CHAPTER 4

DISRUPTING INITIAL ASSUMPTIONS

Coming in here [to the Faculty of Education] I still didn't know the answer, but I thought, "I can do that." I've tutored and I've taught groups in that way, sort of repeating a textbook in a better way, but if you can do it in a way when you are talking to them. I thought coming here would be sort of polishing that ability ... and we haven't been. So I guess that's how physics class formed my questions.

(David, FG1, 14)

The first day of classes at a Faculty of Education is, in many respects, similar to the first day of school in any other educational environment. There is a palpable energy in the building as a new school year promises new opportunities for all involved. Teacher candidates rush through unfamiliar corridors to find their classes and meet their professors for the first time. In anticipation of a new beginning, many professors sleep just a little bit more fitfully the night before, particularly those who used to be elementary or secondary school teachers and have experienced some anxiety before school begins for many years. Candidates who knew each other prior to the beginning their preservice program, perhaps through a common undergraduate degree, experience a moment of jubilation when they catch a familiar face in the hallway or in a classroom. Just like any other educational environment, there are both "ceremonies" (Waller 1932/1961, p. 103) and a "grammar" (Tyack & Tobin, p. 453) to be learned at a Faculty of Education. Unlike the ceremonies of the K-12 system, which tend to be largely about establishing routines and control over the student population, the ceremonies of a Faculty of Education have much more to do with an unspoken question among teacher candidates: *Beyond a practicum placement, what is it that one does during a teacher preparation program?*

Teacher candidates come to a preservice program with both a lifetime of experiences observing teachers teach, and a set of assumptions about what good teaching should look like. Many candidates likely have favourite teachers who they wish to emulate, at least in part, during their teaching careers. It is little wonder, then, that candidates expect to learn "what works" during a teacher education program. They tend to adopt, at least tacitly, the viewpoint of the technical rationalists that assumes theory can be learned in one place and practiced in another. Thus an initial ceremony for many teacher candidates requires an appeal to education professors to find out how to make a positive impression on their first practicum experience. Typically (and naturally), candidates' concerns gravitate toward learning how to effectively "manage" a classroom. In other words, candidates wish to learn how to replicate the ceremonies that effectively controlled them when they were students.

Candidates' prior assumptions about what should happen during a preservice program pose a significant challenge for a teacher educator. If one rejects the premise

that teacher education is more than a set of propositions that can be simply transferred to practice, then it is important to create experiences early in the program that disrupt candidates' prior assumptions about teaching and learning. This chapter outlines some of the ways that candidates who participated in this research experiences such disruptions.

The first section of this chapter describes the major events that occurred during the physics course in this block of classes. The data obtained from the focus group and individual interviews are then analyzed to provide insight into how teacher candidates constructed professional knowledge from learning experiences in the physics course. The comments made by teacher candidates as they looked ahead to their first practicum placements are then presented to indicate some of their initial thinking about how they expect to learn from practicum experiences. The next section provides the perspective and voice of the teacher educator as I analyze the discussions Tom and I engaged in during the September block. Finally, the chapter concludes with a summary of the professional knowledge constructed and co-constructed by the teacher candidates and the teacher educators who participated in this study.

CONTEXTUAL FEATURES OF THE PHYSICS METHODS COURSE

The physics curriculum methods course began with a special 90-minute class in the first week of September with 19 teacher candidates enrolled. The course went on to meet on eight more occasions during this block of classes. Regular class times were from 15:00–17:20 on Mondays and 12:00–14:50 on Thursdays, beginning the second week of September and concluding in the first week of October. Tom Russell was the teacher of the course and I attended each class as a participant-observer.

Tom began the class with a Predict-Observe-Explain (POE) activity designed to build community and encourage teacher candidates to feel comfortable engaging in exploratory, open-ended discussion about teaching and learning physics. After an additional POE activity on the second day, Tom quickly outlined the requirements for a Lesson Study activity that became the major focus for this block of classes. Teacher candidates were asked to plan lessons in groups of four with each person teaching one lesson planned by the group. All candidates were required to plan lessons based on the electromagnetism units in grade 11 and 12 physics from the Ontario curriculum. Two unique lessons were presented by each group during the first round of presentations; the second round of presentations were revised versions of the same two lessons, repeated by the remaining two members of each group. Thus each group had the opportunity to revise its two lessons based on feedback from their peers and from Tom. Asking each teacher candidate to present part of a physics lesson required that approximately three-quarters of the class time in September be devoted to presenting and critiquing those lessons. Candidates were also given some class time to plan their lessons in groups. Tom devoted most of the final class to discussing and processing the effects of the Lesson Study activity.

LEARNING EXPERIENCES IN THE PHYSICS CLASS: TEACHER CANDIDATES

The data provided by the participants during the focus group interview and the individual follow-up interviews were analyzed with a view to understanding how teacher candidates construct knowledge from learning experiences during a physics methods course. Four themes are discussed in this section: Prior Assumptions, Lesson Study, Learning from Peers, and Learning from Tom. Although each theme focuses on learning that occurs as a result of the methods course, there are many instances where the candidates invoke comparisons between past experiences as learners in other situations and their learning experiences in the B.Ed. program.

Prior Assumptions

Participants discussed their prior assumptions about teaching, how they learned physics, and what they expected from the Faculty of Education. Candidates acknowledged that they "were the ones who were successful in the [school] system" (FG1, 6). Their idea of good teaching focused on the transfer of information from a textbook to students in an entertaining way: "If you repeat the textbook, but do it really well, it can be effective" (FG1, 10). As Irene remarked: "I know the material and I've seen teachers all my life" (Irene1, 18). Max summarized the candidates' prior assumptions about teaching when he said: "I'll teach what's in the textbook, I'll get the classroom involved some of the time and hopefully they shouldn't need to read it" (FG1, 16). James agreed that traditional notions of teaching-as-telling dominated his thoughts before he came into to the program, stating: "I thought coming into this program that there was really only one way to teach: you get up and you talk to your students" (FG1, 3).

