

CINDY SABIK

Gilmour Academy

Teaching Scientists, Not Science

Vexation

My “vexation” is that we are not better at educating students deeply and well. Years of schooling too often leave graduates with superficial or misconstrued understandings of everything from what it means to write to basic scientific concepts.

Scientific misunderstandings and misconceptions are often the centerpiece of critiques of this tendency toward mis- or under-education as in this example from Howard Gardner’s book, *The Unschooled Mind*:

College students were asked to indicate the forces acting on a coin that has been tossed straight up in the air and has reached the midway point of its upward trajectory. The correct answer is that once the coin is airborne, only gravitational pull toward the earth is present. Yet *70 percent of college students who had completed a course in mechanics* [emphasis added] gave the same naïve answer as untrained students: they cited two forces, a downward one representing gravity and an upward one from “the original force of the upward hand.”

When questioned about the phases of the moon, the reasons for the seasons, the trajectories of objects hurtling through space, or the motions of their own bodies, students fail to evince the understandings that science teaching is supposed to produce. Indeed in dozens of studies of this sort, young adults trained in science continue to exhibit the very same misconceptions and misunderstandings that one encounters in primary school children. (p. 3-4)

As an educator, I find this situation particularly troubling, believing as I do that education is the only way to prepare our citizenry to face our most troublesome social and political situations. How do we produce committed, articulate citizens with a desire to change the world, to address large-scale, ongoing issues like global warming? How do we produce thoughtful graduates with a desire to be change agents in a world in which the response to terrorism is still to want an eye for an eye, where General Motors’ response to the dilemma of carbon emissions from gas consumption is to offer a free year supply of gasoline to the purchaser of a Hummer? What do we teach to children who have been taught that the existence of a god and a heaven is a fact but that evolution and global warming are myths?

The implications of this vexation, if left unresolved, are clear. We will continue to function in too many places and spaces as the society we are becoming: complacent, unthinking consumers, lazy, uninformed thinkers—inarticulate victims of our own limitations. As a teacher, I firmly believe that the key—the only key—to addressing everything from uninformed voting to thoughtless consumerism is *education*.

Venture

The path I am suggesting to alleviate my particular vexation is to address the heart of the educational enterprise. Gardner is proposing that children enter their years of schooling with powerful, deeply embedded theories about how the world works. His response is to argue that the only time our intuitive theories are interrupted or changed, the only time we fundamentally alter the way we think, is when we think disciplinarily. We change for example, not when we study grammar but when we think like a writer; not when we read a textbook, or fill out a worksheet, or memorize a list of facts, but when we think like a historian; not when we memorize the periodic table or parrot a text on cell mitosis, but when we think like a scientist. So the first question I would like to explore, and would like to pose during the incubation process is, “*What does it mean to think like a scientist?*”

Next, I would like to extend Gardner’s argument by referring to Stigler and Hiebert’s insightful work in *The Teaching Gap* in which they argue, after analyzing classrooms in the U.S., Germany, and Japan, that teaching is

Teaching Scientists, Not Science

a cultural activity—so much so that the most conservative teacher in the United States looks more like the most progressive teacher in the United States than like a teacher in either Germany or Japan. Anticipating that “there would be great variability in teaching methods within the United States” (p. 11), they reported instead that, “As we looked again and again at the tapes we collected, we were struck by the homogeneity of teaching methods within each culture, compared with the marked differences in methods across cultures.” While there are certainly marked differences in teaching styles and philosophies among and between American teachers, Stigler and Hiebert discovered that “these differences, which appear so large within our culture, are dwarfed by the gap in general methods of teaching that exist across cultures” (Stigler and Hiebert, p. x).

What does this mean, that teaching is a cultural activity? It means, according to Stigler and Hiebert that “we learn to teach indirectly, through years of participation in classroom life, and we are largely unaware of some of the widespread attributes of teaching in our own culture” (p. 11). It means that the toddler in Gardner’s model, who observes the world and forms powerful theories about where parents go when they leave the room and why it gets dark at night, will continue to engage in that activity several years later, as she sits in a classroom, observing behaviors of teachers and students, including herself. She will form, again, powerful models of what it means to teach, to learn, what school is, what a classroom is, what a lesson is. Notions like homework, tests, and report cards, papers, labs, and lab reports are part of that model. Appropriate behavior, what is “academic” and what is not; what constitutes “important” or legitimate subject matter and what does not; what is mastery, and what is not, how that is demonstrated and how it is not—all of these are formed, as in Gardner’s model, personally, through observation and analysis, through repetition and application. Notions around school and schooling are constructed in the deepest sense. It is not what we “believe.” It’s what we know and understand intuitively—“in our bones.”

What does this mean for teacher education and school reform? It means that much like the superficial learning that too often occurs in K-12 classrooms, teacher education programs and programs of professional development are relegated to the superficial. Stigler and Hiebert are quite direct about it: “the fact that teaching is a cultural activity explains why teaching has been so resistant to change” (p. 12).

Stigler and Hiebert are correct in “Recognizing [that] the cultural nature of teaching gives us new insights into what we need to do if we wish to improve it” (p. 12). What Gardner’s model addresses, that Stigler and Hiebert do not, is the question of disciplinarity. If, as Gardner proposes, thinking can only change when one thinks disciplinarily (i.e., “like a historian,” “like a scientist,” “like a writer,”) then it follows that we must pose the question “What does it mean to think like a teacher?”

Therefore, the second question I would pose during the Incubator Forum is, obviously, “*What does it mean to think like a teacher?*” and more specifically, “*What does it mean to think like a science teacher?*”

I am not a science teacher. My areas are language arts, humanities, and teacher education. I do, however, seek connection between and among disciplines, and would like to share this line of inquiry in particular with science educators as part of my research process in this project. My course of action to resolve, diminish, conquer, or overcome my vexation is to engage and develop this line of inquiry and research. I am approaching a crossroads where an appropriate venture for my vexation is to share this line of inquiry with Crossroads participants, to solicit ideas and feedback, and to glean from practitioners in the area of science education ideas about what other work in this arena might be worth connecting to.

The question presents a delightfully rich challenge to the classroom teacher on every level. What does it mean to think like a teacher? What does it mean to think like a scientist? What does it mean to think like a science teacher? And even more wonderfully challenging: What does it mean to ask a first grader or a third grader or a tenth grader to think like a scientist?