Coteaching In A Science Methods Course: A Situated Learning Model Of Becoming A Teacher

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COTEACHING IN A SCIENCE METHODS COURSE
A SITUATED LEARNING MODEL OF BECOMING A TEACHER

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A situated learning model of coteaching was implemented in the weekly field component of a secondary science methods course. Students cotaught by observing and assisting their teacher for one period followed by taking the lead in teaching the same lesson with their teachers' assistance during the following period. Students were peripheral participants, reflecting on both their teacher's practice and their own practice. Data supported four positive outcomes of this model for the methods students: (a) comfort in learning to teach, (b) critical reflection in modeling the teacher's lesson, (c) development of confidence in teaching and managing students, and (d) positive effect of seeing and doing inquiry in practice. All participants supported the continued practice of teaching from the classroom teachers' existing lesson plans. Future research is suggested on how real-time teacher assistance during this model could help the methods students acquire the teaching strategies and habits of their teacher.

Before their student-teaching experience, preservice teachers spend time observing teachers in schools, assisting these teachers in the classroom, and, if possible, teaching their own model lessons. In science, this assistance can include setting up and monitoring laboratory exercises and working with small groups of students. These experiences help relieve some preservice teacher anxiety before student-teaching and help solidify their early choice for a teaching career (McIntyre, Byrd, & Foxx, 1997). In teaching model lessons, preservice teachers demonstrate how they can perform the rudimentary tasks of teaching a class as well as designing and implementing lessons congruent with national standards for inquiry education (National Research Council [NRC], 1996). Addressing their ability to perform these tasks is important before they begin a long-term, student-teaching placement. But despite the usefulness of model teachings, these experiences (observation, assistance, and model teaching) do not substitute for being the classroom teacher. After such experiences, student-teachers in science are still faced with beginning the process of learning how to be a classroom teacher with the array of tacit and experiential knowledge needed to master teaching content and manage students in an inquiry learning environment (Flick, Keys, Westbrook, Crawford, & Carnes, 1997; Latz, 1992; Shulman, 1987). Preservice teachers seem aware of this dichotomous process and look forward to obtaining the real learning of being a teacher in student-teaching.

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They clearly articulate this existing dichotomy and lack of knowledge transfer between teacher education programs and the real practice of classroom teachers (Adams & Krockover, 1997; Prawat, 1992; Rodriguez, 1993).

As beginning teachers struggle to become classroom teachers in their own classrooms, they often blame their university preparation, including disconnected coursework and the lack of adequate field experience, for their 1st-year difficulties (Wideen, Mayer-Smith, & Moon, 1998). When asked what could be done to better prepare them for teaching, graduates in science education often cite among other things the need for more and earlier field experience (Adams & Krockover, 1997). However, questions have existed for some time as to whether more of the same traditional field experience of observation and assistance would help preservice teachers become classroom teachers (McIntyre et al., 1997; Zeichner, 1980).

SITUATED LEARNING MODELS IN TEACHING

Situated learning theory draws attention to the cognitive learning that occurs in completing tasks in authentic situations (Brown, Collins, & Duguid, 1989; Lave, 1996). Proponents of situated learning or so-called cognitive apprenticeships emphasize the centrality of culturally situated activity in learning domain-specific knowledge. For example, much of the knowledge for teaching cannot be learned out of context and later applied in classrooms. This knowledge develops for novices in practice with experienced teachers who explicate and model their tacit knowledge of teaching (Lave, 1996). In an effort to place classroom teacher's knowledge in dialectic tension with researcher knowledge, researchers are currently focusing on field-based models of teaching based on situated learning theory. These models place an emphasis on reflective practice through socially situated dialogue stemming from shared teaching experience. In science teaching, the goals of inquiry education are critically examined in the light of teaching practice within particular contexts.