Assumptions about the "one way" to teach followed naturally from the candidates' prior assumptions about how they learned physics. David (FG1, 24) articulated the differences he saw between two ways of teaching high school physics:

> There were basically two approaches from high school teachers. Even if they were teaching from the textbook, there were some that stressed understanding concepts, and from that understanding the rules to equations … then there are others [who provide] the equations which prove the physical phenomenon [first], which I think is the other way around. There are two different approaches for expressing different aspects, and I definitely prefer the former, the first.

The other participants agreed with how David framed the kind of teaching typically found in high schools. James extended the argument to include university physics by relating a story about his first-year professor who wrote the formula for Newton's Second Law on the board and said: "It was the only thing we [students in the physics class] needed to know because everything else could be derived from it" (FG1, 28). Candidates felt that physics teachers "stand and present the material and explain how things work and work through problems on the board" (David1, 5). Candidates assumed that physics teachers tell students about physics and that their

only pedagogical decision concerns whether to explain the concept before giving the equations or to provide the equations and then explain the concept.

Candidates' prior conceptions about how they learned physics were closely linked to their ideas about how physics is taught. In acknowledging that they represent the people who were successful at learning physics in a traditional way, some candidates described tensions between the teaching methods they were familiar with from their experiences as students and the new teaching methods being espoused at the Faculty of Education. As Paul said: "Thinking back to my favourite physics teacher, he just wrote stuff on the board and now, being here, I question why I liked it so much. He wrote so much on the board. I loved it" (FG1, 19). Candidates believed that their abilities to learn from the traditional approach to teaching physics was innate, as shown by statements such as "I am just lucky … because I learn that way" (FG1, 12); "When I was in high school, I was academic" (Irene1, 6); and "I've been lucky in that even with math and physics I've been able to pick it up kind of quickly initially" (Paul1, 19). Their success in physics class, then, was attributed to their rare ability to tune in to the transmission model of teaching that dominates high school and university classrooms.

The expectations and assumptions that the teacher candidates had for the Faculty of Education followed naturally from their prior assumptions about teaching and learning physics. David thought that B.Ed. coursework would focus on "polishing that [traditional] teaching ability" (FG1, 14). Candidates were "pleasantly surprised" (FG1, 51) by some elements of the program, particularly those classes that encouraged approaches to teaching that were not transmission-based. Paul "came to teachers' college [sic] with the expectation that [he] would be taught traditionally … [it took] 2 or 3 weeks to really believe that they were going to do it differently in a lot of the courses" (Paul1, 3). Irene highlighted a shift in her expectations of the B.Ed. program, stating that at the beginning of September she wanted "someone to tell [her] how to improve … [but] now it's all about finding your own beliefs on what to teach and how to do it" (FG1, 88).

The prior assumptions that teacher candidates held at the beginning of this study serve as a lens that reveals the effects of their apprenticeships of observation (Lortie, 1975). Teacher candidates acknowledged that they were successful at learning physics in school, attributing that success to a personal ability to relate conceptual ideas to mathematical formulae. They enjoyed physics lectures and problem-solving. Even when faced with a teacher who was unable to explain the material, candidates agreed that they "could pick up a [physics] textbook and pass the class" (FG1, 15). Coming into the program, candidates felt they were going to learn how to enact traditional pedagogies in a more efficient manner, presumably so physics would be more palatable to a wider range of students. This paradox is interesting: candidates saw themselves as the exceptions in physics class, yet they still felt that they could reach more people if they just taught traditionally in a more effective manner. They came into the program wanting to teach as they were taught, and they expected to learn how to teach well in traditional ways. The apprenticeship of observation shapes teacher candidates' prior assumptions about teaching and learning as well as their expectations of a Faculty of Education.

Lesson Study

Teacher candidates offered comments both on what they learned from the process of creating and enacting a physics lesson and on what they learned from interacting with their peers during the lesson study process. They unanimously felt that lesson study was a worthwhile way to spend the September block of time, because instead of "being lectured on how to teach per se, we're getting up there and practising our teaching" (James1, 3). Paul felt that it was "good to see what it takes to plan out half an hour" (Paul1, 12). Irene felt that lesson study encouraged her to "see through the eyes of a student again" (Irene1, 5) because so much time was devoted to watching her peers teach.

Most of the candidates felt that it was extraordinarily difficult to plan lessons as a group, for a number of reasons. Max offered that his group "wasn't really much of a model for group planning … [because] none of us could meet together …. It was all individual for our lesson planning in our group" (Max1, 3). Irene's group "kind of worked together at the start … [but] then each person prepared their own lesson pretty thoroughly" (Irene1, 4). Paul suggested that his group found it difficult to plan together because they had "four pretty different personalities" (Paul1, 15). David named a tension in his group between his willingness to plan a lesson based on using active-learning pedagogies and the group's desire to plan a more traditional lesson. He said: "You have to give concessions and accommodate, which I felt, at the time, might have taken away from what the real goal of the assignment was" (David1, 15). David felt that lesson study provided him with the opportunity to enact the active-learning pedagogies outlined by Knight (2004), so "it was frustrating [for him] to try to come up with a [traditional] lesson plan … when [he] really wanted to just go that [active-learning] route, throw it out there, take a chance" (David1, 13). The other members of his group were more inclined toward "the old-style route," leading David to conclude that the other members of his group had not "bought into this [active-learning approach] yet" (David1, 13). David presented in the second round of lessons, enacting a lesson that "was more of what [he] wanted to do as opposed to what the group came up with" (David1, 13). In contrast to the other four participants in the study, James' comments indicated that he found planning lessons in a group helpful because "it was great to just talk to the other teacher candidates to see ideas they had and what they were doing" (James1, 8).

The structure of the lesson study activity meant that everyone in the course spent a good deal of time observing peers teach physics lessons. Participants in the study said they saw a lot of traditional, teacher-centred, transmission-based teaching from their peers. Max offered one explanation for the similarities in his peers' lessons: "I haven't seen that many [lessons] that are way off to the side of what you've seen before. We all learn to teach from the same kind of teachers" (Max1, 1). Irene noted that her peers "use the overhead and the board and work through the material … [in the same way her] teachers always did" (Irene1, 10). In contrast to Max, however, Irene felt that there was a "wide range of teaching styles" because "the mannerisms of the people who were up there teaching … [resulted in] different ways of talking to the class" (Irene1, 10). For Irene, the differences in her peers' mannerisms were sufficient to warrant a claim that they were using different teaching styles.

