meaning of the term "practice" is not immediately evident. Additionally, Kennedy (1999) writes, "the terms we use to describe teaching practices. . .do not have the benefit of shared behavioral meanings" (p. 72). Thus, it is important to be explicit about what we mean by "practice" and about how we might use the context of practice to both form and inform our teacher education pedagogies.

Another dimension of the problematic connection between theory and practice is the issue of application. Simply knowing the value of a particular teaching strategy, or the theoretical basis for an approach, or even knowing all the steps involved in setting up a specific activity, does not guarantee that one will actually be able to enact the strategy in a classroom full of real children. Education is not the only profession to struggle with the commonplace occurrence of beginning practitioners knowing enough to pass a test, but being unable to use this information spontaneously in appropriate settings (Hammerness et al., 2005). As Kennedy points out, "the problem facing pre-service teacher education is not merely one of giving teachers a new frame of reference, but in addition of giving them the behavioral enactments that accompany these ideas" (1999, p. 71). The problem of application is further complicated by the fact that rote application of memorized actions is not sufficient to meet the demands of diverse children and constantly shifting standards and curricula. Instead, the ability to apply what has been learned and the ability to make changes and innovate must be learned together, "in the context of a schema that provides a means for reflection and further learning" (Hammerness et al., 2005, p. 374).

The inherent complexity of "real" classrooms full of children also presents a challenge to teacher educators and the field of teacher education. While there is substantial agreement that theory and practice should be integrated and that teacher candidates should be provided ample opportunities to participate in the practice of teaching, it is also clear that these real settings are extraordinarily complex and that this very complexity can make it difficult for novices to glean important lessons from their experiences in these contexts. This problem of complexity distinguishes the field of teacher education from other fields of professional practice because "teachers do many more things at once, with many more clients, assembled at one time, than do most other professionals" (Hammerness et al., 2005, p. 374). Because teachers do many things at once, including dealing with daily routines and schedules, managing the physical environment and responding to the needs of a large number of individuals, it can be very difficult for novice teachers and teacher candidates to focus on the process of teaching and learning. Ball and Cohen (1999) state explicitly that, "[a]lthough the bustle of immediacy lends authenticity, it also interferes with opportunities to learn. . ..[-B]eing so situated confines learning to the rush of minute-to-minute practice" (p. 14). Some contexts may simply be "too authentic" and present an overload of information (Ball & Cohen, 1999). The challenge, then, for teacher educators is to provide frequent "real-life" experiences for teacher candidates while helping them to manage the complexity inherent in these situations.

Despite the immense value of practical experience, experience alone does not improve teaching (Jackson, 1973). Experience is only valuable if teachers and teacher candidates make connections between what they have seen and heard and what they understand about the processes of teaching and learning. Thus engaging in a reflective process is pivotal to the increasing competence of teacher candidates and new teachers. Ball and Cohen (1999) suggest that the theory/practice gap can be reduced when novice teachers and teacher candidates are supported to reflect upon and make sense of their experiences "in the moment." Though this statement is intuitively sensible, the question remains: what does this look like?

From the preceding discussion it is clear that making connections between theory and practice is perhaps the most difficult and problematic task of becoming a teacher and yet this is the very task that teacher candidates are typically asked to accomplish on their own (Zeichner, 2010). Students in our pre-service programs typically take classes on our university campuses and complete field work in schools, but are, for the most part, expected to construct their own understanding of the connections between the two. Although it is doubtful that many teacher educators would explicitly advocate for such an approach, this is the reality in many teacher education programs. Most course work in teacher education does not make it possible to support reflection "in the moment" or in the context of practice. Yet if making connections between theory and practice—and between understanding and action—is the critical element in the development of clinical competence, we cannot ignore the processes by which these connections are made. We cannot leave to chance teacher candidates' making of connections between theory and practice, but we must take the responsibility to create "opportunities to connect practice to expert knowledge. . .in learning experiences for teachers" (Darling-Hammond et al., 2005, p. 402).

