Rooting Science in Empathy: Growing Towards a Sustainable Science Practice for the 21st Century

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"Rooting Science in Empathy: Growing Towards a Sustainable Science Practice for the 21st Century"

Or

“How a Feminist, Trained as a DNA Biochemist, Finds Freedom at an Institution Whose Heritage is German Lutheran”

By Cheryl L. Ney

“To be rooted is perhaps the most important and least recognized need of the human soul.”


I would like to use my experiences in the Chemistry Department at Capital University over the past ten years to suggest what teaching and learning in the sciences at Lutheran institutions has been and be about. In doing so, I hope to address the following questions: 1) What does empathy have to do with science?; 2) What is "science practice"?; 3) What is “sustainable science practice”? and 4) What does a “sustainable science practice” have to do with the teaching and learning of science in Lutheran higher education?

**Exploring the Grounding for Teaching Science**

I came to Capital University in Columbus, Ohio in 1987, as an assistant professor, just after obtaining a Ph.D. at the University of Chicago in Biochemistry. Since that time, with the support of the Dean of the College of Arts and Sciences, Daina McGary, who is well-versed in the work of Ernest Boyer, I have focused my scholarship on teaching, specifically on teaching and learning by women in science. A commitment to teaching on the part of our institutions allows faculty in the sciences the freedom to choose teaching as a focus of scholarship.

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As I look back on my exploration of the scholarship of teaching, I have come to realize that I spent the first six or seven years searching to define the foundations of teaching. I began my teaching career by trying to extrapolate from my own experience as a student to the students in my first general chemistry course — who were a mere 13 years apart, so I thought. Through a collaborative journalling project I conducted with nursing students in chemistry, a project I devised to lower their anxiety about the study of chemistry, I came to realize that their experiences were diverse and different from mine. As an example, they were having an opportunity to discuss their fears and anxieties about the study of chemistry to their professor as a way of improving their learning — something my staid Arizona State University professors would never have done (after all, many of my classmates and I were not the “cream-of-the-crop”, the “target group” back in those days!).

With the realization that I couldn’t solely use my experiences to understand the students in the courses I was teaching, I turned to the research literature on teaching and learning, in general and in the sciences, specifically. Since I was primarily teaching chemistry to female nursing majors, I also focused on the literature describing the experiences of women and girls with science education. Imagine my surprise, when I, a narrowly trained DNA biochemist, learned that there was a research base for teaching. In turning to the research literature on teaching and learning, I had moved away from using “teachers teach as they are taught” is my foundation for teaching. This change...
in direction also demonstrated to me that I could use my highly developed skills in scientific research in doing research on teaching and learning in the classroom. Every good scientist knows that you start a research project by reading the current research literature!

As an example of this practice, I can remember using a Journal of Chemical Education article, entitled, “What Goes on in Student’s Heads in Lab,” to change how I interacted with students in lab. I resisted asking students theoretical questions about their experiment, while they were conducting the experiment. The article reported that students have difficulty enough managing and thinking about the lab procedure, without also having to think about atoms and molecules — those questions can come after the experiment is over! I use this example to show that this research literature is very useful for one’s own practice of teaching.

On the basis of my work in the teaching and learning of science, in April of 1994, I was chosen to be a faculty development leader in the National Science Foundation funded Women and Science project in the University of Wisconsin System. This was serious business — which got me thinking even more seriously about the foundations of teaching — although I really hadn’t conceptualized my work yet as getting at “foundations”. It was during this time that I participated in a discussion (at a faculty meeting, I believe) led by a colleague from the Humanities — a philosopher, I believe — Tom somebody — who was talking about his work— which had something to do with grounding something or other in Lutheran theology, that I connected the notion of grounding to my work. Eureka! I was searching to understand the grounding for teaching. As it happens, I was also actively pursing an understanding of feminist critiques of science, which required an understanding of the epistemology or grounding in science. Armed with the notion of grounding and an interest in foundational issues in teaching and in science, I came upon the idea that pedagogy in science ought to be grounded in the epistemology of science. That is, how we teach science ought to arise out of what we believe about how we know what we know in science.