Paul was much more critical of the lessons taught by his peers, saying that he saw "no real extremes in terms of ideas about teaching" (Paul1, 16). He learned the most from watching what he thought were the poorer lessons taught by his peers:

> When I see something [in a lesson] going well, which actually doesn't happen that often anyway to be honest … then watching it doesn't help me that much because it's one person doing it; it's their style, and they're teaching a bunch of university kids. But it's when I've seen something they've done that clearly is a terrible idea … we're not even talking the whole lesson or anything, just their manner, the way that they talk to people. That's what's influenced me the most. (Paul1, 1)

Paul and David were also vocal about their disappointment with the lack of peer interaction during the lesson study process. Paul offered this interpretation: "I was kind of excited about what it [lesson study] could teach me. But I also saw that it would really require a lot of investment from everyone in the class" (Paul1, 4). David also thought that the success of lesson study depended on "how people reacted or embraced the process," adding that he "embraced it [lesson study] early" (David1, 20). Both Paul and David felt that the majority of their classmates did not embrace the lesson study process, which resulted in many awkward silences during their lessons:

> The point is, if I was in a class where I could actually stand in front of people and people were really interacting with me, and giving me really valuable feedback about what I'd done there, I think that would be great. But as it was, you know, people weren't really into talking to me. When I was at the front, there weren't really any questions, which could be my fault. There doesn't seem to be that investment in taking that seriously. (Paul1, 6).

David articulated a similar frustration:

> The interaction with the class isn't really there. We're presenting to the class and we're not really getting feedback. People weren't really reacting like a class might, but they weren't really participating, they were more sitting back and absorbing. (David1, 17)

Both Paul and David mentioned that they felt that they had done a good job with their lessons, despite their perception that the rest of the class had not embraced the process. Paul credited his group with helping him to plan a good lesson, saying "I think I did a pretty good job … given good [group] lesson planning and then my general lack of unease asking people about my teaching." Paul said on numerous occasions that he wished he had received more feedback from his peers.

In contrast to Paul and David, James was happy with the feedback he received from the group:

> I think feedback is very important. For instance, actually in class, we get up and we present a lesson and we get feedback from the other students. And in my lesson, I used overheads instead of PowerPoint … one of the reasons that I did that is because, not only do I feel comfortable using overheads, but also

> I wanted to see what my fellow classmates thought about it. And some of them … made suggestions about how to improve that. But most of them seemed to think it was a good method. (James1, 6)

James added that he learned from watching his peers teach, saying "there are a variety of ways to fill … however long a lesson is" (James1, 26). Irene suggested that watching her peers helped her to realize that "when people do different types of lessons … [she] thinks about what makes people learn best" (Irene1, 1). Max felt that everyone was "treating the material in the same way" (Max1, 4) and that the lesson study process unfolded "as expected" (Max1, 1).

Irene and David offered some poignant comments about why lesson study was a difficult learning process for the teacher candidates. Irene suggested that the requirement to plan lessons as a group added an additional level of complexity to the process, making it difficult to focus on how she was learning from lesson study:

> I think I also learned it's hard to do lessons … we're all supposed to talk about the learning effect and from what I read … [Tom] put us in groups to improve their lessons … but I think the people got together at first and then went their own ways. It's hard to work together. (Irene1, 3)

David believed that the particular format that was used for lesson study might have been too complicated for those who are just beginning to learn to teach:

> Maybe it could be predicted that it would be difficult to embrace the process of creating lesson plans and then revising and revisiting what went well and what went wrong and then coming up with something better. It's difficult to achieve that when we're all still grappling with these [new] ideas … I've been challenged to think about education … so much so that I wasn't prepared for it. So all of this information is coming at you, and you're not just jumping through hoops, there is actually something of essence there. So we're grappling with all of this, and at the same time trying to follow this [lesson study] process.

Lesson study was a complicated pedagogy that made significant demands on the teacher candidates, both as learners and as teachers. Although teacher candidates universally agreed that lesson study was a useful, productive experience, there was also a sense that the process could have been a more powerful learning experience if there had been more peer interaction. Interestingly, the things that some candidates found frustrating about their peers were almost exactly the same kinds of learning habits that they identified in themselves, namely, a tendency to sit back and absorb a traditional Socratic lecture. Throughout the process, candidates perceived no real deviations from traditional teaching strategies; any differences between the lessons enacted by their peers were due to personality differences. The lessons that were taught in the physics course in September were firmly rooted in a traditional approach to teaching and learning physics: teacher-centred, with a focus on telling the right answers and sharing solutions to problems. Perhaps the real value of lesson study was to give teacher candidates an experience to learn from their inner default teaching moves that they have developed over many years of primary, secondary, and

tertiary education. Again, we come to the importance of confronting the socializing effects of the apprenticeship of observation.

Learning from Peers

The teacher candidates who participated in the study indicated that they learned from their interactions with other teacher candidates, both within the context of the physics course and within the context of the entire program. Comments about how candidates learned from peers in the physics course centred on the interactions that were a result of the lesson study exercise, which was discussed in the previous theme. The overall perception that candidates had of their peers during lesson study varied considerably. In the first focus group interview, Paul asked:

> I think we've all had a positive experience [in the physics course] but do you get the sense that there are people in the class who are feeling a lot differently from us? Do you think that there are people who are going, "I can't believe we are doing … this is such a waste of time." There is a weird atmosphere; I am not sure what it means. (FG1, 70)

David agreed, although he was quick to point out that he had not heard any specific comments. James had not heard any comments from his peers one way or the other. Max theorized that "there are some people [in the class] who don't take comments or suggestions [from lesson study] that well" (FG1, 71). Irene commented at length on Paul's questions to the focus group:

> I think that part of [the atmosphere] is that it is so different every day. I honestly think that I get something out of it because you see good ideas about what to do and what not to do and you see the different takes people have on teaching the same lesson. But even, it depends on the day, how much people are getting out of it. If you have a good day and everybody had something new or different to offer, you might feel like you are getting something better out of it. I personally never felt the time was wasted. But some days, maybe the lessons were all kind of dry and that feels a bit more negative, and you come out of that feeling tired. But I don't feel like I've gotten any bad vibes from anyone on the whole about the experience. Because we have four presentations a day, it is hard for them all to be … I just mean that could be where people might get the negative ideas from. (FG1, 76)

Thus four of the five teacher candidates in the study sensed some tension associated with how they learned from and with their peers in the physics course. Candidates perceived that there were different degrees to which their peers engaged with the lesson study process, and this resulted in a classroom atmosphere that was occasionally off-putting for the participants.