Many of the challenges faced by teacher educators as they strive to help teacher candidates make connections between theory and practice are the same regardless of subject area or developmental level of elementary students. Because teacher candidates sometimes lack confidence in their science content knowledge, preparing science lessons may highlight these tensions between candidates' pedagogical strategies and conceptual understanding. For example, teachers may focus on the "hands-on" nature of an activity rather than conceptual learning. Specific to science instruction, Windschitl (2009) argues that when teachers are left without a structure for understanding inquiry-oriented teaching—a common approach in science classrooms—it is easy for them to rely on intuition or "folk" theories about inquiry and to "develop as independent artisans, picking up a new activity here and a new technique there, choosing these to fit within their own styles and work setting" (Windschitl, 2009, p. 10). Davis and Smithey (2009) indicate that beginning teachers initially focus on aspects of instruction they think will help with interest, engagement, and motivation. Beginning teachers often emphasize hands-on activities, although they may not use these activities in a way that guides students to understand science concepts. Emphasizing activities that are hands-on in nature is not problematic, although it is important to recognize how such activities support science learning.

Further, it is important to acknowledge how students understand the ideas under investigation. In terms of eliciting students' ideas, teachers may "recognize that knowing about their students' ideas and backgrounds is important, but do not know what to do with information they glean with regard to those ideas or backgrounds" (Davis & Smithey, 2009, p. 747). Our goal, therefore, is to guide teacher candidates to understand how to implement science investigations in which elementary students are asked to articulate their ideas about key concepts and in which teacher candidates are expected to respond to students' ideas in a way that guides students toward intended learning goals.

Our Response to Challenges Inherent in Teacher Education

To respond to the challenges discussed above we created a model called the *Supported Collaborative Teaching Model* (SCTM). Our intent was to improve both our practices as teacher educators and the learning experiences of our students through the development of a specific pedagogical strategy. In designing this model we made a series of principled decisions so that each element of the model intentionally addressed the specific challenges outlined above.

The development of the SCTM as a pedagogical strategy was both inspired and supported by our work in a PDS. Our college of education and the local school district began working together collaboratively in 2008 and opened a new elementary school as a PDS in the

fall of 2009. At this time we began teaching our methods courses on site at the school, but we quickly found that simply holding class in a different location did not significantly improve the educational experiences we were providing for our teacher candidates. We were inspired by the PDS model to focus explicitly on the "gap between research and practice and. . .between professional preparation and the real world of school reform" (NCATE, 2001, p. 2), and we began to consider ways that we might take advantage of the opportunities afforded by holding a weekly college class in an elementary school.

In addition, the reality of a PDS made it possible to imagine, create, and test an innovative pedagogical strategy. Our colleague who spends 50% of his time at the elementary school as a Professor-in-Residence was able to talk with teachers at this school about our ideas and coordinate meetings where we might have in-depth conversations with them. His regular presence at the school supervising teacher candidates, attending data team meetings, participating in leadership team meetings and professional development meetings, and so forth established him as a member of the school community. Initially, it was only because of this positive, trusting relationship that existed between the Professor-in-Residence and the teachers that our idea about the SCTM was even considered. These direct lines of communication and openness to innovation supported the development of the SCTM. In the sections that follow, we first provide a detailed description of the SCTM and then explore specific ways in which the elements of the model address the clinical education challenges teacher educators are facing.

Description of the Supported Collaborative Teaching Model (SCTM)

The SCTM was designed to provide teacher candidates with a tightly scaffolded, gradual transition from the role of university students engaged with theoretical issues to the role of a teacher with multi-faceted responsibilities that must be carried out in real time. This setting provided a context in which we were able to support teacher candidates as they transitioned into teaching while simultaneously doing our own investigation of theoretical issues associated with teacher education and the processes of teaching and learning.

In the SCTM, teacher candidates enrolled in our methods courses taught science to elementary students at our partnership school four times during the semester, working with a different grade level each time. The topics for these lessons and accompanying state standards, dates, times, and grade levels were negotiated between the authors and the teachers at the partnership school. Key aspects of the SCTM included the following elements: a) the structure for planning instruction, and b) the structure for implementing instruction. We structured the planning by providing lessons for teacher candidates for the first and second rounds of teaching in order to offer them models for instruction. We incorporated investigations into these lessons, and made available questions to ask, along with possible responses from students. Overall, our intention was to present our students with examples of planning for instruction that supported learning. The teacher candidates were then responsible for planning lessons for the third and fourth rounds in small groups with their peers.

