

Being and Becoming in the Science Classroom*

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Abstract

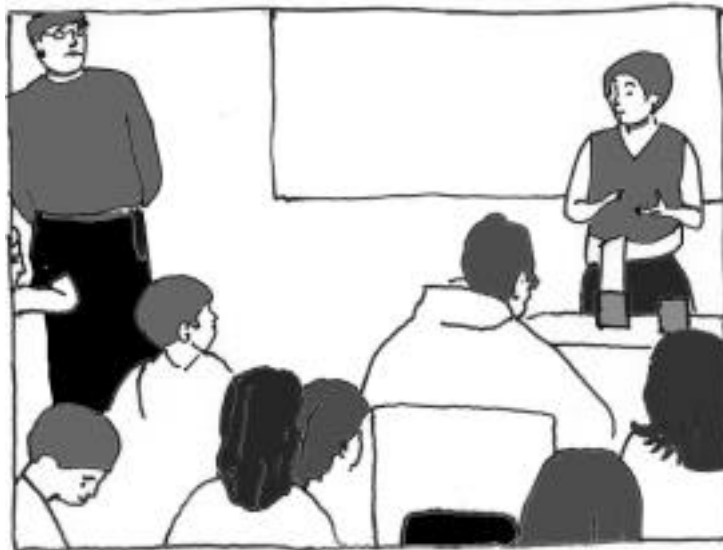
In this article, I propose a non-reductionist approach to teaching in general and to science teaching more specifically. The development of this approach has occurred over the past 6 years while I was engaging in *coteaching*, a form of participating in science teaching praxis with regular classroom teachers. In the process of conducting 6 separate studies of coteaching, I established a large database on the being and becoming of teachers in science classroom. In this article, I outline a framework for understanding teaching (I purposefully do not use the word *theory*) that is built around the following 4 central concepts: *being-in/with*, *habitus*, *spielraum*, and *relationality*. Consistent with this framework, I advocate coteaching as a mode of learning to teach in praxis that eschews problems arising from reductionist approaches to teacher knowledge and its appropriation.

A (Co)Teaching Episode

As a starter activity for the day, Nadine has decided to show how an egg, which will sink in fresh water, will float in salt water (of sufficient concentration). Nadine begins her activity standing in the center of the classroom in front of the chalkboard, with a beaker in front of her on an unoccupied student desk. Michael stands to the side towards the left wall (from camera and student perspective). Thus, in this case, Nadine has taken on the lead and is on the central stage (Figure 1.a).

- 01 Nadine: What will happen if I put this egg into the water?
02 Tom: It's gonna float.
03 Stephen: It's gonna float
04 Nadine: Lindsey has her hand up?
05 Chris: A big baby will be formed.
06 Nadine: Chris, control!
07 Bill: It's gonna float
08 Nadine: Danielle?
09 Danielle: And does it have salt in it?
10 Nadine: It has no salt in it.
11 Danielle: Then it is gonna sink.
12 Nadine: So you think it's gonna sink. Joanna, what do you think?

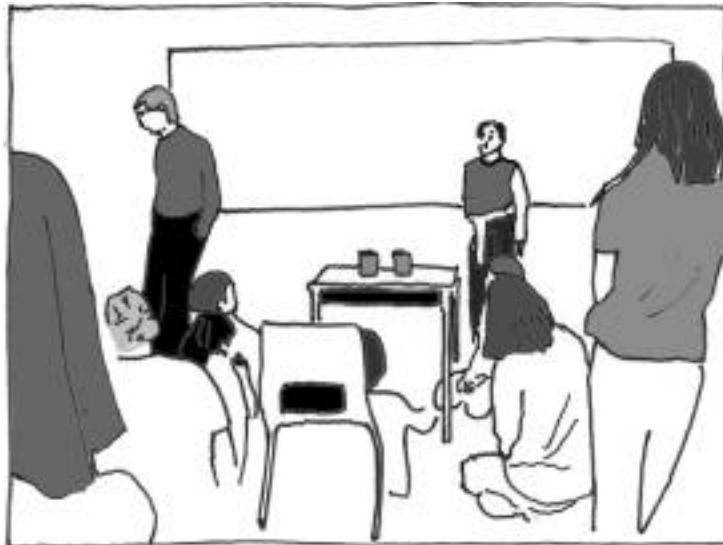
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a.



b.



c.

Figure 1. Michael and Nadine coteach a lesson on floating eggs in fresh water and salt water. a. Nadine has taken the lead and is at center stage. b. When Nadine seems to struggle, Michael as the more experienced teacher comes to help out, asking questions from center stage that get the conversation going again. c. Nadine transits into a different part of the lesson, while Michael walks off center stage.

- 13 Joanna: It's gonna sink.
 14 Nadine: Why do you think it is gonna sink? (Pause) Danielle, why
 15 do you think it is gonna sink?
 16 Danielle: Because there is no salt in it.