Participants found many of their interactions with other teacher candidates in the program to be overwhelming. Paul commented on the intensity of interactions with other candidates:

> One thing that I've been shocked about in coming here is that everyone takes it *so* [italics added] seriously …. I am really not used to taking things so seriously.

> When things get too serious I usually make a joke. It's been kind of overwhelming in that sense, which is kind of refreshing because I am genuinely concerned about quality of education and quality of teaching. (FG1, 96)

> Everything's important. It's important to do this, it's important to do that. Even the teacher candidates, you get into your groups to do group projects and the teacher will give you something to do, and people will take it so seriously and really try to do what the teacher tells us to do …. There is just this attitude that *everything* [italics added] that comes at you in this program is something to just go with, something to take seriously. (FG1, 101)

David noticed a similar phenomenon in his interactions with candidates outside the physics course, mentioning that many of his peers "are just devastated" (FG1, 61) if the assignments they prepare for courses are not well received by their teacher educators. The intensity with which many candidates approached the program was, according to Irene, directly related to the fact that many of them approached the B.Ed. program as the fulfillment of a lifelong dream. She said: "I want to be a teacher, it's not a non-dream, but it's not like I spent my entire life dreaming of it … [while other candidates] seem like they have" (FG1, 102).

Despite the intensity with which many candidates approached the program, participants in the study stated that many of their peers complained about the low quality of learning in the program. David disagreed with this negative sentiment, saying "I am getting a ton out of it. I'm paying attention, I'm finding things, I'm pushing, so I am getting something out of it" (FG1, 48). James argued that the quality of learning in the program is a direct result of "what you put into it" (FG1, 47). Irene said that some of her peers figured out early on that it was not as necessary to complete the weekly readings as it was during their undergraduate degrees. Again, despite some of the negative attitudes of her peers, Irene completed her weekly reading assignments, saying "If I do the reading, I feel like I've gotten a lot more out of it. Some people say it's not real learning, but it's just different learning" (FG1, 52).

Candidates were challenged to think in new ways by the diversity of background experiences that many of their peers brought to the B.Ed. program. As David said:

> Walking around the halls you come across people who've had a lot of experience, who've had none, and everything in between. Some people who've lived with their subject, some who haven't, and everything in between. There are people, maybe I'm not quite in awe of them, but I think that they are going to be fantastic, and maybe I should work as hard as them to be as positive as them. (FG1, 38)

Max mentioned that the diverse backgrounds of his peers encouraged him to think about equity issues in new ways: "Maybe I'm different than other people, but [equity issues are] something I've never really had to think about …. other people are constantly thinking about it" (FG1, 39). Irene provided a similar, more general comment, saying that she learned by "having people to work with who are in a different place" (Irene1, 8).

The other candidates in the physics class had a profound effect on how lesson study was experienced by the research participants. The perceived lack of interaction in lesson study, discussed in the previous theme, caused some of the participants to feel that the other candidates in the physics course were not as committed to the lesson study process as they might have been. More generally, interactions with other candidates outside of the physics course had an impact on how participants perceived their own learning. Many of the other candidates seemed to approach the B.Ed. program with an intensity born of a lifelong desire to teach, while at the same time complaining about the quality of their learning. Although research participants found the intensity of some of their peers somewhat intimidating, they were generally happy with the quality of learning in the program, feeling that it was up to the individual to make the most of the program experience. Finally, participants felt that the interactions with other candidates who had different background experiences were beneficial to the quality of their learning, often finding that such interactions could catalyze new ways of thinking about issues in education.

Learning from Tom

Teacher candidates clearly stated that they learned about teaching from the way they were taught by Tom during the physics course. They were, however, less clear about *how* Tom's pedagogical strategies affected their learning. For example, Irene offered Tom's use of the Predict-Observe-Explain (POE) teaching strategy as an example of what she learned:

> I'd never seen a POE before I came here …. When I saw the first one I didn't know how it would work [for me] because I didn't know if I'd be very good at leading a discussion like that, but seeing them was pretty inspiring. (FG1, 1)

It is telling that Irene focused on her personal response to POE, instead of how she might use POE as a teaching strategy during her upcoming practicum placement. When candidates were asked how they learned from the lesson study experience, their initial reaction was "I am getting E and M [electricity and magnetism] drilled into me" (FG1, 67). Paul commented that "it's interesting that our [initial] answer to your question is that we know E and M really well now" (FG1, 68). They naturally focused on the familiar physics content of Tom's pedagogical strategy, perhaps because they had not yet developed a sophisticated of a language for talking about teaching and learning. David elaborated on this possibility:

> The nature of what we're doing makes it hard to answer … all in all, it's been a positive experience and I am getting something out of it … I don't have the words to describe what I am getting out of it [the physics course]. It is more of a feel. I know that I have the sense that I am definitely benefiting from it. (FG1, 69)

Candidates were more inclined to describe a general, positive feeling about the effect that Tom's teaching strategies were having on their learning rather than name specific effects of those strategies.