The other noteworthy element of the SCTM was the structure for implementing instruction. We divided teacher candidates into groups of three and each group was responsible for teaching one of the science center activities—each of which was to comprise an approximately fifteen-minute inquiry-based lesson. Three groups of three teacher candidates were then put together to form a "pod." Each group in the pod taught a different investigation, although typically the investigations were related to one another. For example, within one pod, one group might have focused on a lesson related to demonstrating the difference between translucence, transparency, and opaqueness, while the next group might have worked with light and shadow, and the third group might have discussed the sun as a source of light.

Table 1. Rotation of roles within a group

	First Lesson	*Second Lesson*	*Third Lesson*
Teacher candidate A	Lead instructor	Supporting instructor	Observer
Teacher candidate B	Observer	Lead Instructor	Supporting Instructor
Teacher candidate C	Supporting Instructor	Observer	Lead instructor

We set up three pods in the hallways of the school, and we invited teachers at the elementary school, one grade level at a time, to bring their classes to our science centers. We divided elementary students into small groups so our teacher candidates typically worked with four to six elementary students. The elementary students rotated through the three different centers within one pod, and when the elementary students transitioned to a new center, the teacher candidates rotated among the following roles: lead instructor, supporting instructor, and observer (see Table 1 for an overview of the roles). By incorporating these roles, we intend for teacher candidates to have both the experience of leading instruction and the opportunity to pay attention to students' comments and questions by being the observer.

On days when the SCTM was implemented, we completed one full SCTM rotation for 45 minutes total (fifteen minutes per center), followed by a break during which we conducted a reflective discussion with the teacher candidates, and then we completed another 45-minute SCTM rotation with different elementary classes. When time permitted we conducted an additional reflective debriefing following the second rotation. In all, the teacher candidates typically had a total of six opportunities to teach the same lesson, all the while rotating roles, and having the ability to revise their lessons as they deemed necessary. After each SCTM day, teacher candidates were required to write reflections, focusing on what they learned about the process of teaching, what they believed the elementary students learned about science, and evidence of that learning.

How SCTM Responds to the Challenges Inherent in Teacher Education

SCTM was created as a "designed setting" to respond to the ongoing challenge of integrating theory and practice in the preparation of teachers. The concept of a "designed setting" is taken from the work of Lampert (2006, cited in Ball & Forzani, 2009) in which she postulates a continuum of practice settings that range from "virtual settings" to "designed settings" to "actual settings." A designed setting is an environment—created by teacher educators—in which teacher candidates can engage in a specific set of critical aspects of practice. In this way a designed setting offered the most effective approach to addressing the challenges of teacher education on which we were concentrating because it allowed us to "eliminate or reduce the need for students to engage with some aspects of the work of teaching while focusing [our students'] attention on particular parts of the work" (Ball & Forzani, 2009, p. 504).

Each element of the SCTM was created to respond to at least one of the many challenges confronting teacher educators today. The first step in our quest to integrate theory and practice was to make sure that teacher candidates had multiple opportunities to engage in a variety of types of practice settings. We taught the same cohort of early childhood education majors during their third semester in a four-semester undergraduate program. We worked together to create the SCTM and utilize three or four class sessions from each course to prepare for and enact the SCTM. Although the teacher candidates in our courses already spent two days each week in a field placement, the SCTM gave them further time to engage in the practice of teaching. In addition, the SCTM experience provided teacher candidates with the opportunity to interact with children from a variety of grade levels, thus expanding their repertoire of experiences. And SCTM made it possible for our teacher candidates to engage in science instruction, which we find may be a rare occurrence in their more traditional school-based experiences because of schools' increasing

emphasis on mathematics, reading, and writing instruction.

The very definition of "practice" is a second challenge facing teacher preparation programs. In our view, practice means that activities are contextualized and involve some of the conditions one would find in a typical elementary classroom. The SCTM was contextualized in that teacher candidates interacted directly with elementary school students and implemented lessons based on state standards and the required district lesson framework. In the SCTM, teacher candidates conducted several cycles of the planning, implementing, and reviewing process. Because practice is thought to be central to learning to teach, repeated opportunities can contribute to the development of behavioral enactments (Hammerness et al., 2005; Kennedy, 1999). A contextualized experience helps teacher candidates learn how to make principled decisions about science instruction, particularly in terms of devising "ways to teach content that is meaningful and engaging to students" (Mikeska, Anderson, & Schwarz, 2009, p. 679). Teaching science in this designed setting provided teacher candidates with multiple opportunities to experience the ebb and flow of instruction and to see consequences associated with instructional decisions.

