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Revamping Math in B.C. Schools: A Personal View.

I. Global Misconceptions. Not only in British Columbia and not only in North America do people have a hard time with math. Imagine a gathering of non-scientific intellectuals anywhere: their ignorance and loathing of math will not likely be matched by those of any other subject. Alone in our corner of the world, we cannot undertake to restructure a public image which has been distorted by centuries of arrogance, complacency, and pedantry. But before we plan our own remedies, let us take stock of the prevalent caricature, in order not to make it worse.

Math lacks a human face. It is almost universally seen as a cut-and-dried subject, full of prefabricated formulas and algorithms, which must be memorized and occasionally applied, and which require a form of stilted, "linear" thinking more natural to the idiot-savant than to the gentleman — not to mention the lady. It is governed by iron-clad laws and indisputable rules, which leave no room for error or uncertainty. It is at least intimidating and at worst totalitarian.

No self-respecting adolescent would or should want to tangle with such a subject. Those who do are often regarded as "nurds", or the equivalent, not only by their peers but also by serious *literati*. More generous souls admire them as "brains" with almost magical powers. (A recent article in the Vancouver Sun opened by saying that a certain math teacher could calculate the heat loss through the dome of B. C. Place "in a flash" — a stunt that few, if any, mortals would actually be able to perform).

It is not widely appreciated that math is just an extension of common sense, refined by systematic doubt and argument. Few people realize that it is primarily not a body of knowledge but an activity which is highly non-linear, largely subconscious, and therefore fraught with plenty of detours, false leads, and sheer nonsense. The final precision and solidity of its results do not stem from any inherent infallibility, but from its relentless striving for clarity and its radical openness to criticism. It originated at about the same time and place that saw the birth of democracy, and it has always flourished most vigorously in open, tolerant societies.

How, then, did such a total misconception come about? For one thing, the modern student has to overcome a language barrier. Over the last four centuries, math has evolved a highly concise and efficient symbolic language, which provides a fast track for the few who twig to it, while shutting out the majority. But even in the days of Euclid it was not considered easy. I hope that the following metaphor will not be considered too far fetched: like a hike up the side of a mountain, I think, the learning of math *is*, by normal standards, exceedingly hard and slow — especially in the middle stretch, after the playful start at the base and before the exhilaration beyond the tree-line. Without the inspiring competence of a guide, a solid sense of direction, and a growing self-confidence, this phase can look like nothing but mud, strain, and blisters: a sport fit only for drudges and kookes.

I cannot believe that this state of affairs could be corrected by clever PR blitzes, ingenious gimmicks, or novel gadgets. As I see it, the problem does not revolve around "today's rapidly changing technological society" but around the amazing animal that has been sitting at its centre for thousands of years, doggedly scaling the mountain of its own miraculous mind.

II. Local Complications. In British Columbia (and neighbouring areas), we have three conditions which make matters worse.

1. Unprepared teachers. Unlike, say, swimming or music, math is apparently not considered to be a skill requiring special training on the part of the teacher. Thus, anyone with a teaching certificate can be asked to instruct students in this subject, which most teachers happen to loath and fear. In their panic and helplessness, these unfortunates cling to the letter of the textbook and seek refuge in formulas, jargon, and memorization — unaware that these are precisely the three archenemies of mathematical thinking.

Things are not ideal, when the swimming coach is afraid of the water, or the music teacher cannot carry a tune. But, in an imperfect world, such situations may have to be tolerated: at least, the former can encourage the kids splashing about in the pool, and the latter can comment on their choral efforts. The ill-staffed math class is worse off, however, since mental movements are invisible, and their scratchy traces on paper most often incomprehensible.

2. Modular testing. In disciplines whose core, at the school level, is essentially narrative or descriptive, it may be appropriate to measure progress by frequent short quizzes, relying on the human brain to synthesize the information spontaneously — as indeed it often will, if it only has the slightest hint of a conceptual frame-work, e.g., its own experience of family or social life. However, for monitoring the slow growth of mathematical (or musical, or athletic) competence, this approach is grossly inadequate.

When linked to the carrot-and-stick system of grades, it becomes truly counterproductive, encouraging students to concentrate on trivia, avoid risks, "dump" the contents of earlier lessons, and entirely neglect what they should be cultivating.

3. Curricular fragmentation. At first glance, the B. C. curriculum appears as a reasonable and useful selection of topics, especially in the early grades. A closer look, however, reveals a monster with too many arms and legs attached to an undernourished body. It is hard to see how students can develop a sense of direction and mastery, as they are whisked from one quick exposure to the next. While it is true that a central body of mathematical competence cannot be cultivated *in abstracto*, it is equally true that a parade of diverse examples simply befuddles the mind that cannot yet see their subtle connections.

This emphatically does not mean "conceptualize now, apply later" or similar nonsense. It does mean that the beginner needs a fairly stable context of discourse and visualization, and that the examples best suited to nurture the growing tissue of skills are those which are not too far from the symbols and images active at the mind's mathematical core. For instance, geometric configurations are probably better than the stock market, in most cases.

What can be done? Item (1) seems to be a long-range problem involving human resources, job security, seniority, and economics. While waiting for its gradual resolution, one might at least try to anathematize formulas, jargon, and memorization in math classes. Item (2) presents difficulties in the short run mainly because of ingrained habits. Over time, it should be possible to compile a provincial bank of exam-problems which require more than one or two steps, span more than one chapter, and possibly have more than one solution. Item (3) presents perhaps the trickiest task, but fortunately one which needs no lengthy waiting: prune, unify, and deepen.

P.S. These are not views of an expert, but of a concerned observer. They are intended for discussion, contradiction, and correction.