Confessions of a Fragile Physics Learner

Linda V. Beardsley
June 2006

For me, the “real stuff” of education lies in the parameters of what Joseph McDonald (1992) calls the “wild triangle;” the I, Thou, and It that David Hawkins (1967) discusses. For me, the real stuff of education is experienced among the teacher, student(s) and curriculum to be taught, daily, in the classroom. Together. But what does this really feel like? How can I figure this out? I decided I could best figure this out by taking a rigorous It, by becoming one of the Thous within the wildness of an undergraduate course, by being a student in a discipline that would be novel for me. So it seemed exciting to contemplate enrolling in a physics course.

It is difficult to know where to begin this “confessional.” When I embarked on this adventure of taking a Physics Course, I imagined myself qualified to be a member of a new, rather exclusive “club;” Instead, I stand before you, a fragile learner.

Let me begin with what I learned. Some of the things I learned were prosaic. I learned about the body of knowledge called classical physics. What was more important to me, I learned to use these formulas.

Some of the things I learned left me breathless. In moving from learning about Galileo’s genius and memorizing Newton’s Laws to considering the particulate nature of matter, I encountered this:

“You exhale many, many breaths so other people breathe in many, many atoms that were once in your lungs…that were once part of you…Believe it or not, with each breath you take in, you breathe atoms that were once a part of everyone who ever lived!” (Hewitt, p. 212)

Well, this was almost too much to comprehend, but it did appeal to my poet’s soul. So this is physics, too, I pondered. Where do ideas like this lead? Everywhere, it turns out. They lead you into the farthest reaches of the universe and into the teeniest tiniest particles we can imagine, the tiny particles that are constantly in motion, in collision with one another, or in
binding energy with one another awaiting the next momentous "tiny bang" to modify their energy.

But then, and here is where I guess my "confessions" really begin, some of the ideas and vocabulary I encountered just seemed to make no sense to me at all. Blackbody Radiation, for example; or computing the decay of certain particles.

I guess my first confession is, I really never learned to care about these minute particles and their travels through space and time. These ideas overwhelmed me; it unnerved me to think about such abstract foreign ideas without a context in which to understand them. So there were times in class when I shut down; I fought the instinct to put my head down, to close myself off from these things into which I could find no entry point. I thought about other things. However, I confess there are other ideas with which I was willing to struggle, to revisit and contemplate over and over again. I am not sure I have really come to understand them, but I do know they mean something to me.

Other strategies that drew me into the dense content of physics were the stories of the scientists, the people, who had shaped this knowledge. I enjoyed hearing about Einstein’s tense marriages, his work in the patent office pondering how to make the trains run on time. Physics was a field that mere mortals had uncovered, debated; they had been exhilarated by its discoveries and ideas. After grappling with the dual nature of light and learning about the quantum, I was fascinated by the play, Copenhagen, by Michael Frayn, which we read to explore the “intersection of science and history” the mysterious meeting between Nils Bohr and Werner Heisenberg in Copenhagen in 1941.

But perhaps what I learned most in my Physics course was about learning and teaching and myself as a physics learner. I learned a great deal about what it means to be lost in an academic course, to be afraid to try a problem, to be befuddled by the buttons on a scientific calculator. To be overwhelmed, confused, inarticulate. To be embarrassed when I did poorly on an exam. This is too hard. When I looked at the homework, dense word problems peppered with odd symbols, I wanted to give up. It was the patience of my tutor who helped me take each problem apart, deal with each section calculation by calculation. He helped me to trust my instincts, entertained my often very basic questions, to develop a comfort level with
scientific notation. Furthermore, it was my tutor who helped me see the connections between the homework problems and the readings. Together, in our weekly meetings, we constructed a world of physics ideas that connected my questions, my mistakes and my correct answers into a framework called Physics for Linda. In our weekly meetings we refined my physics, explored my ideas, my learning. *For the class itself made me silent; I could never find my voice to ask a question, pose an idea, try an answer. To not have a voice in one’s learning was the most frightening experience of all.*

*Being a student in physics reinforced what I have come to believe about teaching and learning and assessment and gave me new insight into what it means to be a challenged learner. I know that for me to find true meaning in text and ideas, I need to be able to talk, to discuss, to listen and be challenged by the ideas of others.* It was the relationship established between my tutor and me that made my learning possible. I learned that I need to start with the big ideas that tug at the soul. Only after I can ponder the notion that my atoms may be made of the stardust of eternity can I find purpose in computing with Avogadro’s number.

*I learned that telling is not teaching. I like knowing what a teacher knows; it is intriguing to me. But what makes me learn from that knowledge is knowing how that teacher knows what s/he knows. That starts to get to the heart of real teaching for me.* In the first lesson, the first slide the professor showed on the Powerpoint was a slide of a painting by the 19th century artist, Seurat. He described how when he was in grade school, his class used to be visited by a representative from the Art Institute of Chicago who showed them various paintings. He liked the Impressionists, even then. He then described how Maxwell’s experiments and discoveries about light, as packets of color, are reflected in the work of visual artists of the 19th century. Artists build an understanding of the world through their art; likewise, physicists are building an understanding of the world through physics. I was hooked. This was connecting for me.

*But even as I lost my voice in the increasingly dense material in the class lectures, the teacher shared his real voice less often. I wanted to know more about how his mind grasped the complex notions he presented in slides. What connections had he made that perhaps I could try? For me, telling transforms into teaching when the teacher shares his/her process of understanding with me.* I know the mind of a physicist must work differently than my mind. I know there are experiences and opportunities that the
physicist has had that I have never had. I want to know these. These help me learn. These help me see that the information is more than vocabulary and text. This information is *lived*, experienced. This information is contemplated, connected. Talk to me; teach me about you and your intellect, as well as about the physics.

*I now know first hand how important it is for guidelines to be clear, for teachers to explain the unique organization necessary to learn in a particular discipline. I now know how important it really is to differentiate instruction, to connect with the fragile learner, to have multiple measures for assessing learning.* I did not do well on the physics mid-term, so I wrote the professor a letter to explain all that I had learned, since he, no doubt, knew all the things I had not learned! Fragile learners are fragile test takers, too!

The fragile learner is holding on to a fragile strand with a tentative grasp. The fragile learner is always wondering. The fragile learner wants to understand, wants to belong, to be invited into the “club” the priesthood, the circle of learners. The fragile learner wants to use physics to understand more deeply notions of time, space, and our place in the universe. Somewhere in the mists of human history, this fragile learner was left behind as deeper thinkers than she divided intellectual life into science, mathematics, and humanities. The schism seems complete forever. Yet most learners know that the world is not neatly divided into domains, exclusive of one another. The world is most exciting and provocative when we can blur the boundaries and know both the science and humanity of our being.

This fragile learner learned that taking physics, that studying the quantum, motion, the cosmos, and energy requires imagination and courage. It is this same imagination and courage that I admire in each and every student I encounter who embark on learning experiences that can taken them beyond themselves, beyond their familiar experiences. As a learner, one should come to respect the subject, and the work of experts on that subject, as these scholars present us all with ideas and concepts that awaken us to new possibilities or new terrors. The question a learner needs to ask herself is, “What do I do now with these new insights we have gained, this new knowledge; this (perhaps partial) understanding?”

One thing I am certain of now that my physics course is over: learning physics requires imagination and courage, and so does teaching. The very
best teachers are those who enter the classroom each year, each day, imagining the best for each of their students and willing to be courageous enough to provide them with opportunities to learn that challenge and inspire them. As a teacher, I can either use what I have learned to help all learners become learners of whatever they need to learn, and include them in the wonder of it all. Or I can choose to exclude the fragile learners from the joy of discovering new ways to see their world and themselves. Taking physics took me further than I ever imagined I could go; now I wonder where it will continue to lead me.

I think in the end we all have choices; we can choose to remain fragile, or we can choose to continue to read, probe and wonder. We can either be content with our current knowledge or we can continue to build our knowledge. I confess I am a fragile physics learner, but my intellect and teaching and vision of the world are stronger for the experience.

References:

