Chapter 7
Response to Section II: Practicing, Modeling, and Influencing Approaches to Teaching: A Commentary

G. Michael Bowen

This section has four papers that have dealt with the *content* preparation of preservice science teachers (PSTs) so that they would have a more adequate background for teaching science. The research in these PST-focused content courses examines the role of the instructor and the practices they engage in, to understand the outcomes in these courses from a variety of perspectives. Each paper draws from a variety of methodological and analytical approaches consistent with the self-study perspective (many drawing on Loughran's work (2006) either directly or indirectly as a starting point).

In this commentary I'll draw some connections between the papers and their findings and the implications of those, but then I'll discuss a facet to consider that I believe is missing in these discussions of teacher education and what that might mean for future research in self-study and teacher preparation as well as in the selection of teacher candidates.

Three of the chapters examine elementary science teacher content courses, and one a secondary content course, but I'd suggest that the findings of each are generally applicable to other preservice teacher audiences (both grade-wise as well as subject-wise). The study by Gilles and Buck examined the role of "enthusiasm", a core teacher attribute that leads to improved student learning (Brophy & Good, 1986), framed with the context of "the teacher's ability to transmit the importance and intrinsic value of learning content to the students (Patrick, Turner, Meyer, & Midgley, 2003)" (p. 122, this volume) and various physical attributes such as speed of utterances, facial cues, descriptive speech, and energy level amongst others (Collins, 1976; Rosenshine, 1970; Turner, 2007). The authors reported that the preservice students found "real enthusiasm" motivating, but saw through "false enthusiasm" (as described by the teacher demonstrating it) and did not find it motivating,

G.M. Bowen (✉)
Faculty of Education, Mt. Saint Vincent University, Halifax, NS, Canada
e-mail: gmbowen@yahoo.com

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although they were still motivated to learn during the inquiry investigation where it was displayed. The authors concluded that intrinsic motivation, perhaps deriving from a "positive environment" (Ritchie, Tobin, Hudson, Roth, & Mergard, 2011), was more of an influence than teacher enthusiasm on student's motivation to learn.

Gilles and Buck noted that as the students were left to be more in control of their learning environment during inquiry activities, as they were able to "move and work with others" (p. 137, this volume) this generated more positive engagement and increased their motivation. One can't help but notice that this parallels the "relational pedagogy" discussed by Trauth-Nare, Buck and Beeman-Cadwallader in their chapter. They also present a diverse series of activities and examined how relational aspects of the class improved learning outcomes in a class where traditional classroom discourse (i.e., teacher focused) was replaced with more peer-interaction and discourse and the teacher's role shifted to one of facilitator and co-learner. Trauth-Nare found that stepping back and giving students more room to have a voice resulted in improved learning opportunities and outcomes.

I was struck, however, by the self-criticism that Trauth-Nare engaged in when she was discussing her class overall:

> …the findings above indicate that sharing authority for teaching and learning was a difficult and hard-won goal for me. Class discussions proved most difficult for me to share authority. Clearly, I had an agenda for helping students to learn particular science concepts and this made class discussion a high stakes endeavor. The dilemma I faced lied in the fact that I had devoted instructional time to discussing an activity, project, or empirical research article as a way to promote understanding.

This seemed overly self-critical to me. Firstly, any individual activity needs appropriate scaffolding to achieve the desired learning outcomes of the course. For some activities/outcomes these can be achieved through negotiation and collaboration with the instructor being more of a bystander. For other activities it can be achieved through more traditional means. Or some mix thereof. Motivation (as noted by Gilles & Buck referencing Pintrich, 2003), not to mention what one needs from the instructor as a learner to learn effectively, changes with age. Children have fewer experiences to relate ideas, concepts and, even, stories to and thus are in need of more hands-on activities to provide the experiences they can align the concepts to. Adults, however, have far broader experiences and consequently can (often) get more out of direct instruction (i.e., being "told" something) because they have experiences they can relate those examples to. In a class full of adults with varied life experiences that means that their competencies are going to be wildly heterogenous needing more support in some areas than others both within and across groups because of variances in their Zone of Proximal Development (ZPD; as posited by Vygotsky, 1978). Consequently, this means that a teacher needs to vary their scaffolding quite substantially within any given class much in the manner of the actual practice described in the Trauth-Nare chapter. There might well be a tension with the instructor wanting to be "efficient" in their instruction in some places (thereby "telling") but in other places wanting to step back and engage in instructional approaches involving "multivoicedness" (Mortimer, 1998) thereby modeling classroom approaches that they would wish the preservice teachers to adopt with their

own students in the future. Wishing to have a "better" classroom usually means using appropriate approaches in the necessary place, not engaging in a singular approach at all times, and sometimes that would mean using teaching approaches that work for adults but which wouldn't necessarily work for children.