Most of this work to date has been done in student-teaching and the internship (post-student-teaching) experience. One model includes the pairing of two student-teachers with one cooperating teacher (Berg & Clough, 1999; Lemlech & Hertzog, 1998). In this model, all three teachers take turns during the day in leading a commonly planned lesson. Teaching is followed by reflective dialogue on how to improve the lesson and its teaching for optimal student learning. Results from this research suggest that student-teachers reflect more deeply on their practice as they plan and teach with each other and the cooperating teacher (Berg & Clough, 1999). Lemlech and Hertzog (1999) found that partnering student-teachers created a learning community of reflective practice in which all parties (cooperating teacher and student-teachers) learned from each other in becoming better teachers. Their concept of a learning community de-emphasized the central role of the cooperating teacher in this process.

Roth and Boyd (1999) have approached the concept of pairing and colearning from a stronger apprenticeship learning model (Lave, 1996). A student-teacher (or student-teachers) is paired with a classroom teacher in which the student-teacher learns to teach in practice at another teacher's elbows. In this model, student-teachers learn to teach while teaching alongside the cooperating teacher, not separately, and sharing the lead in teaching the lesson within the same period or class. The rationale for this approach is to help student-teachers (and novice teachers) better internalize the "tacit dimensions of the experience of teaching and being-in-the-classroom" (Roth, Masciotra, & Boyd, 1999, p. 771). This approach, though an apprenticeship model, places both experienced and inexperienced teachers in the role of colearners, thereby lessening the traditional power relationship between student-teacher and cooperating teacher. All practicing teachers together learn from shared teaching experiences as inhabitants of the same classroom environment (Bourdieu & Loic, 1992). This concept called "coteaching" blurs the distinction between theory and practice, university and classroom,

supervisor and student by learning to teach through reflection and dialogue on shared experience in practice itself (Roth & Tobin, 2000). Roth and Boyd's (1999) work to date showed that this approach toward learning to teach has been "less painful" and "more efficient" for novice teachers of science (p. 63).

The initial research on field experiences modeled on situated learning appears promising in helping preservice and beginning teachers become classroom teachers. In these models, reflective dialogue and change in practice occurs from shared practice within the practical and contextual aspects of teaching in the classroom. The juxtaposition of formal and informal theories of teaching (e.g., inquiry education vs. what works in the classroom) is a reflexive component of this process for science teachers (Cole & Knowles, 2000; National Research Council, 1996). In practice, teacher knowledge is created in the dialectic tension between theory and practice. Bridging the transition from university to classroom through learning to teach and reflect with another in common practice is a laudable goal of coteaching research.

RESEARCH MODEL AND QUESTIONS

In this article, we describe a model of a situated learning field experience for secondary science education students prior to student-teaching. This coteaching model contains elements of previously cited models. This "hybrid" model met the practical concerns and constraints of classroom teachers and what would work for them (Kagan, 1993). Individual students in a methods course were paired with a classroom teacher for two consecutive periods of the same subject. During their first period, they observed and assisted the classroom teacher in teaching the lesson as peripheral participants in the lesson. This participation included helping the teacher implement the lesson through managerial support and direct assistance to small groups or individual students. For the second period, students led the teaching of all or a portion of the same lesson with the classroom teacher's assistance. The methods course instructor encouraged the classroom teachers to more actively assist and help guide the methods students where needed as they attempted to model, not mimic, the lesson. Thus, the coteachers did not have identical roles as teachers (or equal time) in taking the lead in teaching within a class period. Also, by nature of the apprenticeship, the classroom teacher took a more active role in assisting in the lesson during the second period of coteaching.

The focus of this early work was threefold: What aspects of domain-specific knowledge from authentic practice could preservice teachers develop from this coteaching experience? What advantages and disadvantages do classroom teachers and preservice teachers see from this coteaching approach? How do these preservice teachers reflect on their ability to implement inquiry-based forms of teaching (National Research Council, 1996) in the context of coteaching?