A third challenge that confronts teacher educators is how to help teacher candidates apply what they have learned in their university courses in their elementary classroom experiences with children. The SCTM was developed to facilitate the process of application by providing direct and specific supports, including the following structures: 1) specifying the general topic and the curricular standards with which candidates were to work, 2) providing access to content area specialists, 3) providing time to review and plan pre-service teachers' science center lessons during university course time, and 4) giving candidates opportunities to repeat lessons several times so they had chances to change and improve their plans. The additional support of providing model lessons diminished during the semester. This set of supports created a tightly scaffolded learning experience.

As described by Hammerness et al. (2005), effective application of theories must include the ability to innovate to meet the needs of students and circumstances. Each day of the SCTM included at least six repetitions of the same science lesson, providing ample opportunities for students to engage in the process of making modifications between these sessions. During the sessions teacher candidates were able to make immediate, responsive modifications by asking their peers to obtain additional or different materials or by interjecting with an alternate explanation when the students seemed confused or disengaged.

Our SCTM model represented both a contextualized experience to deal with candidates' needs for real world experience in teacher education, *and* a decontextualized experience to deal with the problem of complexity—which is the fourth challenge on which we concentrated. The SCTM science centers were contextualized and involved actual children and real standards, but they were decontextualized because teacher candidates worked with small groups of students for a short time outside of their regular classroom. The SCTM was a clear example of a designed setting that exists in between an actual setting and a virtual setting (Lampert, 2006, as cited in Ball & Forzani, 2009). This model moved us beyond the view that only authentic contexts are necessary for learning to teach and highlighted the reality that all contexts for practice are not the same, nor are they all equally productive for helping teachers learn the skills that are important for teaching (Ball & Forzani, 2009). By removing the need to deal with large numbers of students in a multifaceted physical environment, the SCTM reduced the demand on the teacher candidates and opened up a space where they could test new approaches to teaching. The creation of this particular designed setting was intended to limit complexity and the interference of extraneous information and make it easier for teacher candidates to focus on a few important skills or strategies at a time.

Gaining a clearer understanding of the multi-faceted roles teachers play is another challenge that confronts teacher candidates and the teacher educators who work with them. The SCTM explicitly included three different roles—teacher, assistant, and observer—so that teacher candidates could view the teaching and learning process from three distinct perspectives. By requiring teacher candidates to participate in this experience from these different vantage points, they were able to begin to develop a more robust understanding of what it means to be a teacher. Borrowing from lesson study (Fernandez, 2002; Stigler & Hiebert, 1999), we very purposefully included the role of observer because we wanted to draw attention to the need to focus on what the children were doing and saying. We wanted our teacher candidates to move beyond the vision of a teacher as someone who stands in front of the classroom and delivers snippets of information and nuggets of wisdom. By requiring each teacher candidate to take a turn as the official observer, we hoped to broaden teacher candidates' understandings of what it means to be a teacher.

In order to reduce the discrepancy between what teacher candidates are taught in university classes and what they are expected to do in schools, the SCTM made a point to involve classroom teachers throughout the planning for the SCTM, and our PDS partnership facilitated communication with these teachers. At the beginning of the semester, classroom teachers from three or four grade levels were asked to pick a date for science centers that were convenient for them and to identify the science standard(s) they wanted the teacher candidates to address in their centers. In addition, teachers were asked to observe during the SCTM experience and provide feedback to the teacher candidates and the methods instructors. By including teachers as partners in this model we hoped, over time, to create shared understandings about teaching and learning among teacher candidates, university professors, and classroom teachers.

Finally, the need to reflect on clinical experiences and make connections between these experience and learning theories was the original impetus for the development of the SCTM. The model included several elements that highlighted and facilitated the reflective process. By including an observer as one of the three roles teacher candidates took on during the SCTM, the importance of observation was highlighted. And because the science center sessions were repeated multiple times in the SCTM, students were given a very brief but very real opportunity to address the questions posed by Hiebert, Morris, Berk, and Jansen (2007): "How could lessons based on this information be revised to be more effective when teaching them next time?" (p. 48). Perhaps most importantly, during longer breaks between sessions and/or after the conclusion of the SCTM each day, we conducted whole class debriefing sessions intended to model and elicit the reflective process. Questions posed during these sessions varied, but the following are some examples of our guiding queries:

1. What questions did the children ask that you had not expected?
2. What were the most successful provocations you used?
3. What misconceptions did you find evidence of?
4. Which aspects of the content were difficult to teach?
5. When were the children the most engaged? Least engaged?
6. What surprised you?
7. What was the best comment made by one of the children?
8. What changes did you make? Why?
9. What would you do differently in the future?
10. How might you implement these lessons for a whole class?

