Learning to Learn Other People's Knowledge, acquiring self-sufficiency in a math classroom

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1. Consuming Math vs. Creating Math

Umberto Eco (1970) tells a story of an industrial worker visiting a trade fair. The worker wanders through halls filled with the latest consumer goods, marvels at the newest and coolest innovations on the market, and plans, or maybe dreams, of acquiring some of these upgraded gadgets for the home: a new computer, perhaps, a coffee machine, a dishwasher or television. Later, in that same trade fair, the worker walks through the exhibits of industrial equipment, marvelling at forklift trucks, cranes, or heavy production equipment, impressed, certainly, but without any urge to buy. He has learned to see such tools as ugly, functional, and really useful only if accumulated. Although he may use any of these machines daily at work, he cannot conceive of why he might wish to own one. And although the advertising material he collects can suggest any number of reasons why he needs a new coffee machine, he feels strangely excluded by the promotional material for those tools he uses at work.
Eco's point is provocative: "at the end of his rounds, the ordinary visitor believes he has chosen. He desires beautiful objects, accessible, and not accumulable, and rejects those that are ugly and accumulable (but inaccessible). In reality he has not chosen, he has only accepted his role as consumer of consumer goods since he cannot be a proprietor of means of production." Of course, the worker's willingness to see himself as a purchaser of consumer goods but not of production tools is also an acceptance of his own position in the workforce, subordinate to a person who can and does own such machines.

Consider now an adult student enrolled in a math class. Many will have had unhappy experiences with the subject at school, they will often be trying to learn content with which they once struggled, and they will generally be taking the class for an extrinsic reason, whether it be job training or completion of an educational requirement. The task as they see it is clear: pass the minimum number of math classes and there is no more math in the way of a business degree, pass an exam to gain a high school diploma, or job qualification, or to finally earn the right to study at university. Placed in this perspective, many students view their required math classes as terminal, marking the end of their math studies for life. And clearly, such a perspective influences the choice of study strategies that students employ: they study isolated pieces of knowledge under duress to pass an exam, not to accumulate durable understanding to be used as a foundation in subsequent courses. At the end of his math education, the typical student believes he has chosen. He desires a diet of nugget sized math facts, that are self contained, geared to the exam, easy and painless to memorize but not accumulable. And he rejects an approach that he

considers ugly or "nerdish", although the understanding obtained in this way is accumulable (if inaccessible). But again he has not really chosen, only accepted his role as a consumer of other people's math, since his study methods give him no clue as to how to be part of generating that knowledge. At the same time, the student's acceptance of himself as a consumer of other's math knowledge without a share in the production of that knowledge is also an acceptance of his own position in an educational hierarchy, subordinate to those who apparently learn mathematics with ease, know how to accumulate math knowledge and have progressed to math courses which our math avoidant student knows only by name:

> As perceptive dispositions tend to be adjusted to position, agents, even the most disadvantaged ones, tend to perceive the world as natural and to accept it much more readily than one might imagine – especially when you look at the situation of the dominated through the social eyes of the dominant.
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> (Bourdieu, 1986, p. 130).

2. Overcoming Inertia - e.g. Ruth

Past memories exerted a strong influence on student's relation to mathematics. For Ruth a female student in her late 20's, these are revealed, not by recollection of a moment of mathematical failure, but by the judgment of that perceived failure by one particular person:

> When I tried to recall my earliest math nightmare all I could think of was Mr.. F. All my report cards from him said if I could just apply myself I'd do better, but how can you apply yourself when you are just so behind with the skills and when you feel humiliated at every class period?