RESEARCH CONTEXTS

Ten secondary science education students were enrolled in their second 10-week undergraduate science methods course prior to their 12 weeks of student-teaching. This second course was designed with an 8-week field component in classrooms. The instructor placed 6 students with middle school teachers in one school and 4 students with high school teachers at another school. The instructor placed methods students individually with a classroom teacher for a half day each week—two consecutive periods. High school placements were made so that students' content major matched the subject area that they would teach. Students in middle school placements all taught integrated (general) science. Some teachers had more than one student assigned to them but at different times of the day or week. Teachers from both schools were voluntarily recruited (three from the middle school and four from the high school) and had previously hosted methods students. These teachers regularly implemented inquiry supportive practices in their classrooms.[1] One lead teacher at each school agreed to participate in the coteaching experience as both subject and research participant in this study. These two teachers felt strongly about working with preservice teachers and

jointly planned and reflected on this coteaching experience with the researcher.

After the 1st week of observation, students were instructed to begin coteaching with their classroom teacher. The methods course instructor (and researcher) explained the adopted model of coteaching both verbally and in writing to all participants. This explanation included the active role to be played by classroom teachers. Lessons were prepared entirely by the classroom teacher and were part of the scheduled curricula for the grade level or course. Methods students were instructed to prepare for this curriculum (or content) and upcoming lessons in advance by reading and studying the upcoming topics using teacher-prepared lesson plans, handouts, notes, and/or text. The methods instructor encouraged communication with classroom teachers before the day of actual teaching each week. Ongoing dialogue between the methods students and their cooperating teachers occurred in both the briefing on upcoming lessons and the debriefing on how the methods students performed. No data was collected on these conversations because the principal researcher felt that this additional method would be too intrusive while trying to support the participants in implementing this new model.

The methods course instructor observed each coteaching arrangement during both periods every 2 weeks—approximately three times per episode. Field notes were recorded during each visit, and supportive feedback on teaching was given to each student. The methods instructor did not attempt to become part of the coteaching arrangement during this first implementation of this model but instead focused on gathering field notes on the methods students' and cooperating teachers' tack, including classroom dialogue and interactions. This sideline approach, although not evaluative (or grading) in nature, was accepted convention by the participants.

Methods students kept a reflective journal on their weekly coteaching episode. They also participated in a midterm discussion on campus of what they were learning from the coteaching experience. This discussion led to greater understanding of classroom contexts and the emergent issues about the coteaching process. Classroom teachers also gave detailed feedback on students' teaching in the middle (formative) and end (summative) of the experience using a portion of the state-approved observation instrument for new teachers. At the end of the coteaching experience, classroom teachers and methods students responded in writing to researcher-posed questions about the coteaching process (see appendix). These questions solicited feedback on the process and targeted the potential learning outcomes for teaching from the experience.

DATA ANALYSIS

A cooperative inquiry approach was used in this study (Reason, 1998). The researcher and lead teacher at each of the two participating schools planned, implemented, and reflected on the coteaching experience as a means of preservice teacher induction. Thus, all three individuals were considered coresearchers as well as cosubjects. The goal of this research was the "systematic testing of theory [this coteaching model] in live-action contexts" (Reason, 1998, p. 279). The researcher and lead teachers shared their perspective on the phenomenon of coteaching through paired meetings between the researcher and each lead teacher before, during, and after the coteaching experience. This feedback led to awareness of fine-tuning needed in the implementation of the model as well as ideas for its improvement in the future. Thus, lead teachers contributed to the evaluation of this model and its impact on them and the teaching of the preservice teachers assigned to them (Guba & Lincoln, 1989).

The coresearchers analyzed the data using a grounded approach with cross-case analysis (Maxwell, 1996). Descriptions of how the teachers assisted the methods students in teaching were developed inductively from field notes and checked with the methods students' written accounts of the same (Strauss & Corbin, 1990). Reflective data sources (student journals and question responses) were coded thematically, focusing on the research questions of this study (Strauss & Corbin, 1990). Cross-case comparisons of the data were conducted in search of

common experiences, themes, or outcomes (Maxwell, 1996). Data in the form of quotes that typified a common theme across participants were shared to support assertions from this study. Numbers of cases supporting an assertion were mentioned where discrepancies existed on a theme. Researcher-developed assertions and interpretations were member-checked by the two lead teachers at each of the participating schools. In this way, the three coresearchers and cosubjects of this experience constructed shared meaning from it (Guba & Lincoln, 1989).

