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Making Mathematics Mnemonic, But Fun

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Time and time again, we hear the same old stories of students' poor performance in university-level first-year mathematics courses: students are not learning; many do not care about mathematics because they have no intention of taking mathematics courses beyond a mandatory first-year course; some have mathematics anxiety; others simply are not doing well for a variety of different reasons. Some instructors advise focusing on the content and connecting the mathematics to the real world and students' future careers. But, if students struggle with basic mathematical concepts, then how will they understand and appreciate the real-world applications? There is also an objective reality – it is hard to connect concepts in a first-year mathematics courses to *true* real-world situations that students can relate to. Students need to move beyond first-year concepts, but many will never take any higher-level mathematics courses. The question that first-year mathematics instructors then need to ask is: "What do we do?" In my view, one way to alleviate some of the students' frustrations and anxieties is to give life to the mathematical objects, concepts and notation, taught with the help of fun mnemonics and mantras.

My name is Andie Burazin, and I am an Assistant Professor, Teaching Stream, at the University of Toronto Mississauga. I have just over four years of experience in teaching mathematics at a university level, counting from the completion of my PhD. As a junior faculty

member, I am at the bottom of the totem pole and that, unfortunately, creates constraints when I

teach. I do not make the decisions regarding the broad mathematics curriculum nor about what is

taught in a particular course. The most challenging part for me is reaching out and

accommodating my students, as my classroom sizes are typically over 120 students. Having no

control over the content, nor over the pace at which the course is taught, it is quite a challenge to

go beyond lecturing and experiment with alternatives. Still, I believe that I can see hints of

success - I have noticed, from my limited teaching experience, that students really engage better

when I try to make the mathematics that I discuss more relatable to their everyday, *non-*

mathematical experiences.

Mathematics is a discipline that requires continuous and dedicated practice to understand

various concepts and, most important, to see how each concept builds on the previous. Like

building a house, you cannot build the third floor without completing the second floor. On every

handout that I pass out to my students, on the upper right-hand corner of the page header, I write:

"*practice, practice, practice . . .*", a mantra that I learned from practicing yoga. This mantra,

"*practice, practice, practice . . .*", serves as a reminder to the students that the only way they can

unlock mathematical mysteries is to continuously practice. Simple as that, right? Well,

mathematics is definitely not acquired through osmosis, as some of my students initially believe.

But, as a course that I teach carries on, a revelation occurs. Some students gradually become

aware of why the mantra is written on every handout, and even tell me in person, that the only

way to master mathematics is through *practice, practice, practice . . .* I sit back and smile,

because some students finally get it.

Right from the start as an instructor, when students discussed their homework solutions during my office hours or when I marked their term tests and final examinations, I noticed that they struggled with remembering and understanding various concepts and notation. To alleviate this struggle, I tried on my own to come up with relatable, yet fun and entertaining, expressions using references close to my students' experiences. I kept iterating these expressions during classroom time. After a while, I noticed that my students began speaking like me, using my expressions, while deriving correctly a solution to a problem. At the end of a course, some students mentioned in my teaching evaluations and personalized 'thank you' emails how helpful my mnemonics were helpful for recalling a concept they needed on a term test. I believe that my strategy of iterating of relatable expressions is something that I picked up from practicing yoga. My yoga instructors repeatedly reminded us of simple things that are hard to actually master or live by (e.g. "you must be the change that you want to see"). After hearing several times and internalizing those simple things, certain life challenges became easier and less stressful to handle. Subconsciously, the repetition of expressions spilled over into my teaching of mathematics. The use of fun mnemonics transformed abstract concepts or a bunch of numbers or variables to solve for into something that students are more comfortable with and will recall as they *practice, practice, practice…*

Any instructor can create their own simple mnemonics to help students remember abstract concepts. I will share with you a few of my own that I created myself. No, I do not rap or sing, because I sound like a frog. I enthusiastically and passionately recite the mnemonics to my students. When integrating a power function, I say: "add one to the power, bring THAT power down" (this feels like a mantra; after all, a mantra *is a formula*, albeit a secret one). After students hear this "mantra" several times and I advise them to repeat the mantra as they study,

they do seem able to recall what to do when they have to integrate a power function. The next example relates to finding the domain of a rational function. If a rational function has a value that makes the denominator equal to zero, (division by zero is a major sacrilege in mathematics), then I say: "You can't have zero in the basement (aka the denominator of the rational function) or else you will have 99 problems and …". Students laugh at the Jay-Z reference, because many know the song. This helps them remember never to divide by zero (or else …). My last example is about the natural exponential function, which involves a mathematical constant *e* which has some special properties. I mention that the number *e* is a reminder that this is a very *e*gotistical function. Whenever the natural exponential function is entertained with the derivative or integral, it likes to appear as itself in the result. Then, to explain a related algorithm, I will say: "Half the battle is to rewrite the egotistical function, and the other half is to finish off the differentiation (or integration)." Lo and behold, students become mathematics warriors when differentiating or integrating that *e*gotistical function.

By using mnemonics, possibly with pop culture references, when explaining how to successfully solve mathematics problems, I help students slowly realize that mathematics can be less "threatening" and more enjoyable to learn. As well, I