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Education Notes bring mathematical and educational ideas forth to the CMS readership in a manner that promotes discussion of relevant topics including research, activities, issues, and noteworthy news items. Comments, suggestions, and submissions are welcome.

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During my visit to a school in Kamloops, B.C., an eight-year-old student asked me what the world would look like without mathematics. I told them that I was not sure about the whole world, but my world would be a boring place without all the challenges, excitement, and people that mathematics has brought into it. What I didn't tell this natural-born- philosopher was that I believe that mathematics, from counting one's fingers to engaging in its most abstract forms, is a human way of interacting with the real world, both as individuals and for humanity as a whole.

For almost five decades, as a mathematics teacher, facing that human side of mathematics was a reality of my day-to-day life.

Teachers

Both of my parents were teachers. My Mother was a Grade K-4 teacher, and my Father was Grade 7-8 physics and mathematics teacher. Now, at the end of my own teaching career, I see that, besides being my first teachers, my parents also served as my teaching role models. Just as my Mother before me, I was committed to give everything I had to support each of my student's intellectual, personal, and academic growth; and, as my Father before me, I was always fascinated by human knowledge and eager to share with my students my curiosity about the mathematical aspects of the world around us.

During my studies, I was fortunate to have a string of memorable teachers, from my kindergarten teacher, Mrs. Zlata Telalbašić, to my Ph.D. advisor, Professor Tom Brown. For example, even though, thanks to my Father, the learning of mathematics has been part of my life for as long as I remember, the demonstration of proofs in Euclidian geometry by my high school mathematics teacher, Mrs. Nasiha Kasumagić, sparked my decision to become a mathematician. As another example, the obvious joy with which Professor Mahmut Barjaktarević taught Mathematics Analysis, my very first undergraduate course, influenced my own approach to presenting mathematics.

Still, I think that my best teachers were my sons and my students.

From my sons, as a parent and a witness to their educational journeys, I learned that regardless of all of the love, the best of intentions, experience and knowledge, a teacher needs to respect the fact that students follow their own talents and intellectual interests, and ultimately make

their own choices and decisions. This includes a teacher's awareness that going to school is only a segment of a student's life. Consequently, a student's commitment to their studies may be affected, in a positive or a negative way, by a set of non-academic constraints.

From my students I learned humility.

Despite of all willingness and efforts to share my knowledge and be my students' academic guide, I could not reach everyone in a good way. My classes were a cross section of society and, as such, a reflection of social complexity, including the ever changing political, economic, technological, and educational landscapes. Adding to this, my own rendering of the world around me at an instant of time was not always in sync with the level of diversity of skills, knowledge, educational histories, and learning styles of my students. Accepting the fact that my students may understand some of the ongoing processes in our shared reality better than I did was not easy.

In short, my students taught me that a teacher is a human, not a god, and that all I can do as a teacher is *my* side of our joint undertaking: doing my best to be well prepared for each class, providing clear expectations, being respectful and fair, and willing to engage in academic, and occasionally non-academic, conversations with students.

The Dark Side of Mathematics

Teaching and promoting mathematics over many years made me aware of the *dark side of mathematics*. In addition to being used as a tool of judgement, for so many of my students and for, what I believe is, a noticeable segment of the general population, mathematics is a source of frustration and fear, and an object of open hate.

During my travels with the Math Catcher Outreach Program, I have met students as young as ten years old, that told me that they *hate mathematics*. In almost every class that I visited, and I visited Grades K-12 mathematics classrooms across British Columbia, there was a group of students acting like they were somewhere very distant from that room. For me, that kind of behaviour demonstrated, in a passive way, a dislike and animosity towards mathematics. In my precalculus classes, I sometimes worked with smart, ambitious, and hard-working young people that were so afraid of mathematics that this fear blocked them from even trying to do what they were asked. In situations like these, I often felt rather as a *math therapist* than as a math teacher.

In my view, the mathematical academic totem pole has a strange power to influence the sight of some of mathematicians and mathematics teachers on it: when those individuals look up the pole, everyone above seems very close, almost equal to them, but when they look down everyone below seems very, very far away.

Is a person *stupid* if they do not understand an *obvious* mathematical fact and if they cannot perform a *simple* mathematical task? Yes, in the opinion (and practice) of some teachers, at any level of mathematical instruction. This kind of negative judgement leaves deep mathematical scars that are always painful when touched and are hard to witness.

My personal struggle as a mathematics teacher has been to find a balance between my conviction that mathematical knowledge is necessary for an individual, as well as a community, to safely navigate reality, as well as my conviction that, for an *ordinary* person, learning mathematics is difficult. In my experience, learning a mathematical fact and retaining it over time by a student is the output of a function with, for me, an unknown number of variables. What had I done in my classroom that was too much for my audience? Or too little?

Have I made a dent in the dark side of mathematics?

Then and Now

If I recall fifty years ago to when I was a student, the university mathematics teacher's role was really to be a *demonstrator* of the content knowledge. The teacher would say what they had to say, do on the board whatever they had to do, and leave the room at the end of the lecture. My impression at the time was that our teachers could not care less if we, their students, were able to follow a lecture or not. And, by definition, a university professor deserved everyone's respect just by being on stage.

