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"I Won't Last Three Weeks": Preservice Science Teachers Reflect on Their Student-Teaching Experiences

Troy D. Sadler
School of Teaching & Learning, University of Florida, Gainesville, FL 32611, U.S.A.

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In many teacher preparation programs, student teaching serves as a culminating event that bridges academic coursework and the realities of classroom teaching. Therefore, it represents a significant aspect of preservice teacher education. This study explored student teaching as it was experienced by 13 middle and secondary science preservice teachers. Qualitative techniques were used to analyze individual interviews, group seminar sessions, and written reflections to construct a phenomenological account of student teaching as experienced by the preservice teachers. The aim was to construct a picture of the shared experiences of these student teachers to help understand how they struggled, succeeded, and learned as a part of their classroom practica. These findings are then used to draw implications for science teacher education.

Introduction

Toward the end of the year, he [my cooperating teacher] confessed to telling his colleagues I wouldn't last 3 weeks, which is funny because I conveyed the same sentiment to my friends at home after my 1st week. (Oscar)

Oscar's comment above provides a vivid depiction of the stress, anxiety, and uncertainty felt by preservice teachers (PST) as they begin their student-teaching experiences. In many teacher preparation programs, student teaching serves as a culminating event that attempts to bridge academic coursework and the realities of classroom teaching (Kagan, 1992). For some PST, student teaching offers their first opportunity to actually work with K–12 students; and, for many, it serves as the final preparatory activity before they assume the full responsibilities of a practicing teacher. Like PST in all disciplines, science PST must negotiate classroom management, school policies, relationship building with students, organization, lesson planning, and their own positions within the social structure of the schools (Kuzmic, 1994). Science PST also face challenges unique to the subjects they teach, such as incorporating scientific inquiry, planning and securing resources for laboratories, and safety concerns, just to name a few. While there have been several studies of student teaching (e.g., Borko & Mayfield, 1995; Chandler, Robinson, & Noyes, 1994; Yerian & Grossman, 1997), most have not focused on student teaching in a science

context; although, some notable exceptions do exist (Crawford, 1999; Lederman & Gess Newsome, 1991). Many of the studies specific to science teacher development and concerns have concentrated on the induction phase, which is usually defined as the first few years of full-time teaching (Adams & Krockover, 1997; Luft & Cox, 2001; Luft & Patterson, 2002; Simmons et al., 1999). This study contributes to the area of science teacher development by providing a phenomenological account of the student-teaching experience as interpreted by 13 science PST. More specifically, the study seeks to understand how science PST conceptualized, valued, and struggled with their student-teaching experiences.

Theoretical Framework

In their review of research on teacher development, Wideen, Mayer-Smith, and Moon (1998) questioned traditional notions of the role of student teaching in teacher education programs. Traditionally, student teaching has been thought of as an opportunity for PST to apply knowledge and skills, gained at the university, in actual classroom settings. PST are challenged to use theory provided in their university programs in the authentic settings provided by their student-teaching placements (Britzman, 1986). Wideen et al. (1998) concluded that the distinct goals and tensions among teacher educators, PST, and cooperating teachers, as well as the divergent cultures of universities and K–12 schools, invalidate this traditional view of student teaching. As an example, one of the patterns that emerged from the reviewed studies was the tendency for teacher educators to conceptualize the student-teaching experience as a time for PST to experiment with and reflect on innovative teaching approaches; on the other hand, the PST more often saw student teaching as a challenge they must attempt to survive. These varying perspectives left teacher educators disappointed by a perceived lack of progress among their student teachers and PST frustrated with perceived inadequate preparation for the challenges presented by real classrooms.

Wideen et al. (1998) proposed a reconceptualization of teacher education, including the student-teaching experience. In the following quote, they contend that a complete reorganization of teacher development programs is necessary to affect meaningful change. “We would argue that applying alternative approaches within existing programs of teacher education which are based upon a ‘training model of learning to teach’ is rather like rearranging the deck chairs on the Titanic” (p. 167). They point to the success of professional development schools (PDS) as vehicles for fostering prolonged collaboration among university educators, classroom teachers, and PST (Levine, 1992). Crawford and Kreamer (2004) recently reported on the benefits to both PST and their cooperating teachers as they worked in a PDS-university collaboration specifically focused on enhancing science teaching and learning. As a researcher and teacher educator, I have no doubt that restructuring PST’ education in ways that situate PDS collaborations as a central theme would be constructive. However, I question the conclusion that teacher development within more traditional programs is tantamount to moving furniture on a sinking ship.

It might be the case that PST' education is best served in situations where there are extended interactions and collaborations among PST, university educators, and cooperating teachers, particularly in the context of PDS. Unfortunately, serious constraints may make this arrangement unlikely, or even impossible, in many settings. The responsibilities and expectations of university faculty members and K–12 teachers do not always facilitate the kinds of interactions envisioned. Furthermore, structural elements may present additional obstacles. For instance, consider the case of a large university with a substantial PST population situated in a small town or rural area. In this situation, the goals of a progressive teacher education program can overburden the local school district and create the potential to foster resentment, rather than collaboration. While teacher education in PDS may serve as a useful model, scaling up such programs for large teacher preparation programs, especially in nonurban and suburban settings, would be difficult, if not impossible.

In a discussion of moral education, Green (1988) drew distinctions between ideal, educationally superior worlds and the real world in which teachers and teacher educators work. He suggested that educational settings are often not representative of the best possible situation; education is constrained by actuality, and that frequently means teaching and learning in a less-than-ideal world. I believe Green's perspective can be useful in thinking about student teaching. Many teacher education programs do not and cannot adopt approaches as progressive as those advocated by Wideen et al. (1998). The student-teaching experience cannot always be as intimately coordinated with other aspects of the teacher preparation program as desired; however, the experiences may still be instrumental for the PST. Teacher educators do have some leeway in traditional programs to structure and facilitate student-teaching experiences to meaningfully affect PST' learning. To extend Wideen et al.'s metaphor, innovative approaches embedded within existing teacher education programs may not be analogous to the ideal of equipping the Titanic with advanced navigational equipment, which would eliminate any possibility of a collision, but they are probably not as perfunctory as rearranging the deck chairs. Perhaps teacher educators in traditional programs seek to accomplish some middle ground, rather like readying the life boats or helping passengers understand what they might do if the ship starts sinking. This perspective framed the current investigation of student teaching in the context of science. The experiences of PST during their student teaching are important for teacher educators to understand, even in traditional contexts, to enhance teacher preparation programs.

Overview of Related Literature

Even experienced practitioners often struggle with the challenges presented by teaching, so it is not at all surprising that novice teachers present a number of concerns. Adams and Krockover (1997) reported a series of beginning science teacher concerns, including difficulties with time management, classroom management, the presentation of content, and curriculum development. Lederman and Gess-Newsome (1991) identified similar concerns among science PST and organized them in two general categories in terms of their focus: either focused on self

or their students. Concerns related to self included worries about classroom presence and content mastery; student-related concerns included classroom management and rapport. These patterns are also reflected in reviews of the literature that focus on teacher preparation in contexts broader than just science programs (Kagan, 1992; Veenman, 1984; Wideen et al., 1998).

Another common finding presented in literature related to teacher induction and, to a lesser extent, student teaching has been termed *praxis shock* (Kelchtermans & Ballet, 2002). Beginning teachers are often overwhelmed by the demands of the profession and shift from idealistic notions of teaching to pragmatic approaches, which are often traditional and contradictory to the aims of many teacher preparation programs (Kagan, 1992; Wideen et al., 1998). Drawing from an in-depth case study, Kuzmic (1994) documented how a beginning teacher's idealism and enthusiasm for innovation were suppressed by the unexpected realities of her school. The beginning teacher's greatest struggles involved school bureaucracy and aspects of the job seemingly unrelated to teaching and learning.

Empirical results also reveal a number of student and beginning teachers' reflections on how their preparatory programs contributed to or inhibited their success. A great deal of evidence suggests that beginning teachers do not feel as though their teacher education programs prepared them well for the challenges of real classrooms and schools (Adams & Krockover, 1997; Kagan, 1992; Wideen et al., 1998), citing instruction regarding classroom management (Rust, 1994) and the politics of education (Kuzmic, 1994) as specific examples of how their training fell short. The subjects in Adams and Krockover's study suggested that science content courses were too specific and not applicable to K–12 teaching contexts, but that opportunities for practice teaching as undergraduate teaching assistants was helpful. This group also cited the need for more field experiences to help orient PST to K–12 classrooms. In contrast to these generally negative findings regarding the perceived usefulness of teacher training programs, Loughran's (1994) sample of 2nd-year science teachers offered favorable reflections on their preparatory programs.

Research Focus

The purpose of this study was to explore PST' reflections on their own student-teaching experiences. Through individual interviews, group seminar sessions, and written reflections, I sought to build a phenomenological account of student teaching as experienced by 13 secondary science PST. The aim was to construct a picture of the shared experiences of these student teachers to help understand how they struggled, succeeded, and learned as a part of their classroom practica.

Program Description

The participants in this study were involved in a middle and secondary science teacher preparation program at a large Midwestern public university. These 13 individuals comprised about two thirds of a cohort that completed student teaching and became eligible for licensure in fall of 2003. Although these PST shared a

common science methods course associated with student teaching and participated in a seminar designed to support the student-teaching experience, they came to the program from a variety of backgrounds. Seven participants were undergraduate students seeking bachelor's degrees in science education. These students completed extensive coursework in at least two of the traditional science disciplines. The remaining 6 individuals were Master's students who had already earned undergraduate degrees in a science content area: some were completing an MAT (Master of Arts in Teaching) awarded by science content departments, and others were working toward an MEd (Master of Education) with an emphasis in science education awarded by the School of Education. Regardless of the track, all participants had completed coursework in educational foundations, technology, psychology, multiculturalism, and content-area literacy. In addition, they had completed an introductory methods course specific to middle and high school science instruction. This course was accompanied by a field experience during which students spent a minimum of 30 h in a local middle or high school. During the student-teaching semester, which was the final semester preceding graduation for all of the study's participants, students participated in a 6-week intensive, advanced methods course; completed a 40-hour field placement in the classroom in which they would ultimately student teach; and participated in a professional development seminar designed to support the student-teaching experience. During the first 6 weeks of the semester, participants attended daily classes at the university and spent several hours per week in the classrooms in which they would work during student teaching. The nature of their involvement in their classroom placements varied substantially based on their own comfort levels and the plans of their cooperating teachers. Whereas some assumed major teaching responsibilities, others did little more than observe during the first 6 weeks. Student teaching officially commenced at the beginning of the semester's 7th week. Ideally, participants should have taken over classes immediately and taught a full load by the end of the 7th week; however, this too varied among PST and cooperating teachers. Full-time student teaching lasted 10 weeks, making the entire practicum experience 16 weeks in length. The entire cohort met for biweekly seminars at which time students shared experiences, offered support to one another, commiserated, and reflected on their teaching. As one participant remarked, the seminars were "group therapy for student teachers."

Researcher Biases

I served as the instructor for the second methods course, which was taught during the student-teaching semester, as well as the seminar facilitator. Prior to the student-teaching semester, I had no personal interactions with any of the students involved; but, having worked together every day for 6 weeks, we quickly developed relationships. By the time data were being collected for this study, I knew all of the participants well. Given the qualitative nature of the study, these close relationships can be viewed as both strengths and weaknesses. I was never positioned as an unbiased observer; rather, I was personally engaged with all of the participants. These personal relationships certainly influenced the manner in which I interacted with the

participants; and, although I remained conscious of potential problems and worked to avoid them, the relationships could have also affected my analyses. Our previous interactions could have also influenced the responses participants offered during the interviews. On the other hand, these relationships afforded me opportunities to which a less involved researcher might not have had access. The participants and I were on first name bases and were comfortable talking with one another. Although I generally followed a semi-structured-interview format, the interviews were conversational in nature and flowed freely, allowing participants to explore their own ideas with ease. Less familiar interview contexts can be adversely affected by anxiety and tension (Eisner, 1991). My role as a member of the cohort's community also allowed me to contribute to the seminars during which the participants confided in one another and shared personal stories of success and adversity. The emic perspective I achieved certainly had the potential to affect the kinds of conclusions drawn as a part of this study, but it is this emic perspective that enabled me to collect the kind of in-depth data necessary for gaining perspective on PST' experiences.

