Ian N. Deters
Phone: 419-419-8880
E-mail: iandeters@iandeters.com
Website: www.iandeters.com

Philosophy Of Teaching Statement

"I hate math." I am often hesitant to tell people my profession. I nearly always receive the preceding response and then an unsolicited anecdote as to the cause of their malice toward what I hold dear. However, as irksome as this is, these conversations, combined with my own experience, have allowed me to better understand why people do not like mathematics. It's exacting. It's algorithmic. It's a bunch of formulas. It's not clear why any of it works. It's hard.

It is hard. Math is hard. It is exacting. It is full of algorithms and formulas whose veracity is not always clear. However, I believe there is beauty in the rigor and utility in the formulas. I think that what makes mathematics difficult is precisely what merits it for study. It is my desire to show this to my students. In order to do this I have considered what motivates people to learn and what the aims of education should be.

I believe that people are motivated to learn for two, usually overlapping, reasons: curiosity and the desire to solve problems. Hence, education must be structured to address these motives. In particular, I believe that all education must have the following aims:

1. Critical thought
2. Imagination
3. A sense of context

The ability to think critically, think imaginatively, and to have a sense of one's context serve one much more than any specific fact. While facts may be researched, these three abilities are developed gradually through practice, experience, and reflection. In order to facilitate this, I create an environment that fosters these abilities in the context of learning mathematics. It is my hope that students take these abilities and continue to practice them after they leave my classroom. What follows is an explanation of these ideas as well as how I integrate them into the classroom.

MOTIVATION

"I want to live out life on my own. I want to lift the unturned stone." – Stephen Harris [1.]

My belief is that mathematics should proceed naturally and intuitively. Mathematics should proceed naturally in that it should be presented as the attempt of people to answer some set of questions. Indeed, this is what led to the creation of all mathematics. By introducing topics this way, I am able to whet curiosity and frame the discussion within a problem-solving context.

When possible, I give the historical context of a problem. For example, when teaching calculus, I will often talk about the classical physics problems that led to the development of calculus. When I taught abstract algebra, I introduced it as growing out of the work of Renaissance Italians to solve polynomial equations (which are quite natural objects in themselves) and as having potential applications, due to Weierstrass' Approximation Theorem, in many different areas. In fact, I make it a point to teach the students that the different branches of mathematics have applications in physics, chemistry, astronomy, scheduling, network flow, counting, forecasting, statistics, as well as give us a better understanding of the notions of certainty, impossibility, probability, and infinity. While some students may respond that they'll never be doing any of these things, I reply that they have missed the point. If mathematics has something to say about such a diverse set of difficult problems, it may very well be the case that it can contribute to some problem that they will encounter.

I shall now explain what I mean when I say that mathematics should be intuitive. It should be noted that those who originally solved any problem under examination did it with great effort and almost certainly repeated failure. However, the time constraint of the classroom prohibits anything but a cursory examination of the series of steps which led to progress on or the solution of any particular problem. In order to balance these two observations, when showing the solution of a problem, I choose a particular set of examples to make use of the student's intuition and previous experience to illustrate the salient points of the solution. In this way, students can see that the solution presented is not pulled from the air nor manufactured in an ivory tower but rather is the product of previous knowledge and the desire to try different approaches.

At this point it is appropriate to discuss my views on technology in the classroom. Simply put, computers are to compute. Computers allow us to try different ideas to see what works while being unfettered from the need to do calculations by hand. My students and I use computers to take the grunt work out of testing ideas in order to effortlessly illustrate, whether graphically, numerically, or algebraically, the veracity of various ideas and proposed solutions.

CTRITICAL THOUGHT

Training students to be rigorous and critical thinkers is a process which requires patience and perseverance on the part of both the teacher and student. First, it involves setting a good example. When teaching, I speak precisely and clearly. When I use an illustration or sophistry, I acknowledge it as such. When solving problems, I show how each step necessarily follows from the previous one.

Second, I give students plenty of chances to exercise critical thinking. Fortunately, mathematics, due to its subject matter, is an ideal context in which to practice critical thinking. Almost the whole of mathematics is rife with if/then statements as well as statements of impossibility, existence, probability, necessity, and sufficiency. I routinely ask my students “Why?”, “How?”, “What if?”, “How do you know?”, “Is there a counter example?”, and “Is the converse true?”. Moreover, it also provides an appropriate contrast to real world decision making. While one almost never reasons as rigorously in life as one does in mathematics (usually due to insufficient information, insufficient time, and/or insufficient funds), one still has a standard, expressed or otherwise, for making decisions in any given situation. I like to point this out. Mathematics provides us the luxury of possessing precise information which in turn allows us to demand a rigorous argument for a decision. However, since this is often not the case in most situations, I take this opportunity to ask students to think about what constitutes proof in various situations in everyday life. I want them to understand that critical thinking is not a classroom exercise, but rather a lifestyle. I want them to be aware of their own standards for determining truth.

Learning to think critically is much more involved than simple training. Through multiple examples, I demonstrate reason and the rudiments of logic to students. I show students the difference between impossibility, possibility, plausibility, probability, and certainty. By doing this, it is my hope that students begin to learn to know what they know, know why they know what they know, know how certain they are of what they know, learn to distinguish between different types of evidence, and be clear in their minds as to what they have accepted as evidence in any particular case.