In this situation, the old habitus of asking questions in which students do not have to provide rationales, explanations, or elaborations to their answers. Nadine accepts what students say without following up, or asking them to justify their answers. Nadine does not ask for a justification or elaboration even when Danielle asks whether there is salt in the water where the egg is to be placed. At this point, a possible question could have been why the salt should make any difference, thereby actively soliciting explanations from the students. Only after another student, Joanna, has provided her guess does Nadine return to Danielle to ask for a justification. But the student's answer, "Because there is no salt in it," does little to move toward further elaboration and justification of students' guesses (hypotheses).

At this point, Michael still stands on the outside perimeter of the classroom, but decides to contribute to the conversation. (He is, in fact, much closer to the center of the "action" than students sitting farther in the back. But, as our research has shown, his physical position has to be considered "off stage" and as having less impact and control than being center stage [e.g., Roth, McGinn, Woszczyna, & Boutonné, 1999].) As an experienced teacher, he feels that the conversation "is going nowhere."

Michael therefore asks a question requiring a justification, but without waiting for an answer asks a second question, further expanding the context. Both questions open up the possibility to either provide a rationale, or to make a comparison between substances that itself lends itself for a subsequent request for justification should it not be forthcoming immediately. Of course, asking such questions without deliberating comes from a habitus that has developed in years of teaching and leading whole-class conversations. As the subsequent contributions show, students generate further hypotheses including first justifications ("...is the opposite..." and "...is lighter than...").

- 17 Michael: What kind of differences does the salt make? What would
 18 happen if you use sugar? Is it the same?
 19 Troy: No!
 20 Christian: Sugar is the exact opposite.
 21 Chris: Sugar is lighter than salt, making it float less.
 22 Nadine: I didn't think about that. Dave, what do you think about
 that?
 23 Dave: I don't know. I think it will sink, also.
 24 Nadine: Because it has no salt in it? Anybody else have any
 25 suggestions? Tom?
 26 Tom: It will sink, but very slowly, because when you add salt
 27 you gonna make it... Gestures upward movement.

In contrast to Nadine's question, which students could answer by providing one or the other alternative (sink, swim), Michael's question asks for an explanation. Whereas students could say "the egg floats [sinks]" in answering Nadine's question, Michael's questions ask for justifications and explanations.

From Nadine's perspective, the question Michael asks can be heard as coming just in time; it was productive and appropriate for this context and this conversation. Unlike a decontextualized text about questioning strategies, which might say use stems like "What happens if...?," coteaching affords Nadine to hear questions that allow her to continue a whole-class conversation then and there. That is, although Michael asks a question, the coteaching situation does not take control away from her, but allows her to continue the conversation while affording learning to the students in her class.

Nadine's first contribution in this episode, "I didn't think about that" can be heard both as an admission that she had not thought about whether adding sugar to water would be the same or different than adding salt. She then takes over again from Michael the role scaffolding a student conversation through her questions. Here, rather than asking a question that students could answer by a simple factual statement, she asks what students (e.g., Dave, Tom) thought about the effect of sugar.

Nadine places the egg into the water. The egg slowly sinks to the bottom. Nadine then adds salt to the water, constantly stirring. Nothing appears to happen, and she continues to add salt while stirring, but little seems to change in the behavior of the egg.

- 28 Nadine: What is going to happen? I am going to add some more salt.
- 29 Alicia: It's gonna make it float.
- 30 Tom: It's gonna float back up. I don't know why, but like in the
- 31 Dead Sea, it is hard to go into the water, because there is so
- 32 much salt in it.
- 33 Nadine: Really? Danielle?
- 34 Danielle: I think that the salt would make it stay half above the
- 35 water, half below the water, and so...
- 36 Nadine: So you think it will be, like, suspended? It won't be quite
- 37 touching the ground, the bottom, but it won't also be at the
- 38 top?

Although students make some interesting points about why the salt should make a difference, Nadine seems to begin to struggle. From Michael's perspective, Nadine misses a "teachable moment" when she does not follow up on Tom's contribution, in which he shares an example sometimes featured in documentaries on the Dead Sea. Furthermore, she does not follow up asking Danielle for a justification of her claim that the egg would be suspended.

At that time, the conversation seems to come to a halt, Nadine and the students waiting for something to happen as she adds the salt. There is a long pause, only interrupted by

student comments not loud enough to distinguish their content. At that point, Michael moves from the side of the classroom to come to stand close to Nadine (Figure 1.b). He now has the opportunity to bring the conversation back on track. Bringing the conversation back on track then affords students with continuing opportunities to learn, while also affording learning opportunities for Nadine who experiences in situ how to question and how to get out of an apparent instructional cul de sac.

Michael now contributes in two ways. First, he asks students a question to get the conversation going again and moving ahead: “Why should salt water make a difference?” Nadine

- 39 Michael: So what happened here. At first, it wasn't floating and now
40 it is floating? And the only difference is=
41 Chris: =Salt.
42 Alicia: =Salt.
43 Tom: =Salt.
44 Michael: is salt. But
45 why should there be any difference between salt water and
46 fresh water?
47 Stephen: Because, it makes a difference.
48 Lindsey: I don't know, just a difference.
49 Troy: It's like there is water, and the salt dissolves into it. It may
50 have to do with the thickness or something as the salt
51 dissolves.
52 Michael: So salt water has a property that makes it float better?
53 Troy: Yeah.
54 Nadine: What do you think about that Tom?
55 Tom: When you put the salt in the water you make it heavier,
56 because the salt is heavier, and then it makes the egg
lighter.
57 Nadine: Because the salt is heavier and it makes the egg lighter?
58 And what do you think, Steve?
59 Steve: Because it has more salt in it.