Methods

Sample

The 13 PST who participated in the study were recruited at the conclusion of their student-teaching experiences through the seminar that was required of all cohort members (i.e., middle and secondary science student teachers). The 6 cohort members who did not participate chose not to complete an informed consent form, became too busy to complete the interview, or were not present during the seminar session at which individuals were recruited. Four of the participants reported teaching 7th- and 8th-grade science classes, and the other 9 taught high school science courses, including biology, chemistry, and physics. The student teachers worked in classes of varying levels from below average to Advanced Placement. Six participants taught one subject preparation (prep); 5 PST managed two preps; and the other 2 individuals worked with three preps. This variation was due entirely to the teaching responsibilities of the cooperating teachers who mentored the participants. With 6 female and 7 male participants, gender distribution was fairly equal.

Data Collection

Data were supplied from three different sources: interviews, written reflections, and seminar field notes. I conducted individual interviews with each of the participants in a private office at the conclusion of the student-teaching experience. All of the interviews took place 1 to 3 months following the completion of student teaching. Each was audiotaped and transcribed for analysis. The interviews followed a semistructured format: They proceeded in a conversational fashion, but were guided by a set of questions. The interview protocol (see the appendix), which was informed by the literature reviewed earlier, was designed to encourage participants to explain student teaching as they experienced it.

As a part of their university coursework, all participants wrote a series of reflections throughout the field experiences prior to and during student teaching. At the conclusion of student teaching, participants completed a comprehensive final reflection, which was designed to encourage students to reflect on and discuss the successes and problems they experienced throughout student teaching. The participants were asked to think about what they learned and how the experience affected their teaching. The excerpt below was taken from a course syllabus and describes the assignment:

> *You will prepare a final reflection focusing on your entire student-teaching experience. . . .Think about what you've learned (and still need to learn) in terms of planning, delivery, assessment, classroom management, inquiry, conducting laboratories, managing resources, the thrill of molding young minds, etc.*

The written, final reflections were an additional source of data.

The third data source was field notes taken during the student-teaching seminars. During the 10 weeks of student teaching, the entire cohort met one evening every other week to share experiences and insights. I facilitated those meetings, which typically lasted for about 2 h and were informal in nature. A typical seminar began with a few announcements and a focus question or two, which I provided, such as "How have you handled discipline issues?" or "What kinds of activities have you tried?" In every seminar, student discussion filled the rest of the meeting. I offered comments and suggestions when appropriate and took extensive notes on the student-generated concerns and ideas. These notes served as a final data source.

Data Analysis

The qualitative analysis proceeded in four stages. Member checking was the focus of the first stage (Lincoln & Guba, 1985). I reviewed interview transcripts and the final reflection for each participant and prepared a summary of my interpretations. These summaries were mailed electronically to each participant for his or her comments. Eleven of the 13 participants responded, and all suggested that my interpretation was substantively appropriate. Two individuals made minor corrections.

The second stage was an inductive analysis of the data (Lincoln & Guba, 1985) consistent with the constant comparative method (Glaser & Strauss, 1967). The interview transcripts and reflections served as primary data sources for these analyses. I identified several recurrent ideas within and among participant data sets. These categories were then compared and contrasted to form more general themes that captured larger aspects of the data. Having identified emergent categories and themes, I went back through the data sets to identify specific excerpts that signaled these groupings to ground the analysis in the data.

Peer debriefing was the focus of stage three (Lincoln & Guba, 1985). Another reviewer examined five data sets to independently establish the emergent categories.

The reviewer identified a majority of the same categories and themes that I originally documented. In most cases, we had named categories differently, but the underlying themes were consistent. To establish coherence and plausibility of the complete taxonomy, she also examined evidence of themes not present in the limited data subset. After discussions of the data and interpretations, we established consensus on the final taxonomy.

In the final stage, I used the seminar field notes as a secondary data source to corroborate the emergent categories and themes (Lincoln & Guba, 1985). Given the qualitative nature of the study, the findings are necessarily tied to the context of this particular study; and applicability is shifted to the reader as she or he can most appropriately determine the extent to which the PST involved in this study are reflective of other beginning teachers (Lincoln & Guba, 1985). The actual frequency of any particular category is far less significant than its occurrence, but in establishing what constitutes a category versus an isolated experience, I have somewhat arbitrarily set the occurrence level at three. The patterns discussed in this report were expressed by a minimum of three individuals in any of the data sources. The quotes provided throughout the "Results & Discussion" section were excerpted from interview transcripts or written reflections. All of the names provided are pseudonyms.

Results and Discussion

Given the qualitative nature of the analyses, discussion is embedded in the presentation of results. Participant reflections on their student-teaching experiences were grouped into five overarching themes: challenges, successes, supports, knowledge gains, and ideal teaching. It should be noted that some of these themes parallel interview questions that were posed. However, the themes were also prevalent in the written reflections and field notes. While it can be reasonably argued that the structure of the interviews affected the kinds of topics discussed, the more specific patterns or categories subsumed by these themes were far less influenced by the process of data collection. The fact that these ideas surfaced in multiple data sources, including the PST' written reflections and seminar field notes, both of which occurred prior to the interviews, supports the notion that these categories are truly reflective of the participants' ideas. In the text that follows, emergent patterns subsumed by the five overarching themes are discussed. To support the legitimacy of the patterns discussed, tables are used to present representative comments offered by the participants. As mentioned in the Methods section, all of the patterns identified and discussed emerged from the comments of at least three participants.