While we created the SCTM to help us address the general challenges confronting the field of elementary teacher education, we also designed the SCTM to deal with challenges of science education in particular. In our experience, teacher candidates are often intimidated by science and have few opportunities to see science taught or attempt to teach it themselves.

The SCTM provided our teacher candidates with several low-risk opportunities to teach science to elementary students, which we hypothesized would boost their confidence in their ability to teach science successfully.

Another science education challenge addressed by the SCTM was the idea that all science lessons are created equal. In the model lessons provided to the teacher candidates for the first two SCTM rounds, we were explicit about why we chose certain activities and how other activities might engage students in different ways. During our science methods instruction in our university course, we discussed why particular materials were used to illustrate science concepts and why certain questions were asked to elicit deep thought concerning scientific processes. These class discussions then carried over into the SCTM as we reflected upon why we created the lessons as we did and then, as the teacher candidates write their own lessons, why they created the lessons as they did. In addition, as the teacher candidates took on the role of the observer, we asked them to pay particular attention to the types of questions that draw out students' thoughts, the types of materials that allow students to identify scientific concepts, and what students do or say to demonstrate learning.

For example, during one iteration of SCTM, three groups of teacher candidates were teaching kindergarten students about the differences between living and nonliving objects. One group asked students to classify objects as living or nonliving. They noticed that the students were confusing living/nonliving and real/fake. That is, a plastic flower was described as nonliving because it was fake, but a highlighter was described as living because it was, in these elementary students' perspectives, "real." During the debriefing between SCTM rounds, another group of pre-service candidates mentioned they noticed students making similar comments. The third group did not hear these same comments. They, however, chose not to have students classify objects; they created a poster showing a fish bowl and asked students to discuss objects found in the fish bowl. The differences between the groups provided our class with many such opportunities to discuss how choices made about materials and instruction can shape elementary students' learning opportunities.

Lessons Learned: Logistical and Conceptual

The SCTM has been, by most accounts, successful. We recognize that for these school administrators and teachers our first attempt at implementing the SCTM no doubt required a professional leap of faith. It seems safe to say that these individuals in our PDS partnership school are now familiar with the structure of SCTM and are increasingly willing to collaborate by allowing us to work with their students and even indicating which standards they would like us to address. In fact, many teachers have told us they look forward to the SCTM days so that they may see new teaching ideas and their students can experience instruction in a different way. There is reciprocity built into SCTM in terms of teacher candidates being able to work with elementary students and teachers seeing examples of inquiry-based science instruction.

The success of SCTM is an accomplishment given the number of people involved, and we believe our success, so far, is the result of communication, clarity, consistency, and flexibility made possible by having a relationship with our PDS partnership school. As with most projects that involve multiple participants and multiple institutions, we have learned that communication is the key. We have conducted the SCTM at our partnership school where one of us teaches our course on-site weekly and where another one of our colleagues spends two to three days per week at the school as a Professor-in-Residence. The regular presence of several faculty members and graduate students at the school has made possible the frequent and regular communication upon which this type of program appears to depend. Although official meetings to discuss the "big picture"

of the project are important, we have found that brief but frequent chats in the hallways between classroom teachers and university faculty are often the most productive and meaningful forms of communication.

We have also learned that being clear about our teacher education purposes and our plans is critical to the success of such a model. Teachers, teacher candidates, and children all need to know exactly what to expect in order to best be prepared to learn, and this model highlighted this need for clarity. Thus our efforts and activities proceeded much more smoothly when we provided charts and frequent reminder e-mails about the details of our plans to our PDS school partners. In addition, we have discovered that consistency is a key to this clarity. We have found that when we change the day of the week when we conduct science centers or when some grade levels are invited to participate twice in a semester and some grade levels are only invited to participate once can cause significant confusion and require a great deal of last minute modifying (and mollifying).