Anxiety of mathematics is caused. It requires the involvement of at least one other person whose judgment is valued. For Ruth, Mr. F. is that person. He is remembered for requesting something – more application – without providing the skills necessary to make that feasible. Any attempts that Mr. F. made to help Ruth are not recalled, simply the humiliation that resulted. The same themes are echoed in others student's journals:

> I had a best friend, she was my neighbor and we went to school together all our lives from preschool to that "bad time". It was 7th grade. She and I made a promise that we would work together in math class. Well she comprehended math faster than I did. I fell behind and she didn't wait for me or help me. She began to get more popular in school and I began to resent her and math. I didn't like that "left behind" feeling. I never related the two before today though. I was always just angry with her.
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> (extract from student journal)

> It all began with my parents constantly reminding me that ... (my sister and brother) were ... exceptional in math. Of course, that statement was always followed by the inevitable question, "Why can't you be like your sister and brother?" It didn't stop at home though. School was no different. ... All I ever heard was, "your sister was an excellent student in my math class", or "your brother was such a quick learner in my math class". The only question that rang

> in my head year after year was simply, "why can't I be like ... (my sister and brother)?" That question soon turned into, "face it, you just don't have what it takes". (extract from student journal)

In the case of each of these extracts, at least a decade lies between the event that is being remembered and the time of writing. During the intervening period, the schoolchild who is the subject of the extract has developed into an adult who has sufficiently confident in their academic ability that they are enrolled to take academic courses at a university, the difficulties with mathematics and the feelings that the subject provokes, however, will rarely have been articulated with others:

> (My husband) says he'll help me out if I need it, but I'm apprehensive about going to him. It must be frustrating when you can see something so clearly, yet another is blind.

Instead internalized dialogue will have personalized the feelings of frustration and difficulty so that it becomes separated from its origins:

> My anxiety isn't test related though, because although a little nervous on other class tests I do fine. It's definitely a math phobia. I don't really know why I'm saying this because it's at least fifteen years since I've taken a real maths exam.

At school, when there was perceived to be no loss in failing to understanding material, avoidance strategies, whether mental or physical, are adopted to avoid frustration:

> Looking back to when I was a teenager, I can remember saying to myself that it didn't really matter that I didn't grasp all the math formulas because what use were they in the "real" world anyway.

In the absence of tenable alternatives, these same avoidance strategies are adapted in adult life to situations in which there is a personal involvement and thereby become a possible source of frustration or pain:

> This far I haven't really needed complicated formulas, but knowing some of the more basic things would have saved me a lot of embarrassment.
> When I was accepted for a job as a photo tech in California I can remember the dread of knowing I'd be working the cash register. It wasn't that I was worried about counting the money, it was that California had a 6.45% sales tax and that had to be added to the final total. I panicked several times and messed up on the till. It wasn't until a caring coworker showed me how to work it on the calculator that I felt comfortable doing it. To this day I don't understand the process I was doing!
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> My husband just doesn't grasp how afraid and intimidated I feel about my lacking skills. It comes so naturally to him, he doesn't understand. Kevin (my son) is doing fractions in 3rd grade now and instead of helping him with his homework and helping myself at the same time, I just tell him to go to Dad to get help. "Classic" math avoidance.
> I really want to crack this shortcoming; it's affected me more than I care to admit.

Treating anxiety in the case of students such as Ruth does not mean treating their avoidance strategies. By enrolling in a math class, the student has already undertaken the most important step towards overcoming avoidance themselves. Central to these students' needs is a set of study techniques that are explicitly different from those which they employed in school and which give them the impression that they can exercise some control over their learning: providing students whose natural inclination is towards an internal locus of control with the tools that enable them to see their activity in a math class as being consistent with their preferred methods of working. At the same time it demystifies many of the reasons for their past poor relationship to mathematics by emphasizing the necessary differences in technique that have to be employed in studying mathematics compared to those subjects in which they feel they have a natural talent:

> I'm just beginning to realize that taking any maths class for me will be a full-time pursuit. I won't be taking any other course, that's for sure. I knew I'd have to work hard, of course. But the strategies needed to master this subject seem to require a whole lot more time out of class to keep ahead.
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> (I) found it most interesting that just doing homework and studying isn't enough. With maths you have to be able to break down each problem and understand Why? on each step. This will be new for me, I'm used to studying, memorizing and moving on. Going back and trying to figure out what's going on in each step will be very time consuming but necessary,