Michael attempts to frame the question anew in order to afford a further development of the conversation. Three students simultaneously call out “salt” while Michael makes salient the difference between the two situation (floating, sinking), but he reiterates the question which calls for an explanation of the effect of salt “Why should there be a difference between salt water and fresh water?” (lines 45-46). Two students simply restate that it should make a difference or avow to not having an explanation, but Troy then provides a first explanation according to which the dissolving of salt will change the “thickness” of the water. Michael, knowing without reflecting that “thickness” is not part of a scientific discourse about the phenomena instantly rephrases Troy's comment in terms of some “property” that brings about the change. (Some science educators prefer to talk about a misconception, but in our research, the notion of a discourse or discursive resource has shown to be more fruitful in understanding students' contribution and

learning in classroom communities.) This leaves open the nature of this property and therefore future opportunities for developing the conversation. One such opportunity arises only three turns later.

As throughout the lesson, Michael leaves room for Nadine to reenter the conversation. Here, then, Nadine enters the conversation again by asking Tom to venture his ideas to the question that Michael previously raised. Tom suggests that the salt makes water “heavier,” and therefore the egg lighter, relatively seen. Without pursuing the ideas contained in Tom’s contribution, Nadine asks one more student, who reiterated by stating the observation that the amount of salt made the difference. At this point, Michael realizes that the students in this class do not seem to have developed a discourse about floating and sinking in terms of density. Even the most interested students, having developed considerable discursive resources to talk about science-related topics, did not draw on the scientific concept of density. Rather, they used everyday language to talk about thickness and heaviness (or lightness) of substances.

Again, there appears to be a block. Michael therefore enters again and picks up on a comment made earlier by Tom, but not pursued by Nadine. Tom’s might encourage other students who had seen documentaries on the Dead Sea to recall their prior experience.

- 60 Michael: Orienting himself toward and pointing at Tom Can you
61 repeat but loud enough for everyone to hear?
62 Tom: I am not sure about it, but I thought because the salt is
63 heavier, so it makes the egg lighter, so it floats.
64 Michael: And did you say earlier something about the ocean water?
65 Tom: Oh, yeah. In the Dead Sea, there is lots and lots of salt.
66 And when you go there, it’s hard to go into the water,
67 because it pushes you up.
68 Michael: OK, so you have an actual real life example. Has anyone
69 seen images of that on TV before? (8 seconds)
70 Nadine: As anyone seen that? (2 seconds) I just wanted to open it
71 up Michael moves off to the side (Fig. 1.c)
72 with this little demonstration to show you that an egg will
73 not float in fresh water, but when we add salt to it, then we
74 notice that the egg rises.

Tom begins by stating a hypothesis about the effect of salt on the “heaviness” of water and the relative heaviness/lightness of the egg to the surrounding substance. But Michael takes the conversation in a different direction by asking Tom about his earlier comment relating to the Dead Sea (though Michael asked about “ocean water” more generally). Tom contributes further observations to the ongoing conversation, namely that the salty water pushes people upward making it difficult to go “into” the water. Michael’s subsequent question then checks whether there are other students who know about the effect of the Dead Sea or other ocean water on the floatation of people. Despite leaving a long pause, no further answers were forthcoming. (Although Michael was not thinking

about wait time research, he enacted pauses consistent with this research.) Michael and Nadine realize that the other students either have not seen or do not remember having seen a feature on the Dead Sea. Nadine then changes the topic, explaining what she had wanted to do with this activity, and Michael walks back to his original position toward the left wall (Figure 1.c).

Nadine: I was just accepting yes, no, or, these answers but there is no explanations for it. I can hear myself asking the questions, when I was asking a closed and open-ended question. I really found it helpful when you asked questions that kind of got the lesson going again.

Michael: What happened for you in this situation, what did you think about? You know, when I asked a question, did you think about me asking a question or did you listen to the question or?

Nadine: No, I was thinking about how you formed that the question or

Michael: Because at that moment, you didn't have to do, I mean, at least for sort of 2 seconds or minutes...

Nadine: Right, I didn't have to do anything, no I didn't like shut my brain off, I was listening to your question and how you've formatted that question. And that helped me because it triggers in my head. I was thinking, 'Oh yeah I should be thinking about that,' 'I should be asking about that,' 'that was a good question that really got them going on this tangent or brought them back or 'this got them more focused.' Yeah, that was helpful for me to, to hear your questions and listen to your questions and think about how it related and where you were trying to go with that question, too.

Michael: Did listening to my questioning help you in other ways?