RESULTS

Description of Classroom Teacher Support

Classroom teachers assisted methods students when they took the lead in teaching through helping facilitate the lesson. Teacher help included logistical support such as the collection, dissemination, and setting up of materials needed in the lesson. In addition, all of the teachers gave in-depth verbal and written feedback to methods students after their teachings. Further support occurred through classroom teachers' active assistance during coteaching in helping methods students teach the lesson and manage students. Active assistance included ongoing verbal assistance and interjection throughout the entire lesson. Analysis of researcher field notes and reflective responses from methods students showed that the level and quality of active assistance varied from case to case. Active assistance beyond handling student misbehavior was rare in 5 of the 10 cases. The eighth-grade teacher in this study did not interject at all. In the 5 cases in which active teacher assistance was common, the researcher could describe from field notes the following four verbal types of assistance: (a) assistance to keep the lesson on track, (b) directions to better manage students, (c) clarification and questioning for student understanding, and (d) handling student discipline. All four types of verbal assistance and interjection occurred to support and sustain the flow of the lesson so that it would be taught similarly to the classroom teachers' lessons. In some cases, teachers' verbal interjections helped to sustain the slightly different approach taken by methods students. This assistance mainly served to properly guide the methods students through the lesson in an effective manner, especially at moments during which they seemed unsure of themselves. Teachers verbally intervened during event changes or transitional points in the lesson to help methods students give clear and appropriate directions for the next portion of the lesson. This assistance mainly served to better manage classroom students as they moved to and from laboratory or activity portions of the lesson. Active assistance also included further explanation or clarification of concepts being taught and answering student questions that the methods student could not answer. Teachers also asked questions of their classroom students about what was taught. These questions helped clarify the lesson's content and served to assess student understanding of the lesson. All of the classroom teachers, including those teachers who rarely interjected, interrupted their methods students' lead teaching when they believed it was needed over student behavior issues. Teachers intervened when students were talking excessively or interacting with each other inappropriately.

Teacher Presence Brings Comfort

Most of the methods students shared in their reflective journals and final responses that they felt supported in their attempts at taking the lead in teaching and reassured by having the teacher present, whether they were highly involved in the lesson or not. They felt more comfortable with the teacher present because of the daunting task of attempting to teach a lesson by jumping right in after one period of observation and assistance. As one seventh-grade methods student described the situation in her journal, "I found that when you just step up and do it, it usually isn't as bad as you thought, and your confidence increases. This is definitely high-pressure teaching." During the first period, methods students mainly observed

their teachers but did assist them some when students were doing lengthier seatwork, labs, or other more student-centered activities. During the second period when they took the lead in teaching, they viewed the teacher as their final backup or support if all else failed. One high school methods student in an anatomy classroom shared, "One strength of this approach [coteaching] is that my teacher is there to help me whenever I get into a bind. She helps me to explain difficult concepts, and this makes me much more comfortable teaching." Moving into the unfamiliar practice or domain of teaching from university schooling was difficult for most of these methods students.

Critical Reflection in Modeling Inquiry-Based Lessons

Methods students were keenly aware of what worked well or did not work well in their teachers' lessons. They often cited their teachers' perceived strengths and weaknesses in their reflective journals. They strove to imitate what they perceived as their teachers' strengths in their coteaching. These strengths were the methods or strategies that they wanted to better model in their teaching of inquiry lessons. For example, the high school anatomy methods student shared how her teacher used an ongoing questioning technique that engaged her students in understanding the material in class and in lab. She wanted to be able to do a better job at questioning like her teacher. This awareness of their classroom teacher's practices and students' reactions was helpful in critically analyzing and reflecting on teaching practices, both their teacher's practices and their own practices.

