From Teaching to Learning - A Personal Account

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Abstract   The issue of changing educational paradigms is of global importance. However, change is individual. As such, we must educate ourselves about how individuals change their educational paradigm. This article is an effort to address that need by telling a very personal account of how one individual, the author, changed and is changing vision and perspective. The hope is that the need for an individual and culturally relevant perspective is reinforced, while the commonality of such a change can also be seen. The article chronicles the author's journey from his initiation into the prejudices of a discipline-based higher education system to the lessons he learned in his multidisciplinary work in general education.

This is a personal story about how I am changing my educational paradigm. I say "changing" rather than "changed" because the process does not end. Indeed, as my perspective broadens, I feel that I am changing faster now than before. I am in the middle of this fast moving river, instead of on its banks. Consequently, the tale I will tell will not have an end, only milestones.

A VIEW FROM THE BANK

I am a traditionally trained mathematician, who has taken a traditional route out of graduate school. I have been publishing mathematics research for approximately twelve years in the areas of topology and group theory. I have now attained the rank of full professor and am currently chair of my department. My training and background have poorly prepared me for my career as I now understand it. My former students have similar complaints about their education.

Early in my education I chose NOT to pursue a degree through a school of education, despite a strong interest in teaching. I viewed such a degree as not having the value of a straight mathematics degree. As I pursued mathematics further, I absorbed many prejudicial views about other disciplines, education courses in particular. Anecdotal evidence reinforced these prejudices, as anecdotal evidence often does. I was then easily convinced that education students were weak and education courses useless. I was taught to believe that one could not teach people to be good teachers. The standard phrase was "Teaching is an art, not a craft."

After I received my bachelor's degree, I joined the U.S. Peace Corps. Its training program included a course on the teaching of science, run by a professor of education. He was teaching us the then new "discovery approach" to science. His pedagogical strategy was to get us to learn this material through rote memorization. As a young idealistic individual, I felt compelled to point out this apparent inconsistency. You might imagine the consequences of such an action. I was able to complete my Peace Corps training despite his objections.

Not only did this encounter reinforce my prejudicial views, but I subsequently realized that I could not teach via the discovery approach. It took another 20 years before I acquired the ability to apply such strategies. I have since come to believe that the discovery approach is not a technique, but a frame of mind, a paradigm, and paradigms cannot be taught; they must be experienced.

GETTING MY FEET WET

In the Fall of 1992, shortly before I received tenure, the provost at my university called a meeting of all faculty interested in the issue of general education. I am not sure why I decided to "explore the waters" of general education. It may have been my interest in students. More likely, it was my interest in getting better visibility prior to the tenure decision. Maybe it was both. I was subsequently chosen as a member of the university-wide General Education Reform Working Group (committee), whose charge was to look into the effectiveness of our general education requirements and offer suggestions to improve the program.

Two interesting things happened at the first meeting of this committee. The first was the statement by the newly assigned chair of the committee, "I don't know why we should have ANY general education requirements, but let's research the issue." His statement may have shown a prejudice against general education at the time, but more importantly, this was the first time that I had heard the suggestion that a committee do research to answer an important complex question. All other committees I had been involved with used existing committee expertise (i.e. pre-conceived

notions of the members) to make decisions.

The second interesting thing that happened at this meeting was that the provost proposed to assist us in our research by sending us all to the annual meeting of the Association of American Colleges (now called AACU) to be held in nearby Seattle, Washington that year. As a discipline-trained and discipline-focused researcher, I had never experienced a professional meeting in which university-wide issues were discussed. I had never been in contact with such expertise. Indeed, I had not realized that such expertise existed. And had I realized such expertise existed, the prejudices I had built up over the years would not have allowed me to accept this expertise. It was only through seeing the experts in this context was I able to accept what they had to say as reasonable.

We talked with faculty and administrators from Temple University and SUNY-Buffalo. Both universities had just changed their general education programs. We were told that we could not change general education without a lot of money up front and ten years of hard work. I had a long talk with the director of the program at Temple. He was a mathematician; something he did not seem to want to talk about. But the biggest impact on us was the presentation by Alexander Astin. He had just completed his work on exit interviews of students from one hundred American universities. He got our attention as his research boldly destroyed the mythology about the effectiveness of the research university model in teaching undergraduates. Also, the negative external influences on students he identified, such as commuting, working, and family circumstances, were a profile of the students at our university. This meant we were going to have to work doubly hard to ensure that our students received a good education. Many of the positive factors identified by Astin, such as student-to-student interaction, small group work, and peer guidance, could be built into our new program. When we returned, we began designing a program to do just that. This was to become much more work than I had intended. I was definitely "getting my feet wet" in the "waters" of higher education reform.