Challenges

Participants discussed a number of factors that created challenges for their student teaching. These difficulties included classroom management, time management, institutional and job complexity, unengaged cooperating teachers, university requirements, and special-needs students. Classroom management was further subdivided to reflect more specific concerns. Several participants originally adopted

relaxed approaches to classroom management and found that this created immediate problems. Others struggled with when and how to impose discipline or enforce rules. They had difficulty establishing their own tolerances and found themselves trying to decide when it was necessary for them to step in and encourage students to change their behaviors. For instance, Tara clearly knew that she needed to address a student as he began shooting staples into his own arm, but she found it far more difficult determining what point she should make the class quiet down as the noise level grew in the midst of an activity. Others found their unique status as student teachers to be an impediment to establishing discipline within the classroom. These participants discussed the fact that their students saw them as different from the "real" teacher, a situation that was exacerbated by the fact that many were not that much older than the high school students and had youthful appearances. Another group of participants felt that their classroom management problems stemmed from a lack of discipline prior to their assumption of classroom control. These individuals felt that they were set up for failure because the classes they began teaching had not been properly managed in the first place. Participant comments are presented in Table 1 to support the legitimacy of these interpretations.

Time management was another problematic issue for the student teachers. Time management challenges included dealing with demands on the participants' own time, as well as negotiating classroom time. In terms of their own time, many participants felt overwhelmed by the amount of time required to develop lesson plans and classroom activities. They generally felt confident in their own abilities to come up with good curricular plans, but they never had enough time to complete the planning required. Contributing to this perceived problem was the burden of grading. In particular, the individuals who really worked to infuse inquiry into their instruction expressed frustration with the time and effort required for adequate assessment. Some of the participants also discussed how parental communications, particularly via e-mail, consumed a great deal of their time. In principle, e-mail sounded like an ideal means of sharing information with parents, but several of the participants felt inundated with e-mail messages from parents that required them to devote considerable time to constructing responses. In terms of class time, participants noted difficulty in estimating instructional time required for certain topics. Some individuals reported that they consistently underplanned, while others never allotted enough time for group work and labs. Finally, several participants struggled with covering the amount of material expected by their cooperating teachers. Given the current climate of standards and accountability, this pattern is not unexpected, nor is it unique to student teachers (Abrams, Pedulla, & Madaus, 2003).

Many participants were challenged by the complexity of their responsibilities and of schools as institutions. They found it difficult to complete all that was asked of them, such as maintaining accurate records, organizing student assignments, recording absences, and performing administrative responsibilities. The issue of institutional and job complexity often surfaced during the seminar meetings, and the student teachers shared their struggles and offered a variety of strategies for dealing with these issues. Another prominent challenge was unresponsive and unengaged cooperating teachers. While many participants discussed positive experiences with

Table 1
Taxonomy of Challenges Experienced During Student Teaching

Challenge	Specific concern	Exemplar
Classroom management	Students took advantage of relaxed approaches	Going into the whole experience, I was told don't go in there and smile for however long, but that is just not me. That is not my personality to just go in there and be extremely strict right off the bat. I kind of went in—not that I wanted to be friends but just be myself and at times that came back to haunt me. I definitely need to work on that [management]. (Ted)
	Establishing tolerances	Knowing when to say when as far as classroom management [was challenging]. Like students got chatty or above the level of noise I like in a classroom. I felt uneasy telling them to be quiet or something like that. . . I had to feel them out as far as when to tell them to quiet down and when not to. I had to figure out what was actually horseplay. (Steven)
	Unique status as student teacher	At first, I did not feel comfortable doing any kind of discipline or management because I felt like it was not my place, but then as I took over more classes, I kind of had to. They [the students] were a little bit resistant because I was younger and I was a student teacher or whatever. . . .They did not see me as an older, more experienced teacher, and so it took a lot to get their respect. (Ella)
	Taking over a bad situation	As far as management goes, before I got there, he [the cooperating teacher] did not seem to care if the students were throwing things or talking back or not paying attention. It was hard to keep control. . . . I never felt that I was actually teaching; I just felt like I was babysitting. (Thelma)
Time management	Planning	My biggest fear is to be underprepared, walking in and not being 100% sure of what I was doing, so I spent a lot of time preparing. I went in on Saturdays and worked just because for me it was worth it for me to be more confident and comfortable with what I was doing. That was the biggest challenge just time management. It just seemed like if I was awake, I would be doing something for the class. (Neil)

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Table 1
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Challenge	Specific concern	Exemplar
	Grading	Like inquiry is emphasized a whole lot and what ended up happening is I would get massive amounts of grading all at once, and I think that was a big challenge. How the heck am I going to deal with this? (Tara)
	Parental communications	Keeping up with all the parent's e-mails [was challenging]. There are a lot of parents constantly checking up on their kids. My whole prep period was spent responding to e-mails. . . . Everyday I would get four to five e-mails from parents asking how their kids were doing and what was coming up and why their kid had this grade. My whole planning period was gone. (Wendell)
	Class time	I had some problems trying to get enough to do in the class time because it was block scheduling. If we went too short, I'd have to come up with something so that they [the students] were doing something. (Sal)
	Covering material in the time allotted	I usually felt really rushed [to cover more material]. In finishing the first trimester, we had two sections to cover in about 8 days total.. . .It was, like, impossible trying to get the students through it and hoping they got something out of it. I remember looking at it and thinking I do not even know how I will tackle this, let alone getting the students to understand or remember anything. (Feran)
Institutional & job complexity		Just learning the ropes was hard. You have to have content knowledge and a general understanding of how education works, but finally putting it all together and seeing this is what I have to do for the kids and this is what I have to do for the administration and make sure that I do this—throwing everything together and making sure that it all works is the biggest challenge. (Tara)
Unengaged cooperating teachers		Some of the hardest things was just trying to get feedback. I felt like there were times when I was not really sure how things were going and I did not get a lot of constructive feedback. I was just like, "Oh well, that will get better with time," but that did not do much good for me in terms of what about the lesson—what specifics about this lesson should be changed. (Feran)