Understanding the value of empathy in science

Exploring epistemological issues in science led me to the work of Cathleen Loving, a teacher educator. She has developed a useful framework for understanding two important aspects of the epistemology of science (The Scientific Theory Profile), which she describes in two continua charted on an xy graph (something every scientist can understand). One additional feature of her work is that she identifies the thinking of important philosophers of science about these two aspects of scientific knowledge by plotting their beliefs as points on the graph. Glancing at the Scientific Theory Profile, one observes a scatter plot. This leads one to the important understanding that philosophers of science don’t agree about the nature of scientific knowledge!

The aspect of epistemology in science I want to focus on addresses the question, “Who are scientific knowers?” Using Loving’s Scientific Theory Profile, this question is explored on the x axis and therefore as a continuum. On one end of the scale is the purely rational knower — the one who through the correct and dispassionate use of “the scientific method”, is led to an unbiased, objective understanding of nature. Two popular cultural portrayals of the best examples of this rationality can be found in two Star Trek series — Mr. Spock and Data— one a Vulcan, the other an android — they aren’t even human! On the opposite end of the scale is the natural knower (surprise — it’s not characterized as irrational!). This is the knower whose knowledge is hopelessly biased by their perspective (including emotions) and therefore uniquely their own. Perhaps those who believe in a flat earth, fall into this category. It is important to understand that these are two extreme ends of a continuum and somewhere
between these two extremes, lies modern western scientific knowers.

I have chosen to focus on this aspect of the epistemology of science since many of the feminist critiques of science specifically address this aspect. At the turn of the century and well into the 1960s, scientific knowers would be characterized well towards the rational end of the scale of “who can know” in science. And what gender would these knowers be? Herein lies a critique of science developed by Evelyn Fox-Keller. An early work of hers, examines the history of modern western science and shows that science was founded to be a “truly masculine philosophy” — in which, “thinking objectively is thinking like a man”. Women, emotional creatures, were considered to be incapable of rational thought. But is this so? We now have an emerging and rich history of women in science which shows us that women have been doing science since their days as seed gatherers!

Does a rational investigation of the natural world require a cold, dispassionate stance? Another work by Evelyn Fox-Keller suggests an answer to this question. Fox-Keller has also written the biography of Barbara McClintock, a scientist who won the Nobel Prize in the 1980s for work she had done in the 1940s and 50s. In interviewing McClintock for this biography, Fox-Keller noted not only the patient and careful investigations and finely developed cytogenetic techniques of McClintock but also the empathy, or intellectual identification that McClintock held for the objects of her investigation. McClintock herself used a phrase to describe this relationship which became the title of her biography, “A Feeling for the Organism”. It is this empathy which motivated McClintock’s curiosity and was the basis for how she conducted her research:

For all of us, it is need and interest above all that induce the growth of our abilities; a motivated observer develops faculties that a casual spectator may never be aware of. Over the years, a special kind of sympathetic understanding grew in McClintock, heightening her powers of discernment, until finally, the objects of her study have become subjects in their own right; they claim from her a kind of attention that most us experience only in relation to other persons.

An understanding of how Barbara McClintock carried out scientific research demonstrates two very important ideas. First is the idea that one can do serious scientific research without having to be dispassionate and second, rooting scientific investigation in empathy can lead to important understandings about nature (afterall, McClintock did receive the Nobel Prize!).