Nadine: Yes, because when you would get up there and form your questions a little bit, slightly different way it would ask the students to give more than just a one word answer. This would trigger things for me when I find, you know, when I would get up there and I asked a question, 'Oh no that wasn't good enough, explain, or elaborate and then.'

Michael: You mentioned that in the middle of asking questions, you become aware of the type of questions you ask?

Nadine: When I asked a close-ended question, I think 'Oh' and then I try, make them elaborate further on what they were trying to say.

Michael: So what do you think we, at the university, could do to better prepare you for teaching a lesson as we did today?

Nadine: I realized that I didn't know the science involved in the demonstration, like I could feel in your questioning that you know the science. So I am thinking that I would have liked to have another science course. I think that I would have benefited more than from taking so many subjects that are not important in schools, like art, music, and PE. When we're getting to the classroom those were the three subjects that we probably spent the least amount of time actually doing and learning about.

For a decade now, I have taught together with other teachers; we cotaught meaning that we planned, taught, and debriefed lessons together with the intent to learn from each other, neither to decrease the amount of work nor to teach in a specialty area only. In this work, I have become increasingly aware of the fact that existing theories of knowing and

learning as a teacher did not well describe my own experience as a teacher. While models of teacher knowledge are framed in terms of ‘subject matter knowledge’ or ‘reflection-in-action,’ I was little aware of these constructs during moments in which I experienced as enacting teaching without time out and in the heat of the moment. If these traditional models do not appropriately describe our experience of teaching, what alternatives do we have available? In the remainder of this paper, I am sketching the framework that I (together with Domenico Masciotra, Daniel Lawless, and Kenneth Tobin) have developed over the past several years.

Framing the Issues

It has become a truism that teachers perceive a gap between the content and form of knowledge that they appropriate in university courses and the savvy that they acquire by working in the field. Teachers who have the opportunity to share their praxis with another practitioner will almost invariably point out differences between the extent of their learning by being with a peer and by sitting in a classroom. Thus, one teacher suggested to me the following:

I just improved so much in [teaching kids to think for themselves by asking productive questions]. I don't think three university courses could have given me what [coteaching] gave me in these two months. (Christina 92/11)

Despite much research over the past two or three decades, (science) teacher educators have not been able to deal with this gap. Teachers continue to deplore the gap that exists between their experience in the ivory tower and, time and again, praise their time in the classroom as the true location of their learning to become a teacher. Why might be so, and where do the problems lie?

Let us begin by taking a look at two major theoretical frameworks elaborated over the past two decades: the tri-part teacher knowledge theory elaborated by Shulman (1987) and teaching as reflective praxis (e.g., Schön, 1987).

Shulman (1987) elaborated a theory in which teaching is characterized by three major forms of knowledge including general pedagogical knowledge, subject matter knowledge, and pedagogical subject matter knowledge. From an observer (researcher) perspective, these three forms were useful for classifying the different practices enacted by teachers. However, rather than viewing the classification of practices into different knowledge categories as a semiotic practice, teacher educators jumped to a realist conclusion: The classification scheme was thought to be the real thing. Pertaining to our domain, science teacher education programs were often redesigned to include more subject matter courses as a consequence. For some time, NSF specifically required science educators to include scientists in the teaching of subject matter content courses (e.g., Roth & Tobin, 1996). But, as our recent studies show, science teachers do not explicitly think about content or subject matter content in praxis, when they enact questioning sequences without time out to think about whether they should phrase a

question this or that way (Roth, Masciotra, & Boyd, 1999). While it is still useful to characterize teacher's knowledge in terms of the classification scheme developed by Shulman, teachers still do not recognize their knowledge in terms of this scheme and, based on my experience of teaching, rightly so. In the heat of the moment, I do not think of what I know about physics and physical chemistry, but I enact questioning in the here and now of the classroom. As the lessons unfold, there arise opportunities that are present to me without that I have to think about what to say next in the same way that readers will not have to think about what to say next during a dinner or party conversation. On such occasions, we are in tune with the situation, the people we interact with, the topic of talk. Most often, we abandon ourselves to the situation and are curiously unreflective about the ways in which we engage.

While this theory has done its job in raising among politicians and the general public the awareness of the special knowledge teachers have, this theory simply continued to reinforce the idea of knowledge as a commodity that can be acquired in university classrooms. It reinforced the split between theory and practice—similar to the historical split that separated the practices of architects and craftsmen (e.g., Turnbull, 1993)—because it was thought that this specialized form of knowledge had to be taught in special institutions rather than in the field. Such observations have led some thinkers to abandon traditional rationalist approaches to understanding teaching and to seek for approaches that put a prime on enacted practices. One of these approaches was championed by Schön (1987, 1988) and has become known as reflective practice. There are two, temporally separate components of reflection-in-action, the kind of deliberations said to be enacted by the practitioner in the heat of the moment, and reflection-on-action, the kind of deliberations enacted by practitioners at the end of the day, when they look back at critical instances of their work from a remove. Here I focus on reflection-in-action because it is said to pertain to the act of teaching itself. It has turned out that this