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Table 1
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Challenge	Specific concern	Exemplar
University requirements		My university supervisor would not let me get away with writing simple lesson plans. So I had to have a whole lesson for every single day that I was teaching. That was the most difficult thing because it took time to put it into this specific format and write out exactly what was going to happen. Sometimes, I just felt like I was copying definitions from the book. (Eileen)
Special-needs students		The most challenging part was learning how to teach to the lower students. That was very hard. I taught here [at the university] for 3 years and I thought I'd be ready for a chemistry and an AP biology course, but even in these classes there was still that bottom 30–40%. Initially, I just sailed right over their heads. I did not know what to do about it, and the test scores reflected that. (Irvine)

their cooperating teachers, several cited their cooperating teacher as a fundamental problem with their student-teaching placement. These participants cited an unmet desire to receive critical feedback on their planning, instruction, and management strategies. Others were more concerned with supervision and requirements from the university. University supervisors, who were retired teachers or school administrators, worked with each student teacher. The university supervisors' expectations varied greatly, and some of the participants felt that the work required of them was onerous, unnecessary, and unrelated to their teaching responsibilities. While it is possible that some of the participants' complaints were unwarranted, it appeared that at least some of the supervisors' expectations were unrealistic and burdensome. For instance, in addition to full-time teaching and seminar participation, Ted was expected to read and discuss a few books, respond to late-night phone calls, and prepare daily lesson plans using an unfamiliar and very detailed format (far beyond what was deemed acceptable by his cooperating teacher and the methods course requirements).

The final challenge that was expressed by a significant number of participants was dealing with special-needs students. I use the phrase "special-needs students" because this is the phrase that many of the participants used, but it should be noted that this title included a wide variety of students. For some participants, it included all of the students who were dissimilar to themselves in terms of academic motivation, aptitude, and success. They talked about the challenges of working with English-as-a-second-language students, learning-disabled students, and "lower level" students. For some of the participants, any students who were not on the fast track to college

were lower level. Many of the student teachers struggled with effective ways of reaching these students and felt ill-prepared by the university to do so.

Successes

Despite the difficulties they experienced, the participants also noted several successes. They reported achieving success at relating well to students, delivering individualized instruction, making content personally relevant to their students, reflecting on their own teaching and making appropriate modifications, and structuring inquiry experiences. Participants noted several ways in which they successfully related to their students, including developing good rapport, knowing when their students were confused, and reaching students who had previously been unengaged. Several participants discussed how they developed good rapport with their students, which had the effect of creating positive learning environments. Others reported that they were particularly adept at determining when students had trouble understanding content material that was being covered. Several were also successful in encouraging students who had not been participating in class or just not doing well before the student teacher arrived. Table 2 presents interview and written reflection excerpts that support these categories.

Several participants reported achieving success when using individualized instruction. They seemed to excel when given an opportunity to connect individually with students. Some also reported on the productive use of reflection. These student teachers took time to carefully reflect on what was and was not working in their classrooms and made appropriate modifications. Finally, several suggested that they had successfully incorporated inquiry-based instruction. Although this encouraging result is supported by other studies (Crawford, 1999), it must be tempered by findings (Lotter, 2004) that suggest that PST' interpretations of inquiry often differ substantially from those offered in the National Science Education Standards (National Research Council, 1996). An admitted limitation of the current study is that it did not involve classroom observations that could have confirmed the extent to which participant instruction reflected inquiry; however, some participants (albeit a minority) offered descriptions of their teaching practices that were reflective of inquiry as defined by the National Science Education Standards.

Supports

Participants also discussed some factors that they felt were helpful to them or beneficial to their student teaching experience. Some of these factors were external in that they were supports provided to the students. Several participants discussed characteristics or behaviors of their cooperating teachers that were helpful. These included providing specific feedback and advice, outward expressions of encouragement and specific praise, and granting full control of the classroom. With respect to this last characteristic, the participants appreciated ideas and suggestions provided by their cooperating teachers, but this was most helpful when the participants ultimately possessed the freedom to choose how suggestions would be implemented.

Table 2
Taxonomy of Successes Experienced During Student Teaching

Success	Specific accomplishment	Exemplar
Relating well to students	Good rapport	I am good at setting up a positive atmosphere. I think I do my best to set up an atmosphere where students know that they're going to work, but they're also going to have fun. (Neil)
	Knowing when students were confused	I think I'm pretty good at relating to the students. . . .I am pretty aware of what is going on. If they are understanding or not understanding—if they are listening or if they're talking about the subjects or just something going on during the weekend. (Ella)
	Reaching previously unengaged students	I was able to get to those hard-to-reach kids. There were students who would not even look at me during lectures and stuff. They didn't turn in any homework and failed the tests. . . .So, I pretty much sat down with them and asked them what they were looking for in the class. They said, "I do not want to be in here. I do not need chemistry; I'm just stuck in it." I just leveled with them and told them what I expected of them after I heard what they expected of me and worked out arrangements. Through their grades, I realized that I was getting through to them more. (Oscar)
Individualized instruction		I am definitely good at one-on-one interactions with students. I like sitting down after school and before school and really taking students who are having trouble and wanting to get better and working with them and having a good result with them. That is probably my strongest point as a teacher. (Irvine)
Making content personally relevant		I try to bring my own experiences into things. If I have a story that helps explain a certain point or if I can somehow find something that is current in science to talk about as I'm talking about something that is kind of dry might make it more interesting. I try to address the question, "Why in the world would we ever need to know this?" and make things more relevant. (Steven)
Reflecting		I think I am really good at adapting—at reflecting on what went well and what did not go well in a particular lesson or a particular situation with a student and then making changes. I called it "working out the kinks." I think that is my biggest asset, because I might not do something right the first time, but the second time I will know more about how to make it better. (Oscar)

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Table 2
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Success	Specific accomplishment	Exemplar
Structuring inquiry		I wrote some good labs and adjusted some [more traditional] activities to make them more inquiry based. They [students] had opportunities to work together and really answer some questions. (Thelma)

Science methods courses were also perceived as external supports. Many participants cited specific ways in which these courses were helpful, such as lesson planning in a science context, formulating objectives, asking questions, and lesson ideas. It should also be noted that positive comments regarding the methods courses were usually paired with negative comments regarding more general education coursework. Several participants reported that the general education coursework failed to provide practical strategies for dealing with real-classroom problems.

