A Mathematician's Journey: From Applying the Pure to Purifying the Applied

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Faculty development, as a relatively new enterprise in higher education, has attracted its practitioners from many different fields. In this paper I review some highlights of my journey from teaching calculus and numerical methods full time in a mathematics department (trying to help students see a wide range of applications of some very abstract theories) to now spending most of my time and energy running a faculty development office and doing research on improving teaching and learning in higher education. I examine some of the paths I traveled from a simple committee assignment to a major interest and motivation to work and do research in faculty development. Reviewing my journey has helped me clarify the research questions I am now asking as well as the methodological issues I am struggling with.

When I became Director of Concordia's Learning Development Office seven years ago I was charged with the responsibility of providing our faculty with whatever services seemed appropriate to assist in improving the quality of teaching and learning. I was mandated to be helpful, to be practical, to be useful. In 1973 there were very few "model" programs to emulate so I was traveling in uncharted territory. I tried to travel two tracks: the "high" road looking for theories, models, and so on, and the "low" road, anything that might work.

I Searched for the Theory

My background and training in mathematics had considerable influence on how I approached this practical task, and even on how I conceive research in this area. My selection and training in mathematics, my major strength, had been based on my ability to do abstract work, to develop complex models and systems of logically coherent propositions and theorems. “Pure” mathematics had undefined terms, postulates, axioms, lemmas and theorems. Application was nice but not necessary! The standard for “truth” was logical consistency and rigor. We even have our own “aesthetics”: beautiful proofs, “classical” mathematics, and “modern” mathematics.

Faced with the task of being practical I began, as I would have with any mathematics problem, by searching for relevant theory. What are the basic rules or principles of teaching and learning that I should know and pass on to my colleagues? I was new to this whole area, in fact the area itself was quite new, so I went looking in traditional areas such as education and psychology. With my respect for academia I took a course “Developing, Designing and Evaluating Instructional Systems.” Even though I had devoted an enormous amount of time to my subject matter, and even had a year of teacher training, this course introduced me to a “new” and systematic way of thinking about and evaluating teaching. It gave me a powerful heuristic for designing instruction as well as opened up a whole new literature: Davis, Alexander, and Yelon (1974); Diamond et al. (1975); Gagne and Briggs (1979); Mager (1975).

Some Potholes and Detours

Although this path looked very promising at the beginning, I soon discovered some potholes and detours. These techniques didn’t seem to address traditional university teaching—most of which was lecture with some discussion. It didn’t talk about the problems or potential of teaching and learning in group settings, which was 99.9% of our classrooms. At an even more fundamental level, it offered an attractive basic outline for a design process, without offering much support for the basic decisions that had to be made at each point.

Another path down this road in search of truth in theory led to psychology. Glasser (1976) in "Components of a Psychology of Instruction: Towards a Science of Design" went beyond goals, objectives and methods and introduced cognitive psychology and information processing. Now we were really getting somewhere! Powerful theoretical tools were bearing down on the problems of instruction. But alas, they were far too theoretical to be of much practical use in helping me help faculty teach better.

This "high" road in search of theory seemed to be leading nowhere. Education and psychology seemed to offer little help. Instructional psychology was in its infancy and psychology wasn't offering much help either. McKeachie (1976) in a presidential address to APA was not encouraging:

The progress we have made in learning and educational psychology is not marked by the dramatic breakthroughs in other areas. Rather what we have learned is that learning is more *complex* than we had earlier believed.

I had been looking for theories of teaching and learning to pass on to my colleagues, who I had assumed were just waiting out there with bated breath. I was shocked on two counts. There were not great truths lying around out there; and even when I found some hint of truth, or some reasonably good working hypothesis to offer, the faculty were certainly not very active listeners. Astin, et al. (1974) seemed to reflect my faculty's attitudes towards teaching and teaching improvement "as so straightforward that it required no special training, and yet so complex and idiosyncratic that mere training could never meet its extraordinary demands."