This tension between needing to have preservice teachers knowing and understanding particular content while at the same time wanting to model appropriate teaching practices for science teaching with children is explored in Nyamupangedengu's chapter. Her findings were that an appropriately structured "content" course (in this case for secondary teachers) could indeed both teach the desired content as well as model variously appropriate teaching practices. This lies in contrast to "traditional" science content courses which generally use the transmission mode of teaching (i.e., lectures) supplemented by confirmatory laboratory activities which, in my experience, create secondary preservice teachers who are inclined towards the "lecture" approach to teaching because of the models for it which they can easily draw on. In my experience this entrenchment is so deep that although they might, after a year-long "science methods" course where hands-on inquiry approaches were both modeled and deconstructed (both experientially and conceptually in relation to the literature as per Loughran, 2006), profess that "inquiry" is an appropriate approach for science courses and one they wish to engage in, the classroom teaching they ultimately enact when they are in their own classroom is almost exclusively a traditional approach (i.e., teacher-directed, lecture-oriented, with confirmatory labs etc.) while at the same time they *talk* about their teaching practices as if they were engaging in inquiry investigations and multivoiced, relational teaching approaches (as commented by Hare (pers. comm.) when discussing Chap. 3 of Hare, 1985). That is not to say, however, that engaging in modeling approaches such as that practiced by Nyamupangedengu is without purpose, just that it is an attempt to counteract a teaching tendency towards pedagogical traditionalism which has the inertia of years of being lectured to as a student behind it.

Over the years I've perhaps become cynical regarding these issues of my (as an education faculty instructor) modeling "good teaching practice" whether it be regarding enthusiasm or relational pedagogy or hands-on inquiry practice or whatever, and that cynicism derives from my having lunch in the cafeteria at my university. The building I teach in is dominated by education students, and preservice education students exist in high numbers in the lunch area, so if I go and eat lunch at the right time I can eavesdrop on any number of discussions about our program (I teach a small minority of our undergraduate education students some years, and in other times teach none at all) as our second year students hold court for our first year students. I learn all sorts of things about my colleagues (many I'm quite sure they wish I didn't hear about) but I also learn that our post-baccalaureate education students are very good at being students. Very, very good. And by that, not to sound cynical, I don't mean in their enthusiasm or in their knowledge but rather in regard to the games they play as students to be successful in the program; and one of the biggest of these games seems to be "tell the prof what you know they want to hear so you get a good mark". Clearly, learning to be a teacher is a form of Wittgenstenian "language game" (Wittgenstein, 1958) as far as they are concerned, and for many of

them the "game" part seems to be sticking with the core of their beliefs while professing otherwise (how else to explain the traditional nature of many of their teaching practices after they graduate?). Not to appear to be a "nattering nabob of negativism" (Spiro Agnew in 1970; discussed in Lewis, 2013) but either I and my many colleagues have been terrible instructors over the last 20 years (at least the amount of time we've been teaching our methods students to not engage in lecturing) or something else is going on...and I think it's the latter. We've modeled, we've taught, we've discussed, we've had readings with small and large group interactions, we've participated in inquiry with them, and we've involved them interactively in education research; and at times it seems to be to little or no avail, particularly when one's own children are taught electrical circuits in their grade 6 class through copying diagrams and memorizing the chapter by someone who was a well-thought of graduate from the local faculty of education at which one teaches. A bitter pill, but I think we have to at least look at the issue and how we might address our seeming ineffectiveness as instructors. In some ways, I think the chapter by Fuentes and Bloom starts to touch on what we've not considered.