Internal supports, those factors that were controlled by the participants himself or herself, included a willingness to invest oneself in the school community and their knowledge of content. Interactions with the school community were described in terms of seeking out the expertise of teachers, in addition to the cooperating teacher. Participants also went out of their way to assume an active role in the extracurricular activities of the school. For instance, some helped coach sports teams, and others contributed to schoolwide curriculum reform projects. The other internal support was the content knowledge that many participants possessed. Most of the MAT students, who had completed undergraduate degrees in science content areas, made mention of the usefulness of their content knowledge. In contrast, some of the undergraduate participants cited content knowledge as a cause for concern during their student teaching. Table 3 provides data to substantiate these categories.

Knowledge Gains

The participants reported that they had learned new things as a result of their student teaching-experiences. In some cases, they were confronted with new and unexpected ideas and knowledge. In other instances, existing ideas seemed to be shaped by the student-teaching experience. Consistent with the notion of praxis shock described by other authors (Kelchtermans & Ballet, 2002), several participants described how their once idealistic notions of education had shifted to far more pragmatic perspectives. They came to such realizations as not every student can be reached, some students are not interested in learning, there are many constraints on classroom teachers, and so forth. In a related theme, participants came to a new appreciation of the difficulty of teaching. Wendell talked about how wrong he was

Table 3
Taxonomy of Supports Experienced During Student Teaching

Support	Specific characteristic	Exemplar
Cooperating teachers	Feedback & advice	She [the cooperating teacher] would give me activities and tell me how it worked for her and how I might do it. . . . She would help me a lot with quick little activities or mnemonic devices or things like that. (Wendell)
	Encouragement & praise	The biggest thing that he [the cooperating teacher] did for me was offer encouragement, which really helped boost my confidence in the classroom. (Oscar)
	Granting classroom control	I was let loose [in the classroom] and that was best for me. It really prepared me. I had to figure things out, like how the school would be run, like passes and homerooms and announcements. Things like that was a great experience. (Ted)
Science methods course		I thought the preparation [for student teaching] was good. The last class [science methods] was most helpful. I wish there were more classes like that. I used a lot of the demos and stuff that we did. (Thelma)
Interactions with school community	Other teachers	All of the science teachers were very open with me. I felt like I could talk with them about anything in the school. . . . I also went around to other classes. I went to history class and an English class and it was interesting. (Ella)
	Getting involved	I tried to get involved in the community side of it. I did that by helping out with practices for the 7th grade basketball team. . . . I attended things like band concerts to see the kids outside the classroom and to see faculty outside the classroom. It was a really neat experience and helped me relate to students and other teachers. (Neil)
Content knowledge		I definitely have to say that a lot of preparation in the content area helps me feel confident to teach the area. . . . They [the students] were able to tell that I knew what was going on [in terms of content]. Maybe they were less likely to see me as just a student teacher because I knew what was going on. (Steven)

to think that teaching was an "8 to 3 kind of job." In addition to the workload and time commitments, some participants reported gaining new insights relative to the social and political realities of teaching (e.g., administrative styles, the political pressures of testing, and the significance of personal interactions among faculty and staff).

As a result of their student teaching, several of the participants gained firsthand knowledge that inquiry-based instruction was time consuming and work intensive, but that it actually worked in terms of promoting student learning. Some of the participants reported going into the experience with the idea that disseminating science content was the primary goal of science education, but left believing that content was only part of the task. They ultimately placed much greater emphases on helping students develop life skills and problem-solving skills. Finally, in what I considered to be a positive result, many participants declared that student teaching helped them decide that teaching was the profession they wanted to pursue. Table 4 presents participant quotes that support these categories.

Ideal Teaching

The final theme is based on participant reflections on science teaching and learning under the best possible circumstances. I specifically asked students to consider what science teaching *should* be like in an ideal setting. All of the participants, with one notable exception that will be described later, discussed ideas consistent with reform-based pedagogies, including inquiry, group work, student centeredness, and hands-on and minds-on involvement. Keisha's comment was representative of most of her colleagues:

> *[Science teaching should be characterized by] a lot of hands-on learning and student-led activities. I like for students to really experience something so they can really understand it better. I think it should include incorporations of things that are really hands on or really interesting and different ways of presenting material.*

This result was not surprising because reform-based pedagogies were the central theme of the methods courses that the students completed. However, these positive appraisals of reform-based pedagogies in ideal settings were invariably followed by declarations of how difficult achieving these goals could be in actual classrooms. The overriding message was, "Reform based teaching is a great idea, *but* it is very hard to accomplish because. . . " Impediments identified by the participants included a lack of resources and equipment, time limitations, concepts were not amenable to reform-based approaches, students were unprepared, and students were too grade driven. Table 5 presents a series of participant quotes that describe these impediments. I found it interesting that some student teachers declared their students underprepared to engage in student-centered approaches; and, yet, others felt that their advanced students, who presumably had the requisite skills, were too concerned with external pressures, such as grades, to make effective use of