Is Teaching a Science?

I had come from mathematics with a particular paradigm, a way of solving problems and asking questions, a standard of truth and a model of science. While I hadn't expected to find "mathematical-like" theories, I had expected to find a strongly "scientific" approach. But what type of science? Even in psychology, where I had hoped to find firm ground, if not solid bedrock, the situation was not only "com-

plex,” as McKeachie suggested, but even the basic approach was in question. Cronbach (1975) stated:

Social scientists generally and psychologists in particular, have modeled their work on physical science, aspiring to amass empirical generalizations, to restructure them into general laws, and to weld scattered laws into coherent theory. That lofty aspiration is far from realization.

My basic approach had been severely shaken. Not only had not I found the theories and principles i was looking for, but there was some serious debate as to whether or not they even existed, not to mention the serious debate over how to go about finding “truth.” Perhaps I had come from mathematics with the wrong paradigm. I was looking for answers that didn’t exist. Even psychology itself seemed confused.

I was beginning to wonder if teaching were more an art than a science. Maybe my faculty were right. Kerlinger (1977) in his presidential address to the American Educational Research Association was emphatic: “actual teaching is partly engineering, partly art. It is certainly not a science. There is no such thing as a science of teaching or a science of education.” Fortunately for me, and probably also for the faculty I work with, my journey down the “low” road, that search for anything that might work, was successful. In addition to searching far and wide for truth in theory, I was desperately seeking practical activities to offer the faculty. My faith in the “semi-hard” social sciences was badly shaken. So I now turned to the “super-soft.”

Experience: A Better Teacher

I attended two intensive ten-day residential workshops on faculty development. In the first one Bill Bergquist presented, in an experiential format, a very comprehensive approach to faculty development. Several years later Wally Sikes expended and reinforced this approach in a workshop I attended at National Training Labs.

These experiences had significant impact on me. My faith in the “traditional science” approach had left me discouraged, but through these residential workshops I was “born again.” I was learning through *methods other than lecture*. Throughout my entire graduate and undergraduate training I had been exposed to only one teaching tech-

nique—lectures—no matter what size the class was. Here I was learning, and learning things that I considered important and significant, but in a very different way. I was learning by experiencing and analyzing my experience. I realized, and really understood in a way much more powerful than any reading could ever have suggested, that there were real alternatives to lectures. There were other methods to use in teaching, and they really worked. There could be more to teaching than telling.

These new methods not only presented alternative ways of teaching, but dramatically altered the criteria I used to measure the success of learning experiences. I set new standards for involvement, for participation and for the types of learning I expected, in both the cognitive and the effective domains.

These experiences together with many similar ones only served to reinforce for me the major limitation I had felt in my tours through instructional design and development. Those approaches were either unwilling or unable to address the real problems and possibilities of people learning in *groups*. They were adequate and even quite powerful at the micro-level, i.e. analyzing and designing instruction (unfortunately too often only in print) for a single learner. When it got to the macro-level (large groups of learners) their procedures seemed to produce experiences which, although certainly better than the traditional lecture, didn't utilize the resources and potential of the group for recreating significant learning opportunities.

I Needed Skills Too

I was stimulated by this new standard for what might be possible in organized group learning experiences, in courses and classes; but I also realized I needed a whole new set of skills I hadn't even considered before. I had been searching for learning theories or teaching theories. But to practice faculty development I needed to improve my skills—my skills to design group experiences, to observe groups, to diagnose, to intervene, etc. I needed to learn more about me and how I worked in groups. And I had to do that before I could ever hope to deliver any significant new messages to the faculty, or even to change my own classes. On my pilgrimage, my search for the "holy Grail," I

had been converted, almost become “touchy-feelie,” I saw new alternatives and potentials for higher education, and all of this was from *experiencing* it, not *reading* about it.