At about the same time, I was asked by my chair to attend the Science in the Liberal Arts (SLA) committee meetings. This committee had been meeting for approximately one year to discuss the science requirements for the baccalaureate degree, and how to teach science better to non-science majors. The members of the committee realized that significant numbers of our students satisfied their science requirements by taking mathematics courses, and perhaps there should be a representative from that department on the committee.

What is important about the SLA group is that their courses were developed before the new general education program. It was in the SLA group that I first came across the ideas "metacognitive thinking", "writing to learn" and "cooperative learning." When these ideas also began to be discussed in the general education committee, I was more receptive to them. Even though I may not have joined either group explicitly because of my interest in students or my discomfort with current practice, those attitudes made me more receptive to these new "waters".

SPLASHING IN THE SHALLOWS - AN INITIAL EXPERIMENTAL STAGE

The reinforcement of both groups encouraged me to begin experimenting with cooperative learning in my mathematics classes. At first, I was not sure what I was doing. Consequently, neither were my students. For example, if students refused to work with a group, I really had no counter argument. I had to allow them to work alone. Initially, I created worksheets of problems based on the lecture and had self-selected groups work on them in class. When students complained because I had not prepared a worksheet one day, I felt I must be on the right track.

I began to notice, as I helped each group, that most of the students had not heard or understood the lecture. Instead, they were trying to do the worksheet from information in the book. So why was I lecturing? It was then that I further modified my approach. I would first present a problem, usually in terms of some story. I had re-discovered the Japanese "hotsumon" (spontaneous question). I would have them talk to one another about what ways they could deal with the problem. I would then lecture for ten minutes on a particular mathematical approach and give them a worksheet which explored the approach further. If need be, I would explain more complicated versions of the approach, trying not to talk more than ten minutes at a time. This strategy did seem to lead to a better understanding, or at least less misunderstanding of my presentations.

One difficulty with this new strategy was that not all mathematical approaches would fit into such a format, especially in a traditional curriculum. Today, I would have more concerns with such an approach.

By the spring of 1994, I had quit lecturing all together. I would answer student questions at the beginning of class, but never for more than ten minutes. I would then spend the rest of the class assisting groups of students working on problems. These groups were selected by me, the most relevant criteria being the compatibility of their schedules for outside of class study sessions. I would occasionally talk to the whole group, if there seemed to be a universal misunderstanding about a particular idea, but never for more than ten minutes. I was going in the right direction, but to where? I knew I had more to learn.

JUMPING IN WITH BOTH FEET - THE FULL IMMERSION

In the Fall of 1994, the first collection of "Freshman Inquiry" courses began. This was the first phrase of our new general education program, called University Studies. In Freshman Inquiry (FRINQ), five faculty from five different disciplines get together to create a syllabus around some topic of common interest. I was part of a team which created The City: Visions and Realities. I was joined by a geographer, a criminal justice expert, a drama specialist and an historian. We spent the previous summer trying to create this course. Working together to create one course proved exciting, frustrating and just hard work. The peer mentors joined us on an irregular basis to help in the development of the course. The peer mentors are upper class students who meet with small groups of FRINQ students twice a week. The new perspective of the mentors helped us firm up our ideas. On occasion, we would do what a mentor suggested over what we had created. I was awed by our group's ability to accept the implicit abilities of these undergraduate students. It forced me to ask, "What is my expertise and what can my colleagues offer?" This process of mentor and faculty interaction allowed me to listen to my colleagues more. The mentors not only provided a unique student perspective, but they also acted as catalysts for the faculty to accept each other's strengths. The peer mentors are probably what make the whole program work.

The course became my personal laboratory to experiment with various new ideas. Students were broken up into groups and asked to react together, think together, and do assignments together. We presented exciting new material on city infrastructure, history and art. The faculty discussed and argued about important ideas in front of the students. We encouraged the students individually and in groups to join these discussions.

I was surprised when the students did not become uniformly engaged in the curriculum. They did not really care what we were talking about. They just wanted to be told what to do and what to learn to get the best grade. It was all quite disappointing. Maybe if we just got better organized, we could engage them more.