Table 4
Taxonomy of Knowledge Gains Resulting From Student Teaching

Knowledge gains	Exemplar
Praxis shock	When I went into my student teaching, I was incredibly idealistic. I always said that I was going to be able to reach every student. . . . During that first 2 weeks, all that went out the window. . . . Having experienced it, I have a much more clear idea of what to expect the next time I go into the classroom. (Oscar)
Complexity of teaching	I was able to understand a little better how things work in a school and a classroom. I was used to thinking primarily about how lessons should go in terms of pedagogy and the content. . . . Going into a classroom and experiencing how a school day goes and how you might have one plan and you do it five different times and it will not come out the same any time. . . . I had to come to terms with the fact that things would change all the time. (Steven)
Effectiveness of inquiry	I think at first I did not know how I could get kids to think on their own without my telling them what to think. I know we had classes about inquiry, but I never knew how that would be—especially with some of these kids who did not want to be there. I found that if you gave them an opportunity to think for themselves, they are a lot smarter than they think, and they can do it. I think it makes it more interesting for them to learn, too. (Sal)
Science content	I always saw content as very important, but there is a real need for a teacher to recognize other aspects. I do not think that I recognized this as much as I should have. [It is important] to model appropriate behavior, good speech, formal language. . .giving kids a chance to work with cooperation skills and things like that are just as important as the content that they are getting. (Feran)
Professional aspirations	My biggest success was that I realized that this [teaching] is what I want to do. That was the biggest accomplishment that I have walking away. You have ideas and beliefs, but you don't really know. After 10 weeks, I really enjoyed it. (Neil)

these approaches. The underlying theme was that regardless of the circumstances, reform-based teaching was difficult to achieve.

One participant had a markedly different perspective on ideal teaching and learning. Irvine felt that under ideal circumstances, middle and high school science instruction should model the university approach. Teachers should give extended lectures and periodically coordinate associated labs. Irvine presented an interesting paradox in that he seemed to suggest that this approach did not necessarily best serve the needs of his students, but remained decidedly in favor of it. The following exchange highlights this pattern:

Table 5
Taxonomy of Impediments to Reform-Based Teaching

Impediment	Exemplar
Lack of resources	When I was teaching, there were a lot of experiments that I wanted to do, but I could not because we did not have the resources or the equipment. (Sal)
Timelimitations	There was definitely hands-on work [taking place in the classroom] and that was good, but I feel like there should be more student inquiry in the ideal situation. . . . There was so much to cover and trying to cover it all is impossible, so time was certainly a factor. (Steven)
Inappropriate concepts	I would say that [ideal teaching should involve] 75% inquiry lessons giving students opportunities to figure things out. However, I found that in chemistry, it is pretty hard to do because there are some basic concepts that students need to know. Now I think [that inquiry could be used] in advanced classes, like a 2nd-year chemistry class, when you are not trying to learn how atoms work and how electrons move. You can't see it [basic chemistry concepts] and it [inquiry] is really hard to do. (Oscar)
Unprepared students	Students are not used to thinking in terms of science or critically or things like that. They expect answers to be handed to them and they do not like it when there's no right or wrong answer. . . . I think that you really have to take time to get [students] to step by step think on their own. Like with inquiry, it still has to be very, very, very guided at the beginning. (Tara)
Grade-driven students	When teaching chemistry, the students are very grade oriented, and they want to get a good grade—that is the goal. Most of them are college bound. If you teach chemistry differently [as in a reform-based approach], the students just are not—the students just are not as creative or willing to take risks because they're concerned about grades. (Vicki)

Irvine: In an ideal world, science teaching should look like the way it does at a university. It is in-depth lectures to teach content, so that you know what you are doing, coupled with laboratory experience.

Interviewer: How have your ideas about teaching changed?

Irvine: You cannot teach all kids the same. The "everyone gets the same education" ideal that a lot of people preach is impossible. . .

Interviewer: How do you square the notion of individual needs and the picture of the ideal classroom that you just gave me?

Irvine: If you're going to do it that way, you're going to wind up losing a lot of kids. I will admit that from the start in my ideal model.

Ironically, as Irvine's instructor, I felt much the same way toward him as he had felt toward his students. Just as some of Irvine's students did not "get" the science content he was trying to teach, Irvine did not seem to "get" the approach to teaching that I was trying to encourage. It is also interesting to note that Irvine openly discussed his desire to pursue an advanced degree in a science content field and eventually teach at the college level. These future plans may have contributed to the tenacity of his views, even when he admittedly encountered difficulty with his teaching style.

Implications for Science Teacher Education

This research builds a phenomenological account of student teaching based on the experiences of science PST with the aim of informing science teacher education. The qualitative methods and sample selection preclude generalization of results, but the themes that emerged with these particular participants may be helpful to consider in the design and modification of science teacher preparation programs. This study focused on preservice science teachers, but many of the implications are not necessarily specific to science teacher education. It is likely that preservice teachers in other areas experience similar issues and have related concerns as those expressed in this study. Wherever appropriate, implications specific to science teacher preparation will be discussed.

An idea that surfaced in multiple areas of the taxonomy was the role of cooperating teachers. Many participants discussed the importance of certain characteristics and actions of their cooperating teachers in terms of their positive effects on the student-teaching experience; however, others struggled with cooperating teachers who seemed unengaged, unable to provide critical feedback, or both. This suggests that teacher preparation programs may need to provide support not just to their PST, but also to the cooperating teachers. It seems likely that some participants in this study would have benefited if their cooperating teachers had been trained in how to effectively support student teachers. Pertinent topics might include how to provide critical feedback, how to negotiate classroom control, and the significance of encouragement. Better communication between cooperating teachers and university educators may also help alleviate some of the potential conflicts between the goals of these parties with respect to student teacher outcomes. In the context of science education, in particular, collaborations among university and classroom educators could help better define the kinds of inquiry opportunities student teachers could reasonably attempt.