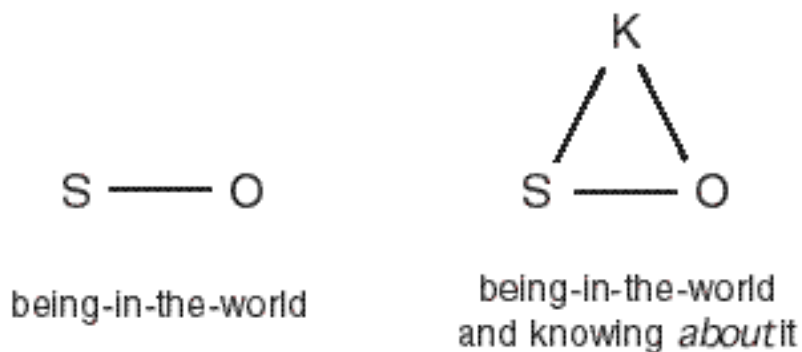


Figure 1. The relationship between subject, world (object), and knowledge about. **Left.** Phenomenological approaches take as fundamental point of departure the direct unreflective involvement of subjects in their world; the world presents itself to the acting subject. The relationship is not objectified. **Right.** Knowledge *about* the world requires that the subject, object, and the relationship is re-presented in the form of signs, entities (letters, drawings) that refer us to and stand for other entities (e.g., Eco, 1984).

concept, too, does not describe teachers' experiences for in the heat of the moment, we teachers are (curiously?) unreflective. While it is true that we may reflect on some event during those moments that allow us to step back, it is not the case for those situations where teachers have to act. It is exactly at these moments when there is no time out for deliberating that beginning teachers feel

that their university learning does not apply (e.g., Roth & Boyd, 1999). One of the main problems with the concept lies in the temporal restrictions associated with reflective thinking of any kind. In short, reflection necessitates a removal from immediate action, which in turn requires time, time that practitioners do not always have (e.g. Bourdieu 1980).

Praxis: Teaching to Learn and Learning to Teach

Being-In

According to a phenomenological understanding of everyday knowing and learning, our fundamental condition is that of *being-in-the-world* (e.g., Bourdieu 1997, Ricœur 1992). Being-in is characterized by an absorbed and transparent coping, an unreflective disposition concerning the way we go about our everyday affairs (Dreyfus, 1991). For example, as I write this article, I am not normally thinking about the keyboard. I am thinking about the kind of argument I want to make and watch the letters and words come up on the screen. I am not thinking about the fingers that make these letters and words appear nor do I look at the keyboard to seek for the correct place where to put my fingers. The keyboard is transparent to my activity of writing a research article. While driving to the shopping center, we do not think that the red light at the intersection means stop and that we have to stop; rather, we simply stop. That is, most of our everyday activities at home or work are enacted without thinking about the activity or the knowledge that it supposedly requires. Let me characterize this relationship of absorbed and transparent copying as a direct involvement of a subject, S, in the world, O, that is, S—O (Figure 1).

This unmediated relation of the subject to its world is broken when there is trouble. For example, when the keyboard begins to stick, or what appears on the screen somehow turns out to be troublesome, I begin to attend to the keyboard. It is no longer transparent to my activity of writing a research article. It demands my attention and I begin to re-present it in terms of its keys, cables, connections, and so on. These re-presentations always are in terms of signs, entities (including ideas) that stand for other entities. My unmediated relation to the keyboard in the way it presented itself has been broken and I begin to regard it in terms of characteristic aspects, parts, the way it relates to other parts of my computer system. Let me express this mediated relationship in terms of a relation S—K—O. Here, my relationship to the keyboard (O) is no longer direct but mediated by (cultural) categories that provide various ways of looking at the entity and to search for trouble. Of course, as I attend to the trouble my practice of writing is disrupted in the same way my article writing would be disrupted if I started thinking about my keyboard while attempting to describe a research methodology or writing an analysis of a teaching episode.

This knowledge about always requires something like “containers,” entities that we can use to encode a keyboard and its part, and which we can manipulate without actually having to manipulate the thing itself. These entities are signs, which can be in material form (e.g., letters, texts, and graphics) or ideas (semioticians call them “interpretant

signs”). That is, we can characterize knowledge about in terms of the placeholder signs for the subject (S_{Sub}), objects (S_{Obj}), and subject-object relations ($S_{\text{S-O}}$) that they are said to stand for. The knowledge K is therefore constituted by the ensemble of the signs that we use $K = \{(S_{\text{Sub}}), (S_{\text{Obj}}), (S_{\text{S-O}})\}$.

These mediated relationships are not the same as the direct relations that characterize our absorbed coping in the world. Knowing signs is not the same as enacting a practice that can be described in the form of a sign. Being able to read a case study of science teaching and applying to it some culturally appropriate analysis is not the same as enacting appropriate teaching. Cooking a delicious dish is not the same as knowing the recipe, including all the instruction for getting from the raw ingredients to the final product. Now my claim is that our theory-practice problem lies in the fact that we, as a discipline, mistake knowing *about* teaching as a prerequisite or even constitutive part of knowing to teach.