This, I think, has changed a lot; now, an instructor who is simply serving as a demonstrator would not go very far to receive students' attention and respect. In my view, the modern teacher in lower-level university mathematics courses is a *moderator* of the content knowledge, someone who is introducing new concepts and helping students to grasp those concepts through various tools of the modern instruction. Those tools include in-class activities, like one of many student response systems, visualizations of mathematical facts, innovative course assessments, all kinds of teacher-student and student-student ways of communication, recorded lectures including the hybrid models of delivering a class, and other online learning resources.

For me, part of my teaching role was always to serve as a *motivator*. This included my efforts to help my students grasp why the topic we discussed was exciting; why learning it may be beneficial for their intellectual development; or why it could be useful for a job or a real-life situation they would experience in the future. I also saw as my responsibility as a teacher to communicate to my students that learning and doing mathematics is an experience that can lead to feelings of pride, happiness, and joy.

But I think that my life as a teacher was simpler even 15-20 years ago than what it has been over the last several years. For example, what was a two-page Course Outline handed-out during a first class is now a complex learning management course container that requires regular monitoring and updating throughout the semester. Or, a drop-in assignment box in the hallway has been replaced by one or more commercial products that students need to pay for, something that disturbs me still. Or, learning how to use and manage various pieces of educational devices and technologies, has become necessary to keep up with the expectations by students and standards set up by our institutions and communities of practice.

As someone who, in 2002, was tasked to promote the use of the Learning Management System of the time in my department; who was a pioneer in creating and using open-source online assignments in the early 2000s; who, in 2008, with Jamie Mulholland, created a full set of recorded Calculus I lectures; and, in 2012, together with Jamie Mulholland and Cindy Xin, experimented with the *flipped* classes, I know that the current set-up of lower division courses was created with the aim to make learning of mathematics more accessible to students. And I know that there is no way back.

My concern is that over the years, we added another thick level of complexity to teachers' jobs. This demanding part of their job, may take teacher's attention away from in-person communications with students and from enhancing their knowledge of the mathematics they teach.

Failures and Successes

How do we define success or failure as teachers?

I think that trying to improve one's teaching practices is a never-ending process. If a mathematics teacher wants to be effective in what they do, it is necessary that they keep learning all the time. This includes both learning new pedagogies and staying on the top of the mathematical content they present.

But trying new things also means a risk of failure.

At one point in my career, I requested to teach a remedial mathematics course with the highest failure rate among all courses with a significant enrollment at my university. Once I started thinking about the way I would like to teach the course, the rules and expectations set up by my department felt like a straitjacket. I realized that the only room for change was in two areas:

- To adjust the philosophy of the course to my own experience and understanding of what it is that a student really needs to know to successfully complete the follow up courses.
- To break down, in-class and out-of-class, as much as possible the barrier between the instructor and individual students.

Fast forward, regardless of all of the work that I put in the understanding, preparing and teaching the course over two years, I was not able to significantly improve the class passing rates. My best was not good enough.

My failure was rooted in my belief that I would be able to make a significant change without addressing the general framework of the course: the class size, the out-of-classroom course support, the assignment structure, and the course prerequisites. Another mistake was in my underestimation of the power of the class diversity.

Here is another of my failures as a teacher, a long-lasting *moral wound*. In one of my Calculus classes, there was a student who I knew for several years through my friendship with their parents. The student, otherwise an intelligent, energetic, and outgoing young person, gave up quite early on attending lectures and submitting assignments. Regardless of the extra work towards the end of the semester, the student failed the course. Even now, it hurts me tremendously when I think that I was not able to motivate the student to fully commit to their studies and to do better in the course. What hurts me even more is the certainty that in large classes, that I taught so often, there were students who faded away without me ever noticing it.

For me, a teaching success was to realize that I played even a very small positive role, in a student's academic life.

During one remedial math course that I taught early in my Canadian teaching career, a student told me that they were just returning to school after a severe head injury sustained in a car accident. When I close my eyes, I can still hear their trembling voice and sense the mixture of hope and fear that they felt. The student worked hard, did very well in the course, and I truly believe that mathematics was part in student's healing process.

Many years later, in a third-year math class that I taught, there was a student who would come to my office after each lecture. They didn't actually have questions related to the course; instead, the student wanted to talk to me about their own mathematical thinking and ideas. And the student was a volcano of ideas flying all across the mathematical spectrum! I introduced the student to some of my colleagues and invited them to join the IRMACS Ramsey Theory Working Group. Currently, my former student is one of the most prominent young combinatorialists in the world.

Probably the most significant teaching award that I've ever received is a message from one of my former Indigenous students who is to about to start their own career as a teacher: "You believed in me at the time when I didn't believe in myself."

Farewell Teaching

I think that the best part of my job as a university math instructor was the privilege of constantly sharing the company of young people and contributing to the quality of their present and future lives. What am I going to do without that source of energy and purpose that has been keeping me go on for so long?

But it is time to go. The fact that I have only *my former students* is slowly sinking in to my mind.

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