Despite the difficulty the candidates had in naming learning effects, David was able to articulate a contrast between Tom's pedagogy and other learning experiences that he was having in the program:

> I've been completely sort of turned upside down by this course. Right from the get-go, starting from Tom's just changing things up and his style and even the class is so different from all of the others, or most of the others, anyways. Right off the bat two days of thinking … Realizing how differently I and maybe others react to what he is doing. Thinking that maybe this is the way or a way to go in teaching physics. More of the hands-on involvement style as opposed to presenting the material. (David1, 3)

David went on to suggest that Tom's pedagogy results in a low-risk, positive, environment:

> Here we are in this [physics] class, that pressure isn't being put upon us, nothing is make or break, you can try what you want. We have our professor saying, this is maybe a way that you want to go, aim for these kinds of goals and objectives, but other than that, do what you want. We have huge flexibility, not ridiculous pressure … we aren't getting something that is super-negative. (FG1, 62)

For David, Tom's pedagogy "really comes back to 'trust the learner'" (David1, 4). Max picked up a similar thread: "From the beginning Tom believed that we could all do this" (Max1, 8). Both David and Max felt that the trust that Tom gave the class inspired them to pay careful attention to physics class. David remarked that he "put [his] effort toward this class and got the [physics] assignment finished first … because we've been given all these latitudes [such as flexible deadlines for assignments]" (David1, 36). Max felt that the trust that Tom placed in the candidates had an opposite effect to what one might expect; instead of becoming lazy about deadlines, candidates in the physics course were "motivated to do things …. everyone's involved pretty well" (Max1, 6).

Teacher candidates who participated in the study seemed to see Tom's class as a productive place to learn, although they found it difficult to articulate what they learned from how Tom taught. There were a few easily named teaching strategies that got their attention, such as POEs and Lesson Study, but the trust that Tom placed in the class resonated much more powerfully with two of the five participants. The issue of trusting the learner stands out in particular because it suggests that they were treated somewhat differently in physics class than in the rest of the program.

Looking Ahead to the Practicum Experience

Although the teacher candidates had not yet had a practicum experience during the first round of data collection, they did talk about their expectations and hopes for the upcoming October practicum period. The comments that these five teacher candidates made can be summarized by two themes: a desire to succeed and

trepidation about the impact they might have on students' learning. Often, candidates spoke of these themes at the same time:

> If I can get through the first practicum without completely messing up someone's knowledge … if I can get the content right and I can keep some sort of decorum in the classroom, then I'm good to go …. Then, try and pique some interests and try and get some kids really interested in what we're doing at the time. Anything over and above that … well, you call that a bonus for your first time around. (FG1, 77)

Both David and Irene spoke about the importance they placed on not "messing up anyone's knowledge" (FG1, 77; 83), as though enacting a particular pedagogy could have lasting detrimental effects on their students' abilities to construct knowledge. Max had a similar worry, "I've always been bad at slowing down for what pace I should be going at to make sure everyone gets everything by the time I move on" (FG1, 95).

Most of the comments about the upcoming practicum were quite positive. James said that he wanted to "take everything in and use it as a major learning experience" and "try different things in the classroom" (James1, 27). Irene looked forward to teaching physics because she felt there were "hands-on things readily available to show students" (Irene1, 21). Max noted that it would be important to try new things on practicum, although he suggested that lesson study showed him that "it's really hard to avoid teaching like you've been taught" (Max1, 5). Paul looked forward to "figuring out what high school is like" (FG1, 131) because his own high school experiences seemed distant. Overall, the teacher candidates were excited to begin their practicum experiences.

When thinking ahead to the practicum, Paul and David took a slightly different position than the other teacher candidates. Although they were both excited to begin their school placements, both expressed some reservation about how their relationships with students and associate teachers would unfold. Paul wanted "a reminder that [teaching] is something [that he] is good at" (FG1, 97), in part to counteract the "seriousness" (FG1, 95) that he observed in the other teacher candidates, an observation that seemed related to his sense of self-efficacy as a teacher. He was also concerned about "being the teacher all of a sudden," especially the "weird balance" between being approachable as a teacher and "being an authority figure" (FG1, 83). David was more concerned about developing a productive relationship with his associate teacher, because he had "been convinced" (FG1, 87) of the benefits of non-traditional pedagogy:

> Maybe the thing that is continuously going up against me is that maybe it isn't done that way in the field, in schools, especially if we have a teacher who is very "old-school" … since I think I've really bought into a certain way of thinking here so far, a set of principles … . My worry is, "Am I going to be able to practice what I've been taught?" How will that be received by the teacher or teachers at the school? Are they going to be open to that [new way of teaching] or are we going to be required to conform? (FG1, 120)

David's biggest concern about the practicum was a fear that he would not be able to enact student-centred pedagogies, a non-traditional approach to teaching and learning that he had taken very much to heart. At the end of the focus group interview, David went so far as to suggest that he was "more ready to go and start [his] own class at the beginning of the year than [he was] to go and work with someone else's class," (FG1, 127) adding, "I am more scared about going in halfway through a class and working with kids who are used to a teacher than I would be right at the beginning" (FG1, 129).

The teacher candidates who participated in this study were both hopeful for and anxious about their upcoming practica. They looked forward to opportunities to try to teach according to their various pedagogical visions, but at the same time they were concerned about "messing up" students' understanding of curricular content. There was a general sense that the practicum was something that needed to happen; candidates were thirsting for their first experiences in host schools. David perceived the potential for a gap between the kind of teaching he would like to enact and the kind of teaching he expected to find, as well as the kind of teaching his associate teachers would allow. Although he bought into the active-learning ideas from the physics methods course, he sensed that most classrooms do not typically involve active learning.

LEARNING EXPERIENCES IN THE PHYSICS CLASS: TEACHER EDUCATORS

From the perspective of the teacher educators, the month of September can be represented by one overarching theme: learning from lesson study. The lesson study pedagogy represented a significant departure from the ways in which Tom had previously started his physics curriculum class. As mentioned earlier, lesson study took up approximately three-quarters of the class time in September. More significantly, this was the first time that Tom included lesson study as a part of his pedagogy of teacher education. Having been a part of three different September start-ups of the physics curriculum class, including one as a teacher candidate, I was uniquely positioned to help Tom interpret this new pedagogy.

The data interpreted in this section are presented chronologically using quotations and observations from my research journal. Data in my journal include my notes during each physics class and the notes I kept during conversations that Tom and I had over the month. The quotations listed in this section are based on transcriptions that I created as part of an observation journal and hence are cited using (Journal, September).