Being-With

Being-in the world, we exist not only in material form as a material bodies among materials bodies, but always and already also as a social body among social bodies. Each *being-in* is also a *being-with* (an Other). Always and already thrown into a world shot through with meaning, our (social and material) bodies are formed by the (social and material) world that envelops them. Bodies are open to the world, and in this openness they are susceptible to be conditioned by the world, formed by the material and cultural conditions of existence in which it is placed from the very beginning (e.g., birth). Through our bodily inclusion in the world (e.g., classroom and school), we are therefore subjected to a process of socialization in which individuation, the formation of Self (e.g., as teacher), is itself a product. The social is grasped as lived experience, through day-to-day praxis, and the singularity of the “me” is worked out as I enact and emerge from each social relationship. “Me” and “I” therefore presuppose a condition of *being-with* (Heidegger 1977). Our bodies—gestures, attitudes, and facial expressions—are the primary means to provide contextuality and indexicality that are the fundamental conditions and stabilizing features of everyday interaction (communication). *Being-with* is the central underpinning of the “co” in *coteaching* (Roth 1998a, 1998b, Roth and Boyd 1999, Roth et al. 1999). But before I come to *coteaching*, I need to develop several other concepts.

Habitus

Being-in-the-world amounts to a non-thematic but caring absorption in everyday activity (Dreyfus, 1991). The world is comprehensible, immediately endowed with meaning because we have been exposed to its regularities from the beginning (see above). We therefore acquire dispositions or systems of dispositions: *habitus* (e.g., Bourdieu 1980, 1997, Bourdieu and Wacquant 1992). *Habitus* generates, without reflection, the patterned ways we interact with the world, that is, our practices that *embody* both actions and perceptions. There exists a mutually constitutive and therefore reflexive relationship between the structures of the world and the structures of *habitus*. Being exposed to and

formed by the world, *habitus* embodies the structures of the world. But, because the *habitus* generates our actions and perceptions, I, the human agent, structure the world itself. *Habitus* therefore constitutes a system of structured dispositions in which the past is constituted in the present. Because *habitus* was formed by the regularities of the world, it is enabled to anticipate these regularities in its conduct. This assures a *practical* comprehension of the world entirely different from the intentional and conscious decoding acts normally attributed to the idea of comprehension. *Habitus* therefore temporizes itself in praxis through a practical mobilization of the past in the very moment it anticipates the future.

Habitus cannot be described in the abstract. Central to the notion of *habitus* is that it only reveals itself in reference to the particular, that is, in definite situations. Thus, what has to be done cannot be specified a priori and in the abstract (e.g., in the form of advice to Nadine for classroom control) but emerges from the contingencies and temporalities of each situation. For example, even though it is highly desirable for teachers to plan thoroughly for enacting a curriculum in classes like those in which Nadine is teaching it must be remembered that the most appropriate course of events will unfold *in* the enactment and cannot be pre-specified. Similarly, it is not possible to sit on the side watching a teacher and his/her class and specify a correct course of action to adopt. Thus, *habitus* produces given discursive and material (perceptual, classification) practices only in relation to the specifics of a setting (*being-in!*). To acquire *habitus*, one has to *coparticipate in* situations with those who already have acquired *habitus* prior to ourselves. The formation of any *habitus* therefore requires being-*in* and being-*with*.

Habitus is not static and closed but an open system of disposition that is under continuous experience-dependent transformation embodying its own history and experiential trajectory. These experiences either reinforce or modify existing structures of *habitus* such that it will sustain more viable practices. To avert the criticism that we are developing a behaviorist theory, we want to add two points about *habitus*. First, being exposed to the social and material world is not the sole form of shaping *habitus*. *Habitus* “can also be transformed via socio-analysis, i.e., via an awakening of consciousness and a form of ‘self-work’ that enables the individual to get a handle on his or her dispositions” (Bourdieu and Wacquant 1992: 133). Thus, reflection (either in or on action [e.g., Schön 1987]) is an additional, though not primary mode by which *habitus* is formed and transformed. Second, the notion of *habitus* does not rule out strategic choice and conscious deliberation as modalities of action. First, the sequences of actions generated by *habitus* may always be accompanied by interests, strategic calculation of costs and benefits, and by other concerns prevalent in the situation. Second, in times of serious breakdown, when the normal routine forms of interacting with the world are brutally disrupted, rational choice indeed takes over—at least in those agents who are in the position to be rational.

