I KNOW IT WHEN I SEE IT…THE EPHEMERAL NATURE OF CLASSROOM INQUIRY SCIENCE TEACHING

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Vexation

The specific context of my vexation begins with my career as a Physics teacher in high school. During my teacher preparation program, I spent an intensive year studying science teaching and living it in a classroom. I had read about inquiry in the *National Science Education Standards* and the *AAAS Benchmarks*. These were ambitious ideals with some inspiring examples of how these ideals played out in classrooms. What was missing was a set of realistic principles that could make my teaching more like the ideal. Suggestions from the *Standards*, such as "learner formulates explanations from evidence", were not enough to tell me how to enact inquiry in my classroom. The idealized examples were too far from my experience with teaching science to help me move in the direction of inquiry. I needed guidance about how to enact inquiry science pedagogy in my classroom that took into account both educational theory and authentic practice.

To seek guidance, I left the classroom to pursue a degree in science education to immerse myself in the research. I hoped to use any understanding I gleaned to help shepherd other teachers along in understanding this elusive form of teaching. I joined a team of educational researchers engaged in systemic reform of middle school science in a large urban district. It seemed the perfect context to articulate the middle ground between theory and practice in the rough and tumble of real classrooms.

The general approach of my team (one common to reform efforts) was to develop curricula, in collaboration with teachers, which served as the primary vehicle for reform. My role within the group was to provide professional development for teacher participants to support their enactment of the curricula to the highest possible fidelity within their local constraints. During this time I came to three significant realizations: (1) curricular interventions, even with the support of professional development, did not significantly change practice; (2) teachers could not enact inquiry curricula, regardless of their design, without a more abstract set of principles to guide them; and (3) current theoretical descriptions of inquiry (including standards) were not adequate to provide this guidance. I had found the schism between theory and practice present even in a context of a resource intensive attempt to eliminate it.

I believe the reason for this persistent gap between the ideals of the standards and enactment in the classroom lies in the act of teaching itself and how it is theorized. The standards focus almost exclusively on the students and the activities they engage with in an inquiry classroom. Particular examples of practice lack any framework of principles that made it clear what made the lesson inquiry. There needs to be middle ground theoretically, a meso-level of theory useful to both researchers and teachers. This meso-level theory needs to provide principles for differentiating inquiry and non-inquiry teaching. My vexation turned toward the question of what this guide/framework/theory would look like for classroom inquiry science teaching.

Kerr (1980) suggested the field of teacher education needed a theory of teaching in order to advance. She specifically differentiated this theory of teaching from theories of phenomena. She suggested a theory of teaching should be a theory of practice – essentially an operational (quality) definition of the practice of teaching. This description of a theory of teaching seemed to suggest an answer to my vexation. However, in the thirty years since Kerr's suggestion a great deal of attention has been given to learners and learning, including teachers as learners. A great deal of energy (and funding) has been put toward the development of innovative curricula to influence classroom science pedagogy. A great deal of the research in science education has focused on cognitive factors (e.g., knowledge and beliefs) of students and teachers that impact learning. There has been a focus on theorizing learning (a theory of phenomenon) and not theorizing teaching. This focus has left science educators, and in particular science teachers, with implications from learning theory, but no well developed theory of classroom inquiry science teaching grounded in authentic practice. My final vexation, that remains for me in spite of years of working and thinking about it, is that I understand and can articulate very little about what differentiates classroom inquiry science teaching from teaching that is not.

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Venture

In response to my vexation my on-going venture has been working toward contributing to Kerr's vision of a theory of teaching, which for me must be grounded in authentic practice. I am attempting, with a group of colleagues, to analyze examples of classroom inquiry science teaching in hopes of creating a functional set of descriptive principles. The work has been iterative – going from data to theory and back again – in an attempt to develop something both theoretical and practical.

The process began in the fall of 2005 when a group of practicing teachers agreed to be part of a study group focused on inquiry science teaching. I was lucky to get a group of exceptional classroom teachers who also took educational research seriously. I explained I was interested in understanding classroom inquiry science teaching and articulating that understanding in a way that was useful to teachers and researchers. Initially, we engaged in discussions and readings in an attempt to clarify a definition of inquiry, which is not clear from the science education literature (Abd-El-Khalick, 2004). We also felt the need to work from concrete examples, so each member brought in video of a lesson they felt represented inquiry science teaching. We began to analyze these lessons in an effort to capture *elements of inquiry,* pieces of the elusive definition we could see evidence of in the samples of practice.

As analysis continued it became clear we needed larger grain-sizes of practice to identify some of the elements we were interested in, and thus we began to analyze sets of multiple lessons. Over the summer of 2005 initial elements of inquiry began to emerge (McDonald, Criswell & Dreon, 2007). Also around this same time there was an opportunity to add prospective teachers to our group. The student teachers were placed with members of the group and also participated in the analysis of practice examples. The novice teachers provided both interesting insight as well as significant challenges. They forced us to be much clearer, cleaner and more specific about the framework we were describing.

For the past two years the group has analyzed classroom practice with the specific eye toward deep research-based understanding that naturally translates into guidance for real classroom practice. What we have found is that we have some ideas, but we remain vexed. What does a theoretical description of practice (i.e., abstracted from specific examples) look like that can guide prospective and practicing teachers when they attempt to enact inquiry science? How do we know classroom inquiry science teaching when we see it? When we agree we see it, what is it about the teaching we see that makes it inquiry? These questions play out in the context of the individual classrooms of the members of our research group as they struggle to enact classroom inquiry science pedagogy. Specifically this vexation plays out for *me* whenever I teach a science lesson and then try and articulate to someone else (my preservice teachers for example) to what degree my lesson constitutes an example of inquiry. Justice Potter Stewart famously said of pornography: "I shall not today attempt further to define the kinds of material I understand to be embraced within that shorthand description; and perhaps I could never succeed in intelligibly doing so. But I know it when I see it." I don't believe our field can afford to take this view of classroom inquiry science teaching. My venture is to define inquiry in a way that others can know it when *I* see it.

Questions for the incubator forum:

- Can you imagine principles of inquiry teaching that are more specific than standards, but less specific than concrete examples of practice? If so, what would they look like?
- Both practitioners and researchers use "inquiry" to stand for "the best possible type of science teaching", but to what degree does "inquiry" overlap with "excellence" in science teaching? By extension then, should a theory of teaching be concerned with excellence, inquiry or both?