Setting the Stage for Lesson Study

Tom began the year by using Predict-Observe-Explain (POE) pedagogy as a way to create a low-risk environment and a commitment to exploring concepts rather than seeking answers. On the first day of class, he used most of the time to lead two POE sequences designed to encourage candidates to talk about the parallels between learning physics and learning to teach physics. He also drew the candidates

into dialogue about the effects of the POEs on their learning by asking several questions:

– What did you notice about what it was like to be learning using the POE approach?
– What features of your learning did you notice by virtue of my using POE to teach you?
– Did anyone feel embarrassed during the POE?
– What tends to make people feel embarrassed in a classroom setting?

(Journal, September)

By focusing on teaching strategies and learning effects rather than on the correct answer, Tom tried to set the stage for the risks that would be required by lesson study. He drew attention to the fact that the POE activities yielded a variety of predictions and explanations, despite the fact that everyone in the class had significant post-secondary study of physics. Implicit in the discussion was the notion that obtaining the right answer was less important than attending to the process of teaching and learning.

After beginning the second class with another POE, Tom introduced the concept of lesson study. Candidates were organized into groups of four and asked to prepare two 20-minute lessons, each to be taught twice to allow for improvements before the second presentation. Each group was asked to base its lessons on a different part of the electricity and magnetism units in the Ontario curriculum. Tom emphasized the atmosphere of trust created by doing POEs, saying:

> One of the things that is going to be really important is that everyone is going to feel a little uncomfortable when they present 20 minutes at the front …. We are going to be good students because we are going to be listening to the learning effects that the teaching has on us. We are never going to criticize one another in terms of "Do x instead of y." We are going to develop a team atmosphere, saying things like "Maybe if you did it this way, you might have this kind of learning effect." (Journal, September)

In the interest of making the risk of doing lesson study transparent, Tom reminded the candidates that the pedagogy was also new to him. He described his reasoning in these words:

> I am pretty sure that this is a different tack from your other curriculum course. Some of you might feel like you're missing out. I've been in this building too many years to be offended if an associate teacher asks you to forget everything you learned here in September. Everything you are told here is likely to go down the drain on the first day [of practicum] in October. Focusing on how teaching is affecting learning is far more useful than 6000 tips on how to teach physics. (Journal, September)

By explicitly describing the reasons for engaging in lesson study, Tom showed how a teacher educator can explicitly model his or her practice and create links between enacted pedagogies and theoretical literature.

Our discussion immediately following the second class helped us to identify some of the broad issues that we noticed after introducing lesson study. Tom commented:

> The issues around how I went into the lesson study were partly due to doing it for the first time. I wasn't unhappy with the way it came out. I actually felt an enormous amount of relief when I asked what they were making of things … and I got the comment that something different was going to happen in this class. (Journal, September)

Perhaps it is not surprising that, as teacher, Tom's first comments about lesson study focused on how he set up the process and his initial reading of the candidates' reactions. Tom also mentioned that he was pleased that he changed the focus of the next class into planning time for lesson study. I had also picked up on the importance of giving the candidates additional time for lesson study:

> I think that giving more time for lesson study underscored your message of "We'll figure it out together as we go." I don't know what specifically made you make the decision, but there was certainly a palpable sense of relief—not that they didn't think they could do it, but just to have that time to sit with their group again. It was good that you had the opportunity to show that you are flexible by changing plans on the spot …. It came across as "I am listening to what you are saying and here is what we are going to do instead." (Journal, September)

Our post-class discussion allowed us to begin to understand how Tom continued to build trust in his classroom. A simple gesture such as allotting time in the next class for candidates to continue planning their lessons helped to underscore the supportive environment that he was trying to develop.

Beginning Lesson-study Presentations

Teacher candidates began presenting their lessons during the fourth class. At the outset, Tom asked the candidates to be mindful of the powerful tendency in teacher education to tell teachers about better ways to teach. This was intended to encourage candidates to think about pedagogy in terms of teaching strategies and learning effects, rather than in terms of best practices. During the first presentation, I recorded the following notes:

> The candidates were very polite and paid rapt attention to their peer who was brave enough to go first. One of the interesting things was that I could have predicted how the lesson would proceed. The candidate fell back on all the default practices of what he has seen teachers do time and time again. I could also have predicted the kind of assessment he would receive from an associate or a faculty liaison: voice control, pacing, timing, moving on quickly after the right answer was elicited. There was a demonstration so that it felt like a science class. (Journal, September)

At the conclusion of the first lesson, Tom called the candidates' attention to the influence of the apprenticeship of observation by asking "Where did he learn to do

what he just did? Has he learned to teach that way in 10 days of classes?" (Journal, September). The candidates were then asked to record observations about the lesson on whiteboards in their small groups. When the whiteboards were displayed at the front of the class, Tom and Shawn both noted the striking similarity between the kinds of comments that candidates made about their peer's teaching and the kinds of comments they were likely to receive from associate teachers. Returning to the ideas that he introduced at the beginning of the class, Tom stated, "A lot of this reads like 'do X instead of Y.' What I am struggling with is that we haven't named the learning effects …. Can we get better, individually and collectively, at naming the learning effect?" (Journal, September). Tom challenged the candidates to attend to this issue when they made comments about the remaining lessons.

Difficulty Identifying Learning Effects

The link between teaching strategies and learning effects was a difficult concept for teacher candidates to understand and articulate. After the second presentation, the candidates continued to make comments in the language of best practices. When Tom commented on how the comments still were not focused on learning effects, several teacher candidates argued that there was merely a semantic difference between a comment such as "do X instead of Y" and a comment such as "the teaching strategy affected my learning in X ways." As Tom encouraged the candidates to talk more about teaching strategies and learning effects, I was thinking about learning effects from my position at the back of the classroom. I noted:

> The semantic differences matter because [phrasing things in terms of learning effects] might serve as a reminder that people are affected by things in different ways. If pedagogy is a unified whole, is it a fair question to ask for the learning effects to be teased out from the teaching strategies, or is it more appropriate to ask for phrases with conjunctions? Saying "The learning effect was A because the teacher did B" is different from saying "The teacher should do X because Y." Is the suggestion being made to conform to a perceived best practice, or is the suggestion being made to address a particular feature of the learning? (Journal, September)

I continued to think about the differences during the third candidate's lesson. Tom ended the class by asking candidates to anonymously record something that they learned about teaching and learning on an index card on their way out.