My trip down the path toward the “harder” sciences and theory, psychology, educational psychology, etc., had been less than fruitful. My trip down the “low road” had led me towards practice and several of the “softer sciences”, human relations and group dynamics, adult development, organizational change. But no overriding theory or organization seemed to exist which would help me pull all these disparate pieces together into a theoretical whole or even a working model to help my day-to-day practice.

Looking at My Learning

Through my residential experiences I had learned to examine my own experiences much more carefully. Rather than look outside for theories, I began to reflect on my own experience; in particular I looked at how I learn, how I respond in new situations, how I define knowing itself. The work of David Kolb has been particularly helpful in giving me some important insights and understanding of my own learning. In his theory, he has attempted to describe a model of learning from experience. He would argue all learning is experiential (Kolb & Fry, 1975).

His model suggests that learning involves a tension between Action and Reflection, between the Concrete and the Abstract. He suggests that productive learning, that is, learning that produces growth and change, involves all four abilities, Everyone uses all four to some degree; but we do have preferences, or preferred ways of responding, to situation, Even though it looks like a circle we don't always have to go around it, nor do we always start in the same place. Since we are making choices on each of the two dimensions we are usually functioning in one of the quadrants. Disciplines, or specialties within disciplines, require and reinforce certain kinds of behavior or activity or quadrants.

My New Perspective

This model helped me in several ways which are relevant to this paper. While I had realized, or at least said I realized, that people as well as disciplines were different, during an intensive workshop with Kolb, this point was really brought home to me. Everyone in attendance wanted to *know* more about Kolb's theory, but there was a real division in the group. Some people were clamoring for more time to consider and explore applications: they defined knowing—"I *know* it when I can *do* it, use it, apply it." Another group was clamoring for more theory, how does this relate to other ideas—they defined knowing differently—"I *know* it when I *understand* it"—when the ideas are clear and logically related. For perhaps the first time I really appreciated the differences between people. Everyone there was articulate and vocal in saying "I want to know"; but they wanted very different things.

When I say I want to know more about teaching or teaching improvement I probably mean something quite different from many of you who are reading this paper. When faculty say they want to know more about teaching, or more often that there isn't anything to know, what do they mean?

I was becoming much more tolerant of differences. I have a deep concern for teaching, and probably even some skill at it (I really think that is why I have this position in Learning Development). I had originally considered my colleagues who appeared to have less interest or inclination towards teaching to somehow be unenlightened or

misdirected. At best they didn't know better, and my truth would set them free; and at worst they didn't care, and student evaluations and the reward system would straighten them out.

I had a greater tolerance for and appreciation of the differences in my colleague's perception of and attitude toward teaching. I had lost a lot of my crusader's zeal. I had not found the truth, but I had learned from examining my own experience. I had more respect for and interest in my colleague's attitudes and perceptions. Perhaps I was only adjusting my expectations and practice to be in line with my potential and promise, but I felt better and even more energetic.

My natural inclination, as well as my training, had been very heavy on the abstract and reflection sides of Kolb. When I was faced with a practical question I naturally went in search of theory. This search had led me down many different roads into new disciplines with very different standards for "proof," explanation, and theory. While each of these areas had strong "ad hoc" potential for particular questions, I needed some overriding model or theory which would help me to understand, in Kolb's reflective/abstract sense, my work with faculty, and their response (or lack of it) to teaching improvement efforts.

A Really Good Problem

I was becoming very involved in this activity. What began as the chairmanship of a committee and then the Directorship of an Office was beginning to consume almost all of my time. I had become fascinated and intrigued by this area and was interested in pursuing it more seriously, to "research" it. I had a background and perspective which was different from many of the people working in the area. I felt I had some important questions worth asking and answering. I was in the middle of a career transition.

My own search for a theory which would help me make sense of my work with faculty had indicated a wide range of approaches with no overriding view which could help in my day-to-day practice. It was not only the faculty developers who seemed to lack "theories" of teaching improvement. Individual faculty member's theories of teaching or models to inspire their practice, seemed in an even sorrier state.