In a few cases, methods students attempted to improve the lesson during their lead in coteaching the next period. The seventh-grade methods student, who viewed coteaching as "high-pressure teaching," regularly modified her teacher's lesson during the second period. On one occasion, she was modeling her teacher's hands-on lesson on simple machines. Students were using LEGO Dacta kits to explore the types of levers through constructing different combinations of fulcrum and lever arms and determining which combinations made work easier (or produced a mechanical advantage). After the students explored the lever types and formed tentative ideas about their usefulness, the methods student named them for the students. However, unlike her teacher who orally taught this portion of the lesson, she wrote the lever names on the board along with a diagram example of each for the students to copy down. She wrote about this lesson in her journal:

> As I observed the class as Mr. L. taught, I was able to pick out areas where they [the students] seemed to struggle, and tried to modify my teaching to make these things more clear. For example, writing stuff on the board and using visual helps for the students.

In these instances, methods students were reflecting on their teachers' teaching and learning how to make adjustments in the context of authentic activity. Knowing how to teach somewhat differently came from their peripheral participation during the first class period in this cognitive apprenticeship. Some of the methods students were observed modeling their teacher's approach, not mimicking it.

Learning on the Spot Through Active Teacher Assistance

In the five cases with high levels of teacher assistance during coteaching, these methods students and their teachers also mentioned one of the presumed benefits of situated coteaching models: learning on the spot from an experienced teacher. Learning on the spot meant that assistance was given when needed and on-the-spot corrections made during the lesson in real time. The physical science methods student liked this aspect of coteaching:

> I do feel that this [coteaching] is the most favorable method, because I have learned about situations while they are on my mind and I am in the moment. For example, if Mrs. S. asks me to draw something to make it more clear, I can do it immediately and have that initial practice.

Her classroom teacher concurred with her position on this aspect of coteaching:

> It [coteaching] allows the preteacher to interact with a classroom teacher and learn from their mistakes on the spot. It is hard to figure out how to phrase ques-

> tions to students during a class discussion and I think my preteacher gained some confidence with this.

Advocates of situated learning models state that this type of learning occurs in action in the context of teaching. In this way, methods students have the opportunity to learn in practice as the lesson unfolds. This learning to practice within practice is in contrast to more traditional models of learning to teach in which methods students teach model lessons based on university knowledge and only receive situated feedback after teaching.

Developing Confidence and Assertiveness

In the midterm discussion, methods students mentioned the teaching skills and strategies that they were acquiring through their coteaching experience. These skills were unique to their individual contexts and included such things as bell-to-bell planning, simplifying complicated material, giving clear and concise directions, addressing various learning styles, working one-on-one with students, and implementing positive disciplinary strategies, to name a few. Yet the benefit cited most often by methods students when asked how coteaching was beneficial in helping them learn to teach was an increased comfort level, confidence, and assertiveness in the classroom. They realized that their confidence and ability to manage their students would directly affect their ability to implement many forms of inquiry teaching. One eighth-grade methods student said,

> It helped me to learn to be more assertive. If you don't tell kids to be quiet, then they will continue to talk. . . . I learned that I cannot be as laid-back as I want to be. I first have to establish the rules I want the students to abide by if I want an open classroom.

The second seventh-grade methods student shared, "I have become better about settling my students before I begin my lesson. Also, recognizing disturbances during my lesson and diffusing them quickly with as little interruption as possible has been improving during my placement." Classroom observation data also supported their self-reported increased ability in managing the classroom through greater assertiveness. Past research supports that the learned ability to manage students well comes from teaching practice, especially in the early years. Getting a head start on this domain-specific knowledge may help ease the transition to teaching alone.

Focusing on Teaching, Not Planning

In this coteaching model, students observed, assisted, and began teaching from their teachers' planned lessons. In their final reflective questions on the coteaching experience, three students stated that they liked not having to create their own lessons to teach each week. They had more time to concentrate on reviewing the upcoming material for understanding and the basic plan of their teacher for teaching it in the classroom. In this way, these methods students felt that they could focus and reflect more on understanding how to enact the lesson. A sixth-grade methods student said,

> I also enjoyed that we were able to focus on teaching and not writing lessons. This took a lot of pressure off of me, and I was able to examine my skills as a teacher rather than as a lesson writer.