Of what use is this foundational understanding of one aspect of the epistemology of science to the science educator? I can think of at least two answers to the question. First, much of the research on the teaching and science, as well as the experience of countless science educators, calls for science curricula and teaching that is “relevant”. Many students want to have some connection, some empathy, or connection to what they are studying. Chemistry, for example, is much more interesting when you understand that you can apply a chemical perspective to yourself and your world. Secondly, much of the research on teaching and learning in general, (plus the experience of countless educators), points to the idea that different people have different learning (and teaching) styles. A science which welcomes people whose thinking is rooted in empathy is an enriched science, one that can provide deeper understandings of nature.

Defining science as “sustainable science practice”

Rooting science in empathy emphasizes the idea that it is humans who do science. Since it is humans — with minds in bodies, culturally situated and historically located — conducting this creative endeavor called science, perhaps it is not quite the value free activity that it is portrayed as. If science is not what we thought it was, what is science? Back we go to foundational issues. If
humans, as natural knowers, do science, than science ought to be reconceived as a human activity. (This is something scholars in the area of science and technology studies have been actively working on in this century.) Borrowing from Arnold Pacey (an historian of technology), I’d like to suggest that we think of science as the “web of human activity surrounding science”. This would certainly encompass much more than what scientists do. It would include the business of science, the governmental activities regarding science, the work related issues scientists, their managers as well as technicians face, the cultural representations of science, science education, the ethics of science, the use and abuse of scientific knowledge and so on. Pacey describes this “web of human activity” as a “practice”. He then goes on to define three aspects to “practice”: technical (which would include methods rooted in empathy as well as dispassionate rationality), organizational (business, legal, governmental) and cultural (values, history, cross cultural, education, etc.) aspects. With this concept of practice, science can be redefined as science practice with technical, organizational and cultural aspects to it. With this definition, science is positioned in society as an enterprise conducted by whole human beings!

What are the implications for teaching and learning about science as science practice? One implication is that this definition of science is useful for understanding science as it is in today’s world. Learning how to apply this understanding of science practice to issues of science and society can help to raise important issues and concerns for our time. This definition however doesn’t clearly speak to the issue of what kind of science practice we would choose for the future. I believe that this is a critical issue. Many young people don’t have as a top priority understanding why science practice is the way it is (some of us do) — I think that if they want to know anything at all about science practice, they want to know about science practice in their future (not just their future employment).

What could science practice in the 21st Century look like? One proposal, coming from several perspectives (including feminist perspectives) is a call for a sustainable science practice.

This is not a call to sustain science as it is but rather to choose sustainability as an underlying value in all scientific research and its applications, as well as in the practice of science.

What is sustainability? Here are some definitions found on the home page of the Center for Sustainable Communities at the University of Washington:

- “A sustainable society is one which satisfies its needs without diminishing the prospects of future generations.” Lester Brown, Founder and President, Worldwatch Institute

- “Our vision is of a life-sustaining earth. We are committed to the achievement of a dignified, peaceful and equitable existence. We believe a sustainable United States will have an economy that equitably provides for satisfying livelihoods and a safe, healthy, high quality life for current and future generations. Our nation will protect its environment, its natural resource base, and the functions and viability of natural systems on which all life depends.” President’s Council on Sustainable Development

- “A transition to sustainability involves moving from linear to cyclical processes and technologies. “The only processes we can rely on indefinitely are cyclical; all linear processes must eventually come to an end.” Dr. Karl Henrik-Robert, MD

A sustainable science practice then, is a practice of science rooted in the value of sustainability.

What could a sustainable science practice be like? Fortunately, models already exist that may provide
some direction for a future sustainable science practice. The earliest example comes from the Science Shops in the Netherlands. The one in Amsterdam, founded in 1977, has as its mission, offering socially under-privileged groups an opportunity to benefit from the University of Amsterdam's knowledge and research potential. Questions brought to the science shop have included, "Is the UV light used for drying offset printing harmful to workers? What are the environmental consequences of milk drainings due to strikes in the dairy industry? Is the cleaner, "Danclan" harmful to dentures?". In 1987, an evaluation of 162 cases at the University of Amsterdam showed that investigations undertaken on behalf of clients of the local science shop have given rise to follow-up research, publications and many other enduring effects on academic practice."