Freedman (1979) reporting on extensive interviews with faculty stated:

Very few faculty members can define the basis on which they evaluate themselves or can offer any rationale for what they do in the classroom. It is apparent that most of them carry on in the way they learned as students. Not only does traditional academic culture ignore basic education issues, it does not even possess the concepts necessary to address them. With no concepts for describing student development, without means to evaluate one's teaching, without even a perspective from which the student may be seen as a person, the professor is denied the most elementary satisfaction of professional activity—seeing desirable things happen as a result of planned action.

The major question or central theme underlying my intellectual work, as well as my daily practice, is to increase my understanding of how professors and faculty developers think about teaching and teaching improvement. For example, why do so few faculty members, rarely more than 20%, respond to the best improvement programs we can plan and offer?

I was depressed by the overwhelming number of models, approaches, and perspectives. I was looking for a theoretical framework which would help me make sense out of all these various theories (integrate them in some way) as well as give me leverage on understanding my work with individuals. Young (1979) suggested a model of faculty behavior, learning and development which might help organize theory and research for faculty development. I would like to suggest another which I have been working on.

A Lovable Theory at Last

With a lead from Wittrock and Lumsdaine (1977) I found attribution theory, Weiner (1976, 1979, 1980). As one who cherishes and craves theory this seemed like a truly "lovable theory." It was certainly rich, incorporating thinking and feeling, motivation and behavior, and it left room to include a whole host of "antecedent conditions".

Although it wasn't written about teaching and learning, I could easily make the translation. Basically it suggested that, as a result of my past history both as a student and a teacher, any implicit or explicit

theories of teaching or learning I might hold, and specific cues from a particular class, I would judge that class to be successful or not; and then I would make (again perhaps not explicitly) attributions as to the causes of that outcome. Underlying those attributions are at least three dimensions: locus (internal or external), control (controllable or uncontrollable), and stability (stable or unstable). These dimensions have consequences in the area of affect, expectancy, interpersonal and personal evaluation, which in turn affect my behavior.

I don't want to discuss the model in any more detail here, but I want to highlight several important points about attribution as a theory. First, it is broad enough to incorporate different theories of teaching and learning. It allows room for personal perceptions, and idiosyncratic values, beliefs or assumptions. It attempts to explain behavior in terms of an individual's own perceptions of the situation and his "theories in use" (Argyris & Schon, 1974).

It is a theory of behavior which incorporates feeling, thinking and motivation. It is in a language simple enough to be the basis of communication with faculty.

It can be applied at many levels: students' attributions about their learning, professors' attributions about their teaching, professors' attributions about their careers, instruction/faculty developers' attributions about faculty or teaching.

What had begun as a search for some specific theory to help teachers improve teaching or at least to help me help teachers improve teaching has resulted in my finding a broad theory which is rich enough to help me understand, or at least ask more intelligent questions, about my work with faculty. I had not originally conceived of my faculty development job as an "intellectual" activity. I had seen myself more as a clearing house of information, a dispenser of "truths" about teaching. As I got more into the job I became both confused and intrigued. Making sense for myself, (which no doubt will help my practice) and contributing to a better understanding of, or even a "solution to this problem" appealed to me inherently. Mathematicians love problems!

Even to call it a problem may only reflect the view of the faculty developer who has too few clients or "converts." I have been impressed that many intelligent and thoughtful faculty have often ignored, and even sometimes actively scorned, our best efforts to evaluate and improve university teaching and learning. If it is a problem it may be ours, not theirs.

Does the Model Fit the Facts?

I had my model or theory which helped me make sense out of what I was experiencing. It suggested reasonable hypotheses to explain faculty members' reactions to evaluation of teaching and teaching improvement efforts. Just having the model would have been enough for the mathematician side of me. But if I wanted to test the fit of my model to the facts I was going to have to do a whole lot more work. People in this "new area" seemed to demand more than "good logic and plausible hypotheses."