In discussions with the participating classroom teachers before and after the coteaching experience, they all liked the aspect of coteaching that kept teachers' existing plans in place. Classroom teachers were able to carry on their sequenced instruction without interruption. The lead middle school teacher felt that sticking with his school's sequenced instruction was better for the learning of his classroom students. In particular, teachers who taught under strict pacing pressures at the high school (due to block scheduling and exit exams) were especially supportive of this aspect of coteaching. The lead teacher at the high school shared, "I felt better coteaching because I did not turn over control of my classroom and still got to cover needed material." Classroom teachers were not party to the creation of artificial settings where inserted model lessons were not a part of the normal class environment. The teaching context was kept as authentic as possible.

Inquiry Is Effective and Possible

All methods students experienced teaching an inquiry-based lesson under various constraints to their use. High school methods students experienced the possibilities of using inquiry in a high school under strict pacing regimes. The physical science methods student stated, "One important thing was that I got to see that a class could be organized well enough to cover the material and use inquiry-oriented activities on the block schedule." These pacing regimes existed, even at the middle school level, because of state-mandated curriculum, scheduling, and standardized testing. Most of the methods students also experienced and described how inquiry activities were engaging for classroom students and captured their interest and involvement better than teacher-directed lecture or discussion. In many instances, this engagement decreased problems with student discipline usually due to off-task behavior. The sixth-grade methods student stated, "The students respond better to inquiry. It seems to be more practical and useful for students. . . . If a class is actively engaged, they will be much easier to manage." However, the third seventh-grade methods student noted that the higher level of student movement associated with certain activities (such as going outside) would be more difficult to manage for intended learning purposes. He said, "This experience [going outdoors] let me realize that trying to become an inquiry-oriented teacher can hold consequences. Classroom management will be the most obvious problem, and student focus would be the other problem." Overall, methods students felt that inquiry seemed more useful, related, and practical to the classroom students. Experiencing inquiry in real classrooms may have been a gestalt moment for some of these students. Teaching and practicing inquiry on campus alone or in artificial teaching situations likely leads many science education graduates to gravely doubt the practicality and possibility of inquiry within classroom contexts and under school constraints. Lack of classroom management experience as beginning teachers only compounds this view. Seeing and teaching inquiry in practice within the authentic activity of these teachers' classrooms may help to bridge this gap, creating a space of possibility.

Adequate Preparation and Ongoing Communication Is Essential

Methods students repeatedly stated that their success in coteaching was directly related to their advanced preparation for their classroom teachers' upcoming lesson. Classroom teachers were the vital link in this process in sharing upcoming lesson plans, texts, and other materials with their assigned student. Methods students saw this vital link of communication as crucial to their success in coteaching. Classroom teachers concurred with this concern. In most cases, classroom teachers took the time to communicate their upcoming plans to their assigned student. However, some of the teachers could not always keep the planned agenda given to their student in advance. Changes in lesson plans occurred for a variety of reasons, including adjusting pacing and schedule interruptions. In these cases, last-minute communication between teacher and student on the adjusted lesson was needed. Methods students found this aspect of this coteaching model to be the most frustrating.

Methods students used their foreknowledge of the upcoming lesson to prepare for it. Preparation included reviewing the content and sequence of planned material so that they would be more informed for their coteaching. Methods students would study the specific content to be taught to mentally prepare coherent and correct explanations and examples. Advanced preparation of this nature was crucial for middle school methods students who were mostly biology majors often teaching physical science lessons. The third seventh-grade methods student was especially struggling with attempting to coteach unfamiliar content, "I was totally unprepared in being knowledgeable about the topic [simple machines]. I know what simple machines are, but I could not come up with relative examples that would strengthen the objectives of the lesson."

Ongoing dialogue between classroom teacher and novice appeared to be a critical component of this socially situated model of learning to teach. This result may have been anticipated from the literature on cognitive apprenticeships. Learning occurs both through the doing as well as the dialoguing within the apprenticeship. All participants agreed that the dialogue could be more fruitful in this model through coteaching over consecutive days.