We explored the issue of learning effects in our discussion after class. We both felt that there was a qualitative difference in the kinds of comments the candidates made after they were asked to attend to the effects that particular teaching strategies had on their own learning. The anonymous comments that the candidates wrote revealed that many resisted the concept of a learning effect and felt that comments pertaining to trying specific teaching strategies were more valuable. We agreed that it was important to be patient with the candidates' focus on trying to tell one another how to teach, rather than talking about how they were learning. Their preference to talk about teaching rather than learning seemed to us to be one important element of the socializing effects of the apprenticeship of observation.

Before the sixth class, several candidates raised concerns about the lesson study process. Specifically, some candidates seemed upset with a perceived lack of participation from their peers. Often, the candidate teaching the lesson would ask for some sort of input from the audience and no one would respond. Candidates were asked to change their seating arrangement at the beginning of class, in the hope that sitting with different people would encourage more discussion and participation. The end of the sixth class was the halfway point in the exercise, as each group had presented its lessons once. Tom called attention to the fact that "it can feel like pulling teeth up here [in the role of teacher]" (Journal, September) and encouraged candidates to pay attention to those situations.

During the post-observation discussion, Tom and I discussed the difficulties that some candidates articulated with the process of lesson study. I felt that the silent majority in the class was slipping into a default student mode and that perhaps candidates were discouraged by some of the reactions from their peers, given the amount of time that they put into planning their lessons. I also noted that candidates, like many teachers, might have a tendency to say that there is a problem with the students, rather than with the lesson itself. Tom took a slightly different angle and brought the focus of the discussion back to the level of risk required by these short lesson-study presentations:

> They are revealing a lot about themselves in this class that they are not revealing in other classes. There may be some reaction here that it is too much, too quickly. I realize that I am getting to see sides of them that I never would have otherwise, but I think that in the long run, there is a payoff. (Journal, September)

Making Suggestions after Some Initial Teaching Experiences

Later that evening, Tom sent an email to the class to draw attention to many of the issues that had been raised. He included the following suggestions for candidates to consider when revising their lessons:

- We are not looking for perfection, just an improved approach that has reasons!
- Work whenever possible to move beyond "traditional" approaches (whatever that means—familiar, comfortable) to a plan that helps "students" be more active, more challenged, and more engaged in the lesson.
- Focus on a Concept—and name your concept somewhere in your plan.
- Just a thought—don't be afraid to stop at any point in the lesson, step out of your teacher role, and ask the class how they feel about particular aspects of what you are doing.
- Also, don't be afraid to call on people by name if you don't get responses—very few people have tried that so far, but that's always an option so it might be good to explore now.

By framing the email as a series of suggestions, Tom tried to encourage candidates to think about the concerns we articulated during our post-observation discussions. The email was powerful because until that class Tom had made few comments about the candidates' teaching. It seems particularly important that the comments

focused on suggestions for improving the process, rather than on specific teaching strategies. He wanted to encourage candidates to think about how to improve the quality of their interactions with the class, and he thought that the ways in which the lessons changed would be an important marker for thinking about what candidates learned from the experience.

We both noticed significant differences during the second round of lessons. The most obvious difference was that candidates were trying to enact slightly riskier pedagogy, including a few demonstrations and POEs. There was more of an effort to engage the class in discussion, and Tom was more vocal about drawing candidates' attention to details such as font size on the overhead and the importance of admitting when one is lost in the middle of a derivation. At the same time, however, Tom was quick to comment that people will initially teach as they were taught, not as they were told to teach. At the end of the seventh class, Tom reiterated that he was using lesson study in the hope "that there will be connections between experiences and preconceptions in this class and what happens when you come back" (Journal, September).

One of the most significant challenges of enacting lesson study pedagogy was working out how to conclude the experience in a meaningful way that flowed naturally into the first practicum. After the final two lessons during the ninth and final class before practicum, Tom distributed a sheet of paper entitled "The Big Picture after 4 Weeks in Physics Class." Candidates were asked to try to describe some of their new perspectives on teaching and learning from (a) planning lessons in a group, (b) watching others teach, (c) presenting their own lessons, and (d) working with equipment for teaching electromagnetism. After 15 minutes of writing, Tom led a discussion based on the writing task.

Teacher candidates reported that, although they planned in groups, ultimately the way in which a particular lesson was enacted depended on the person at the front of the room. They also felt that planning a lesson as a group was quite time-consuming. Tom commented that he was particularly impressed with the fact that the groups got together on their own time to plan, without any prompting to do so. The candidates agreed that watching one another teach was a good way to learn different ways to think about physics content and how to present that content. A few candidates stated that they watched their peers with an interest in finding ideas on how to teach particularly challenging topics. The class seemed to unanimously agree that there was no reason for concepts in electromagnetism to be presented as dryly as they often are at the high school level.

The richest portion of the discussion centred on what candidates learned about their teaching as a result of lesson study. The general consensus was that knowing physics is not the same as knowing how to teach physics. We suspect that this realization was underscored by the feeling created in the class by the few candidates who tried to improvise their first lesson. Tom took the opportunity at the end of class to emphasize the link between providing experiences in teaching via lesson study and providing experiences in physics via POEs:

> I have always been fond of the idea of letting students have some experience with the stuff before you teach them the theory, and then let them go back

> and ask them how things are different now. We don't give them much of a sense of the before-and-after; perhaps that is part of the reason kids walk away without a good conceptual understanding of physics. There is an incredible sense in science teaching of tell first, explore later. (Journal, October)

Ending the semester with a reminder that teaching is built on a culture of telling was an important way to bring the lesson study experiences full circle. Tom began the term by providing a POE experience that was unlike what students typically encounter on the first day of class. He ended the term by naming the experience of lesson study as a way of pushing the notion of "explore first, explain later" (Journal, October).