I taught only one term of FRINQ that year, as my new job as department chair pulled me away. I did teach another course the following spring in the SLA curriculum. I taught a group of self-professed math phobics the basics of algebra using environmental modeling. The class was small, so I could relate to the students better. We spent a lot of time talking about social and ethical issues around the environmental movement. Outside assessors joined the class a few times to ask the students questions about mathematics I would never have thought of. I still did not get the engage-

ment that I wanted. The projects I had them do did seem, however, to attract their interest more. And the students did seem to leave the class with a better understanding of the role of mathematics in their lives. I did too. For the first time, it made real sense to me that mathematics was important in their lives. They could make more informed decisions if they could actually use the mathematical tools we thought we had taught them.

Another project that I was coerced into at about the same time was PASS, the Proficiency-based Assessment Standard System. This project is trying to develop a university admissions system based on student proficiency. I was involved in the initial efforts to decide what the mathematics proficiencies would be. In the Fall of 1994, I was asked to act as the coordinator for my university. This project has engaged many high school teachers in re-thinking how to deliver curriculum, so that students can reach the proficiencies. It also got me thinking about what the goals should be for my students and how I should assess them. I subsequently found high school faculty with expertise in goal setting and assessment that helped me feel confident enough to try implementing student performance goals in my classes.

SWIMMING WITH THE CURRENT - NOW WE ARE GETTING SOMEWHERE

I rejoined the City team in the Fall of 1995. We had a better organized syllabus which gave the students more choice early on as to what they would study. I encouraged the team to create student proficiency goals for each term, which we did and shared with the students. I was hoping to get student input into the development of these goals, but they did not seem to readily understand them until the Spring term.

The Spring term of 1996 was when the class really came together. The students seemed to finally "get it." In particular, each individual's interest and effort increased tremendously. I believe several things contributed to the student success of that Spring term. First, I developed, with student input, some preliminary grading rubrics which better defined what it meant for a student to attain a certain level of proficiency. Second, I gave the students a clear Spring term group assignment. I told them that if they did everything on the assignment as described, they would earn a "C" in the course. In order to earn an "A" they had to create something better than that assigned. Third, the peer mentor and I stopped answering the students' questions. That is, we turned the questions back on the groups. The mentor was better at it than I was. She had the students create the schedule for the mentor classes. She told them that she would help wherever she could, but they had to decide how best to spend the time. Also, they had to decide what I meant when I said something in class. She was not going to translate for

them any longer. In the main class, we had outside experts come in to give lectures as we had done in previous terms, but all of my class time was spent moderating discussions with the students about the final project.

I have never before experienced the excitement that was generated by these students doing these projects. The quality of the work was beyond anything I had seen before. The students developed working relationships that are still strong, six months after they finished their projects.

I am still unsure as to what happened, or if I could recreate it. The peer mentor says that she already has recreated it in a course she is mentoring this term. I want to know how. Unfortunately, I am not teaching freshmen this year. I will have to wait to find out if I can reproduce that energy.

A PARALLEL STREAM

Writing has been an issue for me since I started teaching FRINQ. "How do I teach something I am not an expert in?" To get to my current answer to that question, I would like to back up and tell another story.

I am writing a cookbook. I have been creating and collecting recipes for over twenty years, but I did not know how to write a cookbook. Early on in my involvement in the general education committee, I realized that the answer to my writing problem might be with the expertise that existed on campus. I approached a graduate student I knew in the English Department and asked her "What could I learn from a writing course in the English Department?" Her response was anger. I believe she did not take the question seriously. She actually thought, I believe, that I was being flippant and condescending. I gave up the idea of getting help from the English Department.

In the first term of FRINQ, I read student work and tried to comment, but I was unsure of how to guide their writing. Most of my comments were grammatical. In one attempt to add some "reality", I wrote a letter to the National Gallery regarding an exhibit of theirs. I decided to use my students as editors. I gave them the first draft (spelling errors and all) to correct, to see what the students could do with the letter. It was a failed effort. Some of the students actually added new errors to the old.

It was then that it occurred to me that I did know something about editing work. I had been doing that professionally for many years with mathematics research articles. From that point on, I would write a critique of a student's paper on a separate sheet of paper, putting only editing marks on the paper itself, like I did when reviewing a mathematics paper. That did seem to help the students better understand what I wanted, but their writing still seemed to lack a personal voice.

In the Fall of 1995, we asked the students to write an autobiography. We received a bunch of chronological accounts of when they were born, where they went to school, and what town they lived in. Very boring stuff! It was difficult to get myself to read them. At this point, I decided to ask the students to re-do them. I told them that I had made a mistake. I had not explained well what I had really wanted. I had not wanted a list of dates and places; I wanted to know who they were. The REAL purpose of this assignment was for me to get to know them. I asked them to pretend they were meeting someone for the first time that they liked. What would they say about themselves? How would they define themselves?

