Some Effects of the Changing High School Math Curriculum

By David C. Vaughan

Each year as I prepare and revise my first-year courses in mathematics (which are meant for a general audience, not just mathematics students), I reflect on the substantial changes forced by the changing skills of the incoming students. The typical student has decreasing skills and knowledge in several areas.

One major area is the understanding of theory. We have rearranged our courses so that there is almost no requirement to understand the theoretical underpinnings of calculus, linear algebra, etc. in first year. We used to require students to take ideas learned in class and prove something they had not seen before. Now we rarely ask them to repeat simple definitions. The high school curriculum does not include a substantial abstract element, such as set theory or Euclidean geometry. In many cases, students tell me that the use of function notation is very limited, and expressions are often written in words. Students drill on many problems of a specific type and then have a test that consists of questions that are minor variations on the drill problems. At university, we expect students to put several ideas together, but we now need to use laboratories in mathematics to help students learn to do this.

In the past, lab (or tutorial) time allowed students to ask questions about homework and class material. Now we find their study habits are significantly poorer. Typically, students will tell me they never needed to do homework at high school to get good grades. When they come to university, an 80% student often drops to 60%, with many dropping out completely. A major reason for this is that students don't start to work on their own until after their first bad test, and by that time they can be so far behind that they can't catch up. The labs we have developed are used to force students to start working right from the start, as well as to teach them to integrate the current work with previous material. The type of material presented has shifted almost exclusively to applications, with the cookbook approach taking a larger role.

Developing an overview of the subject must wait until the students have been given the training needed in study habits and fundamental knowledge. The types of questions asked and their structures have also changed. We used to require students to perform sequential operations on a given function, so that the results of Part A are used in Part B, etc. However, the majority of students have such poor basic algebra and arithmetic skills that their answers to Part A will be wrong and the values make no sense in Part B. They tend to rely heavily on calculators

but, when their initial algebraic manipulations are wrong, the numerical evaluation will not be of value. Many also tend to feel that the number out of a calculator has some special significance and does not need to be checked. In statistics, a quantity we need to use is the variance, a sum of squares of real numbers. Every year, several students will compute this value and come up with a negative number! It is true that many routine calculations, including algebraic ones, can be done quickly and accurately on a calculator, but if there is no sense of the value expected, it can be a serious problem. Before calculators are used, a solid grounding in the methods and operations is essential, so that such problems as noted above are minimized. Unfortunately, it is often the case that students are encouraged to use calculators before they have mastered the methods themselves.

I know that high school math courses are not viewed as university preparation courses. However, given that our political and business leaders tell us that future jobs will be in technical areas often emphasizing computing skills and that people will need to be flexible and life-long learners, it is very curious that the high school curriculum tends to be at odds with these notions. Anyone who has worked with a computer knows that correct spelling, grammar and punctuation are essential. When I read their work, I worry about how students will learn the computing skills needed in their careers. The reality is that we will be using computers in math more and more, but the universities don't have the resources for remediation. Proper training, which is useful in any career path and not just university, must take place in the schools. High self-esteem and low skill level will not land a job.

Having worked with my daughter on her grade nine and grade ten math programs (she is essentially being home-schooled in this area), I have had an opportunity to see what is in these courses. The truth is, the grade nine work is simply repeated in grade 10, with only a few additional new ideas included. The Ministry of Education's curriculum guides for grade 9-12 math courses indicate that statistics can be a substantial part of the work, but this is all denoted "optional". Any optional topic is rarely covered.

If we accept the view that the future job market will require technical expertise, then it is important to ensure that our children receive the necessary preparation in high school. There must be a substantial element of abstract work to help develop the skills necessary for computing and mathematics. Topics need to be mastered before calculators are used. The amount of work should be substantially increased. If such measures are not undertaken at the high school level, the only students who will get the requisite instruction (and be in a position to be successful) are those who attend private schools or get home schooling. We

cannot afford to limit our children's futures by continuing to reduce the content and requirements of their mathematics courses.

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