Spielraum

Competent teachers always seem to do the right thing at the right time. They have a capacity to anticipate problematic situations. This capacity to anticipate, to make salient

in the present certain aspects of the future is acquired in praxis, and in a familiarization with the field. This capacity arises from a familiarity of *being-in-the-classroom* even if we do not objectify it and are therefore like the fish, which do not objectify the water that supports them and structures their activities. The anticipation that characterizes competent teaching has nothing to do with the susceptibility to the mobilization of explicit knowledge drawn from memory. This anticipation only reveals itself in practical situations and under the contingencies of an ever-unfolding time. The range of action possibilities available to the agent at any one point constitutes a *Spielraum*, room to maneuver (Roth et al. in press-a). An extended *Spielraum* provides more possibilities for action without stopping to think (reflect) on what to do next. *Spielraum* arises from a practical sense, which locates the next move in the unfolding situation. For the experienced practitioner in a familiar situation, unlike for Nadine in the above quote, there is therefore no question what to do next; what comes next is part of the possibilities of the situation. It is this *Spielraum* that differs across individuals and in effect can be used as a distinguishing characteristic between an inexperienced and an experienced science teacher (Roth et al. 1999). The pressing matters to be completed (Gr. *pragmata!*) are constituted in the relation between the anticipations and expectations on the one hand and the probabilistic structure constitutive of the social world on the other hand (Bourdieu 1997). That is, the objective probabilities that constitute the extended *Spielraum* exist only for the master teacher, who has already developed a sense of the game. This sense is developed in praxis. *Pragmata*, the pressing matters that orient anticipation and the generation of practical action are never produced in the form of explicit forecasts of what is going to happen, or in terms of explicit rules of behavior.

Relationality

Relationality is a matter of knowing-in-action without reflection. It involves a direct rapport teacher-student(s) and can only be displayed “in-situation.” *Relationality* manifests itself by, through and within the ongoing knowing-in-action. Indeed, it is well known that many types of activities (e.g. jazz improvisations or hitting a baseball) are incompatible with a stop and think attitude, because the practitioner opens herself up to failure through a loss of synchronicity. In respect to education, these events might include dealing with problematic incidents while teaching inner-city classes (Roth and Tobin 1999) or exploring students’ understanding of scientific phenomena (Roth Lawless and Masciotra in press). Knowing is enacted but it does not require reflection. Highly developed knowing-in-action is endowed with its own capacity for supervision without reflection.

Knowing-in-action arises from *relationality*, because it is only in relation to particulars that human agents produce given discourses and practices (Bourdieu and Wacquant 1992). The genesis of *relationality* is associated with the development of teachers’ range of actions, room to maneuver, or *Spielraum* (Roth Lawless and Masciotra in press, Roth Masciotra and Boyd 1999). In advanced master teachers, this range of actions develops into an integrated network of action possibilities. This network empowers teachers to establish an extended *relationality*, which is coextensive with action that is self-conscious and thoughtful by itself without enacting a stop-and-think mode.

Relationality involves not only the objectified knowledge about the reality but also the construction of the reality at hand (e.g., classroom and students)—Bourdieu (1980) distinguishes these two forms of knowing in terms of *sens objectifé* (objectified sense) and *sens pratique* (practical sense), respectively. For example, to establish a harmonious relation with the child, the teacher must enter the child's reality. Entering a child's reality is not possible if one has not constructed it. By construction we do not mean simply to have knowledge *about* but to relate feelingly and knowingly here and now to the child. Knowing-in-action means relating-in-action: it is a matter of being *in relation to* something or someone. Knowing is therefore more than being situated, context-bound, and reactive; knowing-in-action means actively situating oneself in, participating in, and shaping the setting (Lave 1993).

In the course of the present inquiry, it will become clear that *relationality* constitutes a more viable indicator than reflectivity for understanding the climate and degree of harmony of the teacher-student-classroom world. Whereas reflection emphasizes logico-mathematical knowledge—associated with “detached reflection” (Heidegger 1977) and “objectivation” (Bourdieu and Wacquant 1992)—*relationality* expresses the rapport of the teacher with her experienced reality—associated with “transparent coping,” “absorption in praxis” (Heidegger 1977), and “practical understanding” (Bourdieu & Wacquant 1992). This rapport displays teaching and learning situations in holistic rather than reductionist ways.

Praxeology: Walking the Walk

In a recent conversation, Peter Grimmett, a long-time advocate of teaching as a craft (e.g., Grimmett, 1996, 1998; Grimmett & MacKinnon, 1992), told me that teacher educators have to begin to walk the walk (personal communication January 26, 2000). He told me about his practice of teaching learning to teach courses in the field, where the issues to be talked about arise from the events that happened in the student teachers' classes on the same morning. Rather than teaching students about cognitive development on a particular day because the course outline indicated it, lived experience provides the starting points for professional interrogation and development of understanding through critical and informed analysis.

In my terminology developed here, Grimmett talked about praxeology, with its correlate “method” of hermeneutic phenomenology as the tool for teacher development. That is, he engages students in developing understanding out of their experiences. By introducing relevant existing knowledge in the teaching community, he brings in the resources for a hermeneutic reflection. In this way, student teachers no longer experience a gap when they are asked to move from theory to the praxis of teaching. Rather, praxis is primary, and understanding of praxis, praxeology rather than theory, is developed out of the primary experience.

Some readers may think that we advocate a return to professional schools, immersing student teachers in the field and abrogating the need of explanatory discourses. However,

this is not at all what Grimmett or we have in mind. Rather, the hermeneutic explanation-seeking component in our hermeneutic phenomenology relies on the historically constituted disciplinary knowledge that is used as a resource in the analysis of lived teaching experience. As Ricoeur (1991) pointed out, it is only through critical and informed analysis that we can develop understanding; but all critical analysis already presumes and in fact is enveloped by understanding that arises from lived experience.