DISCUSSION

Classroom management and student discipline are the foremost difficulties that novice science teachers will face as they begin to teach (Adams & Krockover, 1997; Latz, 1992; Lederman & Gess-Newsome, 1991). Beginning to work through these issues is similar for these novice teachers as other novices, especially in student-teaching arrangements (McIntyre et al., 1997; Pilarski, 1994). Learning to manage students and appropriately interact with them for optimizing classroom learning seems to be a domain-specific knowledge that is developed in practice (Brown et al., 1989). Greater assuredness in interacting with classroom students now is evidence of the beginning development of classroom management and discipline skills. This coteaching arrangement appears to have begun this process of development in a teacher-supportive environment. This earlier development of the experiential knowledge of managing students may allow student-teachers to move to other concerns or issues in their teaching sooner.

Coteaching allowed students to observe and test out new strategies, management procedures, and styles used by their classroom teachers. This arrangement encouraged the modeling of the practices of an experienced classroom teacher. This modeling occurred through the peripheral participation of the methods students through advance dialogue and preparation for lessons as well as observation and assistance in practice (Brown et al., 1989; Lave, 1996). Active classroom teacher assistance may have helped in the implementation of these modeled practices. Even in cases of rare classroom teacher interjection, methods students were modeling and developing practical teaching knowledge through practice with their classroom teachers.

Another benefit of this coteaching model included a heightened awareness and reflection on the effectiveness of classroom teachers' lessons and teachings. This heightened awareness of their teachers' performance was likely due to the coteaching arrangement. Methods students were keenly aware that they would have to teach the same lesson immediately afterward. A few of the methods students were observed making adjustments in teaching their teacher's lesson to make it better. Heightened observation in practice may have led to a greater degree of critical reflection of teaching. As peripheral participants, methods students appeared to easily pick up on what was not working, with some of them critically reflecting on what would work better. This process of observation, reflection, and change in implementing a lesson appears to have existed for some of these methods students—a process that is a common and necessary skill for reflective teachers.

Using the classroom teachers' existing lesson plans became a win-win situation for both classroom teachers and methods students. Methods students did not have to spend time and effort in planning artificial lessons of unknown efficacy. Instead, they concentrated on teaching the authentic lesson plan of their teacher, including understanding the content, how to present it, and how to navigate classroom management issues. Teachers liked retaining their own planned curriculum due to time and content constraints. This was especially true of the high school teachers who taught under the time constraint of block scheduling and content constraint of the high school exit exam. This aspect of the coteaching model may appear promising to university and college programs seeking field experience models amidst these ever-growing constraints.

Methods students had the opportunity to see and put inquiry into practice in their coteaching placements. Inquiry teaching is a complex skill that novice science teachers will struggle to implement (Flick et al., 1997; Welch, Klopfer, Aikenhead, & Robinson, 1981). Methods stu-

dents had the opportunity to model inquiry lessons and perceive the positive effect that these lessons had on students. This experience was likely the beginning of the development of this complex skill for them. More important, methods students may have acquired an enduring cognitive awareness that inquiry can be done in the classroom, even under various constraints. This awareness may be instrumental in influencing the use of inquiry practices in their future classrooms. This influence may affect some as new teachers and others after they struggle through learning to teach in their early years (Wideen et al., 1998).

As in all field placements, the interaction between field student, cooperating teacher, and university supervisor are important for ongoing communication and a quality experience for the field student (Borko & Mayfield, 1995). The lack of communication and understanding that existed to varying degrees in this experience is no exception. Being present in the schools only once per week was a drawback of this field experience. Greater immersion in the authentic teaching process would be desirable in situated learning models. By faithfully meeting with classroom teachers the day before the coteaching episode, methods students were able to prepare for coteaching. However, daily contact and continuity with the classroom would likely smooth this logistic concern.