Several issues emerged as areas of need in preservice education programs. These issues were situated across several themes (i.e., challenges, successes, and supports), but all directed attention to potential components of PST' training. As in most appraisals of beginning-teacher concerns (e.g., Kagan, 1992; Wideen et al., 1998), classroom management was a significant issue. However, this study was interesting in that several students discussed the fact that they had heard about successful management strategies, but did not want to use these approaches. Their preferences for more relaxed styles created problems, and they, despite their original

aversion to authoritative styles, ended up resorting to those approaches. Classroom management may be an issue that PST must negotiate for themselves in actual classroom contexts. Time management and the complexity of teaching were other issues that came up frequently. It might be that at least some aspects of these issues can only be experienced when one assumes responsibility of a classroom, but teacher prep programs could encourage students to develop specific strategies for time management, as well as explicitly discuss complexities of schools and the teaching profession. Although time management is likely a concern for most preservice teachers, it may be particularly important for science teachers as they plan and prepare laboratories. Laboratory activities present planning challenges as in the acquisition and organization of resources, as well as challenges for the management of class time. The most engaging, hands-on science activities always seem to run longer than a single class period allows.

An additional focus on working with special-needs students would be another valued addition to science teacher education programs. Although all of the participants had taken a class in special education, they struggled to connect with special-needs learners, including students with learning disabilities and English language learners. Given the extent of this problem, in future classes I plan to supplement the information gained in the general course with more content-specific suggestions and examples in the science methods courses. Demands for scientific literacy can present unique challenges for teachers working with special-needs students. Textbooks typically contain hundreds of technical vocabulary, which can make reading and comprehension difficult, especially for students who are new to the English language or have reading problems. Science education programs that direct preservice teacher attention to these factors and offer strategies for working with these students would be helpful.

Two other issues that support previous findings related to science teacher preparation arose in the success theme: content knowledge and reflective practice. While ample research supports the significance of both content knowledge (see, Zeidler, 2002) and reflective practice (see Loughran & Gunstone, 1997), this study revealed that student teachers themselves saw the merits of both a rich body of science content knowledge and the ability to critically reflect on one's own teaching practices. Another recommendation for teacher education emerged from the support theme. The experiences of individuals who made efforts to become part of the broader school community were enhanced by those efforts. This kind of involvement could be built in as a programmatic expectation. While it is true that adding such requirements as this contributes to an already full workload, the participants, who reported engaging in these activities on their own, did discuss constraints on their time, but generally felt that the results of their involvement far outweighed the problems associated with time management.

In contrast to much of the research on teacher development (Adams and Krockover, 1997; Kagan, 1992; Kuzmic, 1994; Wideen et al., 1998), the participants in this study had generally favorable appraisals of the teacher preparation, at least with respect to the science specific methods courses. While this conclusion may be considered suspect given my roles as both course instructor and researcher, it is

not entirely unique within the field (Loughran, 1994). The fact that several students reported that they attempted inquiry learning activities and other approaches advocated in the methods course further supports the notion that the science education courses had positive effects. Admittedly, the extent to which participants implemented inquiry consistent with NSES is not addressed by these data; but, based on the descriptions of instructional practices provided, it seems likely that the student teachers claiming success with inquiry were at least moving in the right direction (i.e., less emphasis on traditional approaches and more emphasis on student-centered approaches).

The participant views on teaching, particularly with respect to reform-based pedagogies, can be interpreted in at least two ways. Rust (1994) suggested that it is not uncommon for PST to maintain their idealistic views of teaching, but that these views typically change as they transition to full-time professionals. This perspective suggests that the participants' focus on inquiry and other student-centered pedagogies will be overwhelmed by the perceived impediments. While the participants certainly did cite several reasons inquiry did not work in specific contexts, most still believed that it was an ideal approach to teaching science. Loughran (1994) provided a different, slightly more optimistic interpretation:

> *The effect of preservice education is not so much "washed out" as repressed. Among the competing demands and complexities of teaching, the ideals once held in preservice education lose out in the real world of school. There is not so much an attitude shift (they still espouse to the notions of learning encountered in their preservice program), rather an acceptance of what is possible at this point in their careers. (p. 383)*

Although I disagree with Wideen et al.'s (1998) conclusion that significant change cannot be affected by traditional teacher education programs, I strongly support their calls for an "ecological" approach to research in teacher education. They suggest that teacher education and its effects cannot be adequately understood by examining small aspects divorced from other contextual factors. The research presented herein examines a significant, yet limited component of science teacher preparation. Follow-up work is necessary, particularly with respect to interactions among PST, cooperating teachers, university supervisors, and teacher educators. In addition, to gain more clarity on issues, such as how teachers' ideals are affected by instruction, as well as the profession, extended studies that can document the evolution and adaptation (Lederman & Gess-Newsome, 1991) of teacher ideas are needed. The current study contributes to this area as it documents the beginning of what will become a longitudinal cross-case study of science teachers as they transition from students to beginning teachers to veteran educators.

Oscar's declaration of impending failure within the first 3 weeks of student teaching, recounted in the opening lines of this paper, might have aptly characterized many of his colleagues' thoughts. It is likely that they were all focused on survival at the outset of the experience. However, it would be an oversimplification to suggest that the participants were just attempting to survive. They certainly struggled with

challenges, but they also achieved successes and continued to learn about what it means to be a science teacher. Their stories are far from complete, but I can report that everyone survived. When asked about what they planned on doing in the next 5 years, all of the participants reported that they would be teaching.

> I'll be teaching. . . because I just love it.
>
> (Oscar)

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Appendix

1. Please describe the structure of your student teaching. What subject(s) did you teach, and what specific content did you cover? How did you and your cooperating

teacher deal with student discipline? How much control did you have in terms of planning and implementing curricula, classroom procedures, and so forth?
2. How did you fit in with the school community? Did you feel as though you were part of the school community, or did you feel like an outsider? How did you relate to administrators, other teachers, and students?
3. What was challenging about your student-teaching experience?
4. What kind of success did you have? What are you good at in terms of teaching? What areas are you still uncomfortable with and need to work on?
5. Do you feel prepared to run your own class? (YES: What led to that preparedness?) (NO: In what ways are you unprepared?)
6. How would you characterize your teaching? Provide specific examples to support this characterization.
7. In an ideal world, what should science teaching look like? How did your student teaching differ from this ideal?
8. How have your ideas about teaching changed over the period of your student teaching?
9. Where do you see yourself professionally in 5 years? Where do you see yourself professionally in the distant future (15–20 years)?