As with almost every aspect of life in schools, a most necessary ingredient is flexibility. On some days in order to fit science centers into the schedule we had to reduce each session from fifteen minutes to twelve minutes. Sometimes the elementary students arrived in groups of three and sometimes in groups of seven. There were days when we had what we discovered was an optimal schedule that allowed us to conduct full debriefing sessions between class rotations, and on other days we did not debrief until all the teaching sessions were over. And then there were days when plans for outdoor investigations were dashed due to rain. But through all this we continued to remind our pre-service teacher students that this is what the real world of teaching is like: things rarely go according to plan and you need to be able to change quickly and with as little fuss as possible.

What we have learned about the pedagogy of teacher education and what our university students have learned about teaching and learning are issues of greater significance and import. Perhaps most significantly, we have learned how difficult it is for our teacher candidates to allow children to experience ambiguity or confusion. Although we frequently discuss the fact that mistakes and confusion are often precursors to learning, many of our students seem to expect learning to proceed on a direct, gradual, linear path from not knowing to complete understanding.

For example, during a debriefing session following the previously mentioned lesson on living/nonliving, several teacher candidates commented that the plastic horse we had included in the set of materials provided a challenge for both the kindergartners and for them as teachers. They complained that the plastic horse confused the children because toys are non-living, but that horses, represented by the toy, are living. We suggested that this confusion provided a wonderful opportunity to have rich discussions about the topic and perhaps tap into students' misconceptions and naïve understandings. In the subsequent round of science centers, several groups kept the plastic horse in the set of materials, but one group did not. In the final debriefing session, this group stated that they took out the plastic horse because it confused the children. Recognizing our teacher candidates' discomfort with ambiguity and confusion is a newly discovered challenge to our work as teacher educators. By implementing the SCTM as a designed setting in our courses, we have successfully dealt with many of the challenges of teacher education and also uncovered new, deeper challenges.

From their experience with the SCTM, our pre-service teacher candidates appear to have developed greater understanding about the many factors that influence teaching and learning, including an appreciation for the power of direct experience with concrete

materials. For example, one of the groups worked with the first grade students to make shadows by shining a flashlight onto an object in a box through a hole in the box. The teacher candidates then asked the students how they could make the shadow disappear, expecting the children to turn off the flashlight or put their hand in the path of the light. Though several of the small groups of children did do this, one child simply took the lid off the box. This made it possible for the teacher candidates to initiate a discussion about light sources and their impact on shadows. Analogously, the description of this event during our debriefing session made it possible for us to explore the power of concrete materials and what learning opportunities are afforded to children when they are in charge of manipulating materials and able to see the scientific concepts in action.

Future Directions

Although we feel the SCTM has been successful as a vehicle for engaging teacher candidates in science teaching, we are continuing to refine this model. One of the issues with which we struggle is how to help teacher candidates to reflect on deeper aspects of the lesson—beyond immediately apparent things such as student behavior. When asked to comment on the SCTM, one pre-service correctly commented, "We've never been trained as observers, what you need to watch out for." This comment indicated to us that although we emphasize observation while candidates are conducting their fieldwork, we need to be clearer about what it means to be an observer, particularly if the purpose of observing is to find evidence of their own and elementary students' learning. It has become apparent that simply asking teacher candidates to assume the role of an observer, and even equipping them with a sample documentation form, is not sufficient guidance. In addition to finding ways to clarify the role of observation in teaching, we hope to explore the use of video to encourage candidates' more in-depth reflection and analyses.

Overall, we believe that the SCTM provided important growth opportunities for teacher candidates, practicing teachers, and elementary students to engage in science teaching and learning, and it offered a specific and detailed example of how a thoughtfully designed setting can address many of the perplexing challenges of elementary teacher education. Working in this setting also opened up opportunities for us to examine issues associated with the pedagogy of teacher education. For example, we were better able to investigate how participating in this experience shaped teacher candidates' perceptions of how instruction can support elementary students' learning and what counts as evidence of this learning. Ultimately, we hope to investigate the impact of the SCTM on our students after they leave our course and enter student teaching. As we assemble findings from various investigations surrounding the SCTM we expect to be able to present a well-informed example of how methods courses can be structured to address challenges facing elementary teacher education and to support teacher candidates as they bridge the gap between theory and practice. SUP

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