Training students to be rigorous requires having high standards. Training one's mind to be rigorous is akin to training for a marathon. It is admittedly difficult, but it is worth it. To this end, I demand the best from the students and give them clear feedback to this effect. While I do not expect all of them to be prepared, I teach them as if they were. Finally, while I seek to demand the best from my students, I also seek to display a spirit of humility, gentleness, and helpfulness. I admit that the material is difficult to master, encourage and praise students when progress is made, and make myself available to offer help when it is needed. Math is hard. The students are to study. I am here to point the way, help, and encourage.

IMAGINATION

"Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other." - Paulo Freire [2.]

Although many consider it absent from mathematics, I believe that imagination is an essential part of mathematics and of learning itself. No solution can exist without first being imagined. No ground may be gained unless the mind is allowed to freely posit without restraint. Curiosity may not be sated until one is allowed to wonder about the possibility of what is not known. Indeed, when solving problems and satisfying curiosity, it is imagination which asserts and reason which confirms. A solution might be unique, but the path to it surely is not.

My approach to creating an environment in which imagination is encouraged is threefold. First, I encourage students to question me. I do not present myself as an unquestionable authority, but rather invite students to question the material I present. When I do not know an answer, I admit it. One of the ways I try to get students to learn to ask questions is to stop at various points in the lecture and ask if they have any. If none are presented, I bring up questions for them. This conditions the students to be comfortable asking questions themselves and presents them with the types of questions that are useful to ask when learning mathematics.

Second, I inform my students that failure, far from deserving fear, is natural, should be expected, and is part of learning. While I expect excellence from the work that students ultimately turn in, I encourage them to not be afraid of making mistakes while they are creating that final product. In order to facilitate this, I entertain and explore students' ideas during class regardless of their veracity. If their notion proves correct, I praise them. If not, I thank them for their input and encourage them to try again. Mathematics, like anything else worthwhile, requires a great deal of practice to master. I try to instill my students with a spirit of inquiry which is resilient in the face of failure and modest gains.

Third, I emphasize the unity of mathematics in order to demonstrate that there is typically more than one way to think about a problem. By the unity of mathematics, I mean the fact that mathematics is not a tree of many branches, but rather a chord of many, interwoven strands. While we examine each strand at a time, I emphasize the connections between the strands. One way to accomplish this is to try to cast the same question into different mathematical contexts. For instance, the fundamental theorem of algebra may be set in the context of algebra, topology, or complex analysis. As another example, one may observe that polynomial differentiation can be accomplished through computing the limit of difference quotients or matrix multiplication. Such examples illustrate that in mathematics, and indeed in knowledge itself, while there may be distinct sets of ideas, there is also a unifying spirit which pervades them. I think this sentiment is best expressed in the following quote:

"There is no science but tells a different tale, when viewed as a portion of a whole, from what it is likely to suggest when taken by itself, without the safeguard, as I may call it, of others."
- John Henry Newman [3.]

A SENSE OF CONTEXT

My years of study have led me to learn a large body of facts. However, this is far less important than my learning of the *existence* of a far larger body of facts. I have been exposed to many ideas which I had not previously considered. While I rarely memorized all of these ideas, I did retain the fact that such ideas exist and where to find them. In particular, I became aware, at least in part, of the breadth of humanity's curiosity and research. I realized that if I had a question, I was probably not the first and that there was probably a paper written on it. I obtained a larger sense of my intellectual context. It is my intention to pass this on to my students. I do this in two ways. First, when it is germane, I will mention fields of research and study, mathematical or otherwise, related to the topic at hand. I do this in order to expose students to as many ideas as possible.

Second, I emphasize the past. The greatest tool for solving any problem is the past. Indeed, the first step to solving any problem is considering what others have done. From my experience, it seems that when people encounter problems in life, mathematical or otherwise, there is a tendency for them to believe that their experience is somehow unique. However, this is usually far from true. Often problems have been previously encountered and considered. I think it is important for students to realize that the problems they consider are often classical and that potential solutions exist in examining the solutions that others have found for similar problems in the past. I tell the students that, typically, problems are not unique and have previously been considered. I demonstrate this during lectures by offering solutions to problems that begin with first considering what has already been solved and what is already known.

SUMMARY

In summary, I believe that people are motivated to learn by curiosity and the desire to solve problems. In light of this, I seek to present mathematics naturally and intuitively. I use this as an environment to help students develop critical thinking, their imagination, and a sense of context. It is my hope that they continue to practice and develop these abilities after they leave my classroom. If they do, I believe they will have a powerful and positive effect on their world.

Quotations

1. Harris, Stephen P. "The Educated Fool." Virtual XI. EMI Records, 1998.
2. Freire, Paulo. "The 'Banking' Concept Of Education". Ways Of Reading. Bartholomae, David and Anthony Petrosky. Boston: Bedford/St. Martin's, 1999. 349.
3. Newman, John H. The Idea Of A University p. 100. London: Longmans, Green, and CO., 1907.