Here again I was on new ground. I was out of my element in research methodology in this area. My first inclination would have been to develop some tidy questionnaire and then "number crunch" the results to find some generalizable results. I have not followed that path because I don't feel our knowledge in this area, our appreciation of all the subtleties and fine points, is sophisticated enough to make this technique fruitful.

I have been gradually finding support (among the “experts”) for what I intuitively sensed was a better way to go. Cronbach (1975) suggested “instead of making generalization the ruling consideration in our research, we reserve our priorities.” As we go from situation, to situation, our

first task is to describe and interpret the effect anew in each locale, perhaps taking into account factors unique to that locale or series of events. As results accumulate, a person who seeks understanding will do his best to trace how the uncontrolled factors could have caused local departures from the model effect. That is, generalization comes late, and the exception is taken as seriously as the rule.

I believed we needed to study individual cases in much greater depth but I was still concerned about generalizations, the old security blanket from my mathematician days. Stake (1978) helped me along when he explained that disadvantages of case studies disappear “when the aims are understanding, extensions of experience and increases in conviction in that which is known.” He goes on to say:

What becomes useful understanding is a full and thorough knowledge of the particular, recognizing it also in new and foreign contexts. That knowledge is a form of generalization too, not scientific induction, but *naturalistic generalization*, arrived at by recognizing the similarities of objects and issues in and out of context by sensing the natural covariations of happenings. To generalize this way is to be both intuitive and empirical.

So I could have my understanding and maybe even my generalizations too. In my job whose prime purpose was to be practical, but with a depth of understanding, I would have to reconsider general laws Stake wrote:

It is the legitimate aim of many scholarly studies to discover or validate laws. But the aim of the practical arts is to get things done. The better generalizations often are those more parochial, those more personal. In fields such as education and social work, where few laws have been validated and where inquiry can be directed toward gathering information that has use other than for the cultivation of laws. A persistent attention to laws is pedantic.

I am now off on an intensive study of faculty and their views of teaching and teaching improvement. I use in-depth interviews with faculty, some lasting up to three hours. This method produces incredibly rich data which is often complex, confusing, sometimes contradictory, and almost exhausting to analyze.

I am still troubled by the nature of self-report data and am following with interest the debate in the psychological journals (Nisbett & Wilson, 1977; Ericson & Simon, 1980). My pilgrimage in search of truth always seems to lead me to more and more complex questions. Just another good problem for an old mathematician!

My Research and Practice Married

What I have described as two separate roads are now closely intertwined. My interviews with faculty not only help my developing research interests but also serve as powerful intervention on our campus. Part of my responsibility is to increase faculty concern for the quality of teaching and learning at Concordia. My interviews encourage and stimulate faculty to think about their teaching practice while at the same time provide research data.

I don't think any of my faculty colleagues consider themselves research subjects at all. I am investigating a complex phenomenon, asking interesting questions, and I want and need their help.

I have rarely found faculty who are not eager to talk about the nature of their work. In fact, they seem flattered to have been asked, to be respected for their perceptions, insights and knowledge. We have interesting conversations which are rewarding in and of themselves.

One of my major problems is time. Not surprisingly, that is the problem most often mentioned by faculty. Fortunately, my area of research closely overlaps and intersects with my daily work; and in that way I am able to think about my work when I am researching, do research when I am meeting with faculty and running workshops, and go to professional meetings like POD to talk about my work and my research at the same time.

My journey from full-time mathematics to faculty development had led me to visit many different areas, changed the nature of the "truth" I was seeking and even the very methods I was using. Even if

I never complete this career transition or never finish my journey in search of "purifying faculty development" I must admit that getting here has profoundly changed my conception of teaching and learning, improved my own classes dramatically, and been both stimulating and enjoyable.

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