Basic science content understanding and preparation was one aspect of teaching in this study that could not be learned in situ. Although only one student (a biology major teaching a seventh-grade class) had to teach a topic that was out of field, this middle school case served as a reminder that understanding of scientific content underlies effective pedagogy (Grossman, Wilson, & Shulman, 1989; Hashweh, 1987). Novice teachers can study and plan to overcome this constraint (Borko, Bellamy, & Sanders, 1992). However, methods students under this coteaching model did not plan the lessons that they would coteach. Thus, coteaching students with subject-specific majors, such as biology, should be carefully placed with classroom teachers teaching content within the students' majors.

The five methods students, who experienced active teacher assistance while coteaching, had the opportunity to learn appropriate actions in teaching while they cotaught. Besides the learning from peripheral participation and reflection on practice, they also learned within practice. Their experience in coteaching most closely resembled the coteaching model cited by Roth and others (Roth, 1998; Roth & Boyd, 1999; Roth et al., 1999; Roth & Tobin, 2000) in which two or more individuals practice together. These methods students learned in practice through active teacher assistance as a partner in their lessons. This learning was not tacit but clearly vocalized or demonstrated. But, did this added learning in practice improve their level of teaching performance beyond the modeling and reflection on practice carried out by all the methods students? Researcher observations of all students showed improvement in their ability to teach by the end of coteaching, especially due to increased confidence. Further study is needed on how this active assistance in practice or on-the-spot learning in this model can improve teaching performance in coteaching and possibly in student-teaching. Extending the duration of the coteaching experience would be a first step in studying its potentially unique positive influences beyond the modeling arrangement of this experience (Duquette, 1996; Wideen et al., 1998).

Past research on this type of learning suggests that novice teachers learn by improving aspects of their teaching attributed to their veteran coteacher (Roth, 1998). The importance of the selection of classroom teacher role models, who teach through inquiry, cannot be understated for the induction of preservice science teachers (National Research Council, 1996). Further research that would identify the particular teaching strengths of classroom teachers would allow more targeted observations of potential student learning in this model. The ways a coteaching arrangement leads to greater reflection, and perhaps change, in the practices of experienced classroom teachers should also be investigated. Paired arrangements in learning to teach such as this one may indeed short-circuit the lengthier and more "painful" trial-

and-error learning that is frequently cited by beginning teachers (Roth & Boyd, 1999).

APPENDIX
Researcher-Posed Questions About the Coteaching Process

Methods Students Questions

1. How was coteaching beneficial in helping you learn to teach? Be specific and cite examples.
2. How could coteaching be improved in helping you learn to teach? Be specific about the problems that you encountered with specific examples as well as your suggested remedies/solutions.
3. How has coteaching helped you in each of the following categories of prime importance in learning to teach:
   a. Developing understanding of learners?
   b. Developing understanding of teaching strategies?
   c. Developing understanding of yourself as a teacher?
   d. Developing a comfort level before a class?
   e. Developing understanding of professional responsibilities?
   f. Developing understanding of inquiry and use of constructivist learning theory in practice?
4. The concept behind coteaching is that you learn to teach in the context of real classrooms and "at the elbows" of a master teacher. Teacher-coteacher modeling, assistance, and interruption are a part of this process. From your experience this quarter, do you agree or disagree with this concept? Be specific about your situation.
5. How has your teacher assisted you while you took the lead in coteaching the class? Be specific about the type of assistance.

Classroom Teacher Questions

1. How did coteaching work in your professional opinion in helping preservice teachers learn to teach before their student-teaching semester?
2. How would you improve the coteaching process? What would you modify or change to make it better?
3. Do you think that coteaching or some modified form of this model of learning to teach in a methods course is worth doing again? If yes, explain why. If no, what do you think would work better?
4. In what ways or what area did you see your preservice teacher improve as a classroom teacher by the end of the coteaching experience?

NOTE

1. These practices included hands-on and laboratory-based activities that helped students explore and develop scientific concepts. Some of these activities allowed students to apply their learning in the laboratory, through projects, or in engineering type activities.

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