Bloom sets himself up in his design of the content course for elementary preservice teachers so that a conflict arises between he and the students in mid-course. To his credit, rather than forging ahead he puts on the brakes and rethinks what was going on and his instructional approach and, the authors report, he then engages the students in a different manner through thinking about their identity development as a teacher. In other words, he considered their "identity" as one shifting from "student identity" to "teacher identity" and this meant engaging in teaching practices regarding the content of the course differently. This was driven, for instance, by his noticing in student reflective notes that students were looking externally for rules about what constituted high quality work rather than establishing those high expectations on their own accord (as a teacher might well be expected to do). In enacting his changed approach to teaching them he began engaging in what Loughran argues is the more effective approach of both modeling practice *and* engaging the preservice teachers in understanding the thinking, knowledge and reasoning that underlay choosing to engage in that practice (Loughran, 2006).

Yet, at the end of the day good praxis (that integration of practice and the theory that underlies it) such as Bloom was engaging in is not necessarily "good teaching" because we have no sense of those issues that other chapters in this section reflect. We don't know if he demonstrated enthusiasm (I'm sure he did, but…), we don't know if he demonstrated aspects of caring (not explicitly studied in these chapters, but a comment arising in several of them), and over and beyond that we don't know what attitudes about teaching teaching he modeled in his approach. At this point it's worthwhile noting that we don't, in science education, often talk about attitudes. I've personally always found that odd because so much of engaging in science effectively seems to reflect "attitude" as much as it does "practice" or "skill". An attitude is, according to the Oxford Pocket Dictionary, "a settled way of thinking or feeling about someone or something, typically one that is reflected in a person's behavior" (Attitude, 2009). Llewellyn (2013; p. 2) identifies a number of "habits of

mind" that typify science (and other disciplines too), quite a number of which I would argue display an attitude inasmuch as they are a practice of science:

Commitment	Integrity
Creativity	Openness
Curiosity	Persistence
Diligence	Reflection
Fairness	Sensitivity
Flexibility	Skepticism
Imagination	Thoughtfulness
Innovation	Wonder

It's a considerable list, and yet if these reflect "science", then they surely should be modeled in teaching about science, or in teaching science methods for that matter.

Attitudes matter because the idea of identity and attitudes are closely interlinked (Smith & Hogg, 2008), yet it is unusual to see the concept of "attitudes" discussed in the science education literature, particularly in relation to preservice teacher preparation and more particularly in relation to developing those attitudes in any way that reflects "good teaching". Looking at my lunchtime experiences, I would point out that from the perspective of developing a professional identity the attitudes – towards the practices being taught – held by many preservice teachers do not seem to reflect the attitudes we would like them to hold. We would like them to take our arguments, our modeling, our readings about "good science teaching" and have them apply them to their own thinking about classrooms, but many seemingly do not. There are reasons for that.

As anyone who has worked in areas of racism, misogyny or even class-related issues knows, it can be remarkably difficult to change attitudes. There is a remarkably in-depth literature on attitude change in the social psychology literature, and for the most part science education literature neglects to engage it even when we discuss identity theory and the construction of science teacher identities. I'd argue that this is important because of what is known as the "backfire effect" and how it relates to attitudes and attitude change.

The "backfire effect" (Nyhan & Reifler, 2010) suggests that when presented with factual evidence that contradicts something about which people have strong opinions or attitudes, rather than changing their mind to align with the evidence people often continue to hold their original views more strongly than ever. Despite the contradicting evidence they hold those views, and even strengthen them. It is a motherhood statement in science education that people often teach the way they were taught, and that it is remarkably difficult to change that. The social forces in schooling, the influence of standardized tests, the intransigence of much formal curriculum certainly influences this difficulty, but in any system where those problems exist there are a few teachers whose identity AS a teacher has them engaging in practices we promote. I think our general lack of success at changing the rest of them is because we try and argue people out of the practices that they've experienced as students…we don't look

at it as changing their attitudes about teaching instead our approaches are evidentiary-based…and the backfire effect kicks in.

At the end of the day there is nothing wrong with improving our use of modeling inquiry, of modeling enthusiasm, of engaging in relational pedagogy as instructors…these are all necessary to providing the foundations on which the development of a professional teaching identity based on more than just understanding pedagogy and content can be built, but overall as a science education community I think we need to work more seriously on the development of attitudes towards the teaching of science and attitudes towards the conduct of science and the associated "habits of mind" as part of that identity development. That, I suggest, means paying more explicit attention to the literature on attitude change in the future.

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