Becoming-in-the-Classroom through Coteaching

Becoming a teacher means to develop the *Spielraum* and *habitus* that characterize competent teaching. This, according to Bourdieu, can only happen in the experience; if we *coparticipate* (being-with) *in* the classroom (being-in), we participate in the patterned activities, practices, which in themselves make sense: we “are the ways we do things.” We understand ourselves in the way we objectify our experiences of being-in/with an Other. These experiences constitute the ground that reflexively elaborates (objectified) discourse about teaching. As teachers, we never just do things in a stable world, but interact with students who are also agents themselves. Thus, students and teachers construct their Self-Other continuously and emergently in situation. “Teacher” and “student” arise out of the dynamic of each situation, and personality can only be attributed to individual bodies in a retroactive manner. To be a teacher does not mean just to expose a stable self into the classroom, but to engage in a continuous construction of “teacher” arising from the interactions in and with the (social, material) classroom (e.g., Giddens 1991).

In response to the problems experienced by preservice teachers and based on our experience of teachers learning from teachers as they coparticipate in praxis, we have developed coteaching. Coteaching is a mode of teaching grounded in *being-in/with* as the fundamental condition of existence (Roth 1998a, 1998b). In coteaching, several practitioners share (*being-with*) the responsibility of teaching this class (*being-in*). They plan lessons together and work side by side in the classroom. This does not preclude that one individual take a greater and more central role in some situations (e.g., during planning or questioning).

Coteaching works because *habitus* generates (discursive and material) practices only *in the relation to* particulars; as with other practices (e.g., Bourdieu and Wacquant 1992) there is no better way to experience it other than in the praxis of doing the real thing together with another practitioner. The benefits of coteaching fundamentally arise from the experience of *being-together-with* that leads to a silent pedagogy where people learn and harmonize their practices with more experienced practitioners, without having to make their learning thematic. By working with another person, particularly with an experienced Other, new teachers come to enact appropriate teaching as a way of being in the world.

It is the objective homogenizing of group or class habitus that results from the homogeneity of conditions of existence that enables practices to be objectively harmonized, without any strategic

calculation or conscious referent to a norm, and mutually adjusted in the absence of any direct interaction or, a fortiori, explicit coordination. (Bourdieu 1980: 98)

Being-together-with, which underlies non-thematic learning and coordination of practices, allows *coteachers* in the classroom to experience events under the same conditions of temporality, openness of activity toward the future, and constraints to have to enact without the leisure of theoretical (atemporal) reflection. Practitioners experience the synchrony between themselves and with the class. Under certain conditions, two experienced practitioners can enact lessons, improvising and exchanging roles during questioning, with a feel for the implicit intent of the other, without objectifying the events and communicating about it (Roth 1998b, Roth and Tobin 1999).

In order to appropriate *habitus* without the tinkering required in trial and error, the teaching of a practice (*métier*, craft, trade) requires a pedagogy that is different from that of teaching propositional knowledge. It has been suggested that often the most vital modes of thinking and action cannot be made thematic, and therefore cannot be taught by talking about them (e.g., Bourdieu 1980, Dreyfus and Dreyfus 1986, Schön 1987). Rather, to learn these modes of thinking and acting, practitioners have to coparticipate in doing the real job, which allows them to learn enacting teaching in similar ways even if teaching situations are too complex to be broken down in a small and manageable number of variables. Such a view of practice is a viable one not only for the learning of material practices such as those required of butchers and midwives (Lave and Wenger 1991). Rather, such pedagogy is also appropriate for the conceptual and methodological practices of doing research in academia more generally (e.g., Bourdieu 1997, Roth and McGinn 1998); and they are especially appropriate for teaching (Roth 1998b).

In our ongoing studies (of which we have conducted seven so far), all teachers who experienced coteaching emphasized the tremendous amount of learning they experienced. Even experienced teachers typically make comments such as “I don’t think three university courses could have given me what [coteaching] gave me in these two months.” (Tammy) or “This experience has changed my thinking about this unit [although] I wrote it, tested it, and had done workshops with teachers on it for the past three years.” (Gitte) (Roth, 1998a). Teaching interns in our research especially drew benefit from working at the elbows of a more experienced practitioner:

[Nadine:] Yeah, that was helpful for me to, to listen to your [Roth’s] questions and hear your questions *then and there*, as it happened, and then to think about how it related to the demonstration and where you [Roth] were trying to go with that question.

Conclusion

The framework outlined here and in detail described and made concrete with many examples from my teaching in the cited references has been very fruitful in our work. Kenneth Tobin and his collaborators at the University of Pennsylvania has made changes

to their teacher training program in which all those involved coteach. Nobody present in a classroom may sit and watch from the sidelines but everyone coparticipates in teaching. The positive change largely associated with this change in program is being written up as a book at this point in time.

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