The re-done assignments were also difficult to read, but for a different reason. Most of the students understood what I wanted. The papers were hard to read because they were so real. It seemed voyeuristic to read them. It was then that I began to realize that the grammar of these pieces was almost irrelevant. In fact, the most powerful article had the worst grammar and the worst spelling. This student was already an excellent writer. It was then that it occurred to me that I could approach my cookbook writing in the same way. I could write my cookbook as a collection of stories (with inserted recipes) telling who I am in relation to my ethnic background and the food of that region. It is because of the insights gained in trying to deal with student writing that allowed me to personally grow as a writer. Also, I now feel confident that I can help my students be successful writers. I now understand the over used phrases, "Know your audience" and "Write from the heart".

ANOTHER TRIBUTARY

Four years ago I moved. I used to live in the city, a short distance from the university. I now live in the country, an hour bus ride, if I take an express bus. I try to arrange my schedule to take the express bus. The characteristic of express buses relevant here is that they tend to get the same passengers day after day. These people, trapped in a bus together for two hours each day develop a community. I am now a member of such a community. This particular community includes people from across the social, political, and professional spectrum, with widely differing perspectives. We talk about these differing perspectives.

One of the discussions that naturally arises on the bus is jobs. Another is travel. I often find myself talking about what a mathematician does and why mathematicians travel. Since the taxes my fellow travelers pay help fund my salary and frequent research trips, I have begun thinking about how what I do affects them. As a result, I have initiated conversations on the bus about how mathematical concepts are involved in everyday experiences and the design of common objects. For example, bank machines need the prime number code to operate, and computers are based on Boolean

algebra. However, the prime number code and Boolean algebra have little to do with my mathematical research. My specialty, knot theory, has at best tenuous connections to everyday applications such as DNA research, robotic motion and computer search routines.

These conversations, along with extending my concern for students to society, got me thinking. I am a smart, talented individual. I have a lot to give to society. So why am I spending so much of my creative energy on something that has little apparent connection to everyday life.

I believe that academics do not in general do the research they do because of its impact on society. They do the research they do because:

1) they are good at their particular specialty,
2) they enjoy the work,
3) they get immediate rewards, such as tenure, promotion, regular raises and trips to exotic places.

How does this relate to me? I am tenured and fully promoted, so tenure and promotion are no longer relevant. The way that tax revolt is shaping up in this country, I suspect that my income will soon begin to decline in real terms. I don't expect my pay to increase much in the foreseeable future. I now travel too much, and would be happy to do much less. As for enjoying the work, abstract mathematical research is becoming less interesting to me, as I begin to develop interest in the way my profession functions and should function.

SHOOTING THE RAPIDS

I have now come to an exciting turbulent point in my professional life. I must deal with the question: "Where does a mathematician go whose vision and perspective have changed to the extent that the profession no longer makes sense, at least for him?" I am not sure. The "rapid waters" of educational change are pushing me in many directions at once.

I am still a mathematician, although there are those who try to deny that. I still have the training, experience, and abilities of a mathematician. When I try to explain to others what my current interests are, they attempt to find another traditional label. Other mathematicians often say, "Oh, so you are going into math education." No, that is just another specialization. Non-mathematicians tend to say, "Oh, so you are interested in assessment." Well, yes, that is true, but only as a tool, not a discipline.

The answer to the question "Where am I going?" is "I don't know yet." The question is like asking a mathematician in a new research area "What theorems are true?" I don't know yet, but I do have several projects under way and I have a good sense, I believe, where I want to go. But I am not yet "through the rapids", so where I will end up is not yet clear.

One thing is clear. Higher education needs to re-assess its purpose in society and to try to systematically connect its various functions to that purpose. Who are we educating and why? What should the students in our programs know and be able to do when they complete these programs? To what extent are our programs currently doing that and how can we organize to do it better? What really is the role of research? In what ways does research support the university's purpose and in what ways does it detract? How are pay, promotion and tenure supporting or not supporting the expressed purpose of the university? How will faculty be able to re-assess their own role? Hopefully, I have contributed to the answer to that last question by outlining the path I have taken in my re-examination of my role in the university.

There is much turbulence ahead for all of us involved in higher education, and there are many "rocks" in our path that could destroy higher education institutions. I hope to be able to help in the recognition and avoidance of some of these "rocks" in the rapids we are now shooting.

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