It should not be surprising that, having found a strategy for beginning the study of the subject, other aspects become demystified. The success of others, once seen as evidence of a talent that was naturally given, now becomes viewed as the benefits of experience. Experience is acquirable:

> What came to my mind was the comment of the girl in my group who said she recalled the same concept of the word problem given in class to a problem from a math class a while ago. She didn't really know the answer, but remembered the fundamental figuring out process. Where as I didn't have the foggiest as I'd never (not in a long while) seen that type of word problem. I expect after coming across similar problems over and over again you instinctively know how to tackle them.

3. The Politics of Mathematics Anxiety

As math teachers, we walk into a math class hiding behind the persona of a mathematician and backed by inherited assumptions of what mathematics is, what mathematics education should be, and how we were taught mathematics. We teach, or rather we *can* teach from a position of strength: after all, we know the material – the class does not – and that is always a very comfortable fallback position if the going gets tough: *it also makes us potentially part of a problem.*

Our presence in the classroom, the tone of our discourse when we talk about or teach mathematics, act as critical reality definers for student's perceptions of mathematics. For a period of time, and particularly when students have no other accessible role model, we embody mathematics for our students. How they interpret our actions, our comments,

our manner, may be very different from how we intend, but it will be decisive in how they view mathematics and how they perceive themselves as math learners.

The presentation of mathematics in an academic setting is a *re*-presentation of the reception history of selected aspects of mathematics by those in a position to articulate *their* reception: the academic community monitors its own product. Entry to a field of academic study is carefully controlled, with admission and progress dependent on demonstrating the knowledge and approach considered appropriate by those already working in the field. While this academic stewardship acts as guarantor for the collection of skills with which we orientate in the process of gathering and evaluating knowledge, and safeguards that body of insights which represent the cumulated achievements of this academic tradition, it should not be forgotten that these skills and insights developed out of the understanding of one particular group in society sufficiently wealthy and powerful to be able to legitimate their interests through the education process. The process is self-perpetuating. Students who appear to intuitively display a shared grasp of the processes and expectations of the study of mathematics are considered to be naturally talented and encouraged: others lose out by comparison. The experience of mathematics as "other people's knowledge" which lies at the root of mathematics anxiety is directly related to this exclusion by comparison.

The impression of natural talent can often be recognized as an articulation of the prior embodiment of the forms of behavior inherent in the culture of the school through the culture of the home and the social *milieu*. For those students not fortunate to have been able to acquire the necessary preparation from their class or cultural background, the precondition for being able to participate equally in the classroom is met only by becoming conscious of, and learning to use, the expected skills second-hand. While this is true of all academic subjects, it is particularly true in mathematics where the assumptions of the classroom tend to exclude the knowledge that the child brings from home. The transmission of study skills appears only possible within a formal school framework, however, when a teacher is made aware that the skills to which they owe their own school success (and, by extension, their present position) are not the result of 'natural talent' but rather can be identified, analyzed and passed on:

> (...) Students will be judged on their product regardless of the process they utilize to achieve it. And that product, based as it is on the specific codes of a particular culture, is more readily produced when the directives of how to produce it are made explicit". (Delpit, 1988, p. 287)

Where this is not the case, students are placed in a position where information, which they require to successfully assimilate material *in the style in which it is being presented*, is being withheld from them. By providing widened access to the *codes* of educational advancement, opportunities are created for students outside of the culturally dominant class to earn entry to the academic establishment on its terms. The presentation of the stylistic traits of academia as codes of discourse which can be learned and appropriated as tools, enables students to understand more clearly, and, therefore, to meet, the criterion on which selection for academic progress is based. At present many students experience mathematics classes in which the ground rules, which enable a fortunate few of their classmates to appear naturally talented while the majority struggle to find relevance in the approach taken, remain implicit.

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