CONSTRUCTING PROFESSIONAL KNOWLEDGE FROM TEACHING AND LEARNING EXPERIENCES

Teacher candidates coming from physics backgrounds naturally began their conversations about teaching and learning with familiar rhetoric about learning physics. The idea that teaching-is-telling immediately came to their minds. The cultural routines of teaching internalized via the apprenticeship of observation, both at the secondary and tertiary levels of education, are particularly powerful as these effects seemed to be the bedrock on which candidates grounded their assumptions about teaching and learning. Candidates said that their prior conceptions of teaching physics were essentially limited to transmission models of education. Teaching physics was initially framed as a tension between explaining physics concepts and demonstrating mathematical equations through problem solving. The big pedagogical question for candidates was one of order: Should concepts be taught before formulas or after?

The effects of the apprenticeship of observation influenced not only candidates' assumptions about teaching and learning, but also their assumptions about what can and should be learned at the Faculty of Education. Essentially, candidates expected that a teacher education program would tell them the most effective ways to enact transmission-based pedagogies, while also providing plenty of opportunities to practise the same teaching moves they had witnessed former physics teachers and professors make time and time again. The teaching practice that teacher candidates had been exposed to over their entire lives is the same practice that helped them become successful students. It is precisely the same kind of teaching practice that, coming into the preservice program, they expected to be exposed to from professors at a faculty of education. The long apprenticeship of observation generated many prior assumptions that candidates had about teaching and learning.

During September, the effects of the apprenticeship of observation on teacher candidates were seen to be disrupted in three ways. The first and arguably most important disruption came in the form of the lesson study pedagogy. Here teacher candidates were encouraged to interpret their prior assumptions about teaching while confronting those inner teachers we all have inside us, created over many years of observing other people teach. Perhaps it was the tacit nature of the apprenticeship of observation that made it so difficult for candidates to plan lessons in groups; they were at once discovering their default teaching moves and trying to negotiate

how to plan lessons with peers who were making similar discoveries about their own ideas about teaching. David and Paul found it particularly difficult to plan their lessons in a group because they were trying to interpret their default teaching moves and the needs of their groups, while also coming to terms with their self-imposed expectations to enact new pedagogies based on ideas that had resonated with them during the physics class. Strong dissonance occurred for these two candidates in particular, as evidenced by their repeated use of adjectives such as *frustrated* and *disappointed*.

The teacher candidates who participated in the study noticed the tendency of their classmates to plan and enact lessons based on traditional, transmission-oriented approaches to teaching and learning. Again, this tendency was of particular concern for David and Paul, both of whom indicated that they were disturbed by the lesson study experience. Both saw the potential for lesson study to push their thinking about teaching and learning in new directions; both felt that the experience fell short of its potential. In particular, David and Paul were frustrated by a perceived lack of willingness in the class to engage in discussions about the quality of teaching and learning during lesson study.

Peer interactions also had the potential to disrupt the effects of the apprenticeship of observation. Four of the five participants noted that there was some level of tension among people in the physics class during the lesson study process. Irene commented that the entire process felt exhausting, that there were good and bad days, and that any perceived tension was probably a result of feeling overloaded by lesson study. Thus the tension between candidates in the physics class may have reduced the possibility that peer feedback could disturb the effects of the apprenticeship of observation. In contrast, teacher candidates consistently reported that their interactions with other teacher candidates in the program, outside of physics class, encouraged them to reconsider many of their prior assumptions about teaching and learning. The diversity of perspectives offered by other teacher candidates in the program was a significant factor in disrupting participants' prior assumptions.

Finally, the pedagogy that Tom used throughout the month of September seemed to disrupt some of the effects of candidates' apprenticeships of observation. Although the participants were largely unable to name particular features of his pedagogy that had specific effects on their learning, they did speak of a different *feeling* in Tom's class. Tom's classroom was perceived as a low-risk environment that was grounded in his trust of the candidates. In particular, David was impressed by the degree of trust placed in candidates as shown by his enthusiasm for Tom's flexibility about due dates for assignments. A focus on *trusting the learner*, to borrow a phrase from David, represented a disruption of candidates' apprenticeship of observation. It is interesting that feeling trusted seemed to represent such a radical departure from candidates' previous experiences of school.

Lesson study was an explicit attempt to disrupt the effects of the apprenticeship of observation. From the perspective of a teacher educator, the pedagogy was viewed as a mixed success. Although Tom was able to create an environment in which candidates felt trusted and respected, lesson study may have been too complicated for teacher candidates at this early stage in their careers. Despite Tom's explicit

modelling of how to talk about the effects particular teaching strategies had on learning, candidates were mostly unable to differentiate between teaching strategies and learning effects. This critical realization helped Tom and I understand the extent to which we had underestimated the effects of the apprenticeship of observation. The difficulty that candidates had talking about learning effects was a direct result of a lifetime of observing and learning to mimic teachers' behaviours. In hindsight, it was unrealistic to expect candidates to be able to do anything other than offer corrective advice about how to behave more like a teacher. It is unlikely that candidates' past educational experiences provided them with significant opportunities to systematically explore the effects of particular pedagogies on their own learning. Although candidates had witnessed thousands of hours of teaching, they had not had opportunities to explore the means-ends relationship between teaching strategies and learning effects. Instead, as Ethell and McMeniman (2000, p. 98) suggested, "they had been left to guess" about the pedagogical intentions of expert practitioners. Rare is the teacher who makes learning about learning the primary focus of a day's lesson.

In summary, September was a month of disruption. The degree and nature of the disruption of the apprenticeship of observation was varied but present across all five participants. They spoke of the ways in which their prior assumptions were challenged by Tom's pedagogy, including but not limited to lesson study and interactions with their peers. Two participants showed evidence of experiencing particularly strong dissonance between their prior assumptions about teaching and learning and their visions of the kind of teachers they wished to become. The traditional language that candidates use to discuss issues of teaching and learning began to move away from metaphors for telling about physics and toward metaphors associated with active learning. The teacher educators' perspective was also disrupted by the events of September. Although the effects of the apprenticeship of observation had been recognized in the past, the lesson study pedagogy provided fresh insight into the critically powerful role that prior experiences play in teacher candidates' development. The apprenticeship of observation creates an inner, default teacher in each of us as it also shapes and limits the language we use to talk about teaching.