At the time of this study, 2070 questions had been brought to the shop. Out of that 1875 cases had been passed on to university scientists, with 385 cases requiring original research to be answered (research conducted by graduate students — some of which led to Ph.D. dissertations!). This model of a science shop shows that resources for university research can be shared with the community to the benefit of both.

The Dutch Science Shop model has been adapted in the United States, where it is called "Community-Based Research". A comprehensive analysis of 12 case studies of this type of research has been compiled by researchers at the Loka Institute. These projects resulted in concrete changes to the community such as: energy conservation retrofits of over 10,000 low-income housing units in Chicago, a moratorium on forest logging pending the conclusion of Alaskan legislators and activists, replacement of poisoned drinking water with a safe water line into a rural Kentucky community (and a legal judgement requiring the establishment of an $11 million community health fund) and the creation of a new health program in Chicago for refugee women, to name a few. Other important findings about community based research are:

- Community-based research processes differ fundamentally from mainstream research in being coupled relatively tightly with community groups that are eager to know the research results and use them in practical efforts to achieve constructive social change. Community-based research is not only usable, it is generally used to good effect.
- Community-based research often produces unanticipated and far reaching ancillary results, including new social relationships and trust, as well as heightened social efficacy. It may thus provide one constructive response to the growing concern that American civil society is in crisis and unraveling.
- To create a U.S. community research system that would provide service as comprehensively and accessibly as does the Dutch system would cost on the order of $450 million annually (45 times the current investment in community-based research but less than 0.3 percent of total U.S. R&D expenditures) in 645 centers (50 have been identified).

"This research differs from the bulk of the R&D conducted in the United States, most of which — at a total cost of $170 billion per year — is performed on behalf of business, the military, the federal government, or in pursuit of the scientific and academic communities' intellectual interests."

Teaching and learning science for the 21st Century
How would our institutions, and our teaching and learning of science change, if developing a sustainable science practice in our society were a goal? Could we use community based research to accomplish this goal? Some institutions are already moving in this direction with their emphasis on service learning. A chief concern regarding service learning on our campuses is that,
service learning is a curricular emphasis that competes with plenty of other curricular goals (as well as other types of interests) on a university campus. What would it mean for an institution to boldly choose service learning as their sole focus — even in the sciences? To commit the human and material resources of the institution to the ac of teaching and learning for sustainability?

**Freedom for individuals within institutions an institutional freedom**

There is one final issue I would like to raise. While, I personally am eternally grateful for the freedom that Capital University, a institution of Lutheran higher education, provides to me to envision sustainable science practice and to work towards those ends by what means I can, I have to ask myself the following question: How and by what means do our institutions become more than the sum of its individuals acting out their freedom? I wonder if we, all of us, at universities and colleges — faculty, staff, administrators, students and their parents as well as Board of Trustee members, have the courage to work towards creating some kind of “institutional freedom” that would allow for the development of universities of vision and promise. Can we break free from the constraints of today’s corporate culture that are lurking in many of our institutions, where teaching and learning have often become solely about preparing for the job market? Can “we” as Institutions of Higher Education strive for the wholeness God wants from Abraham — not perfection but integrity?20

Footnotes
1 While in Chicago I was a very active member of Augustana Lutheran Church (across from LSTC), where we had a two-year-long discussion centered on “faith seeking understanding, understanding seeking faith”
4Rosser, Sue V. *Female Friendly Science: Applying Women’s Studies Methods and Theories to Attract Students*, Pergamon Press, 1990.
12*ibid*, p 200.
14http://weber.u.washington.edu/~common
15Zaal, R. and Leydesdorff, L., “Amsterdam Science Shop and its influence on university...
research: the effects of ten years of dealing with non-academic questions”, Science and Public Policy, 14 (6), 310-6, 1987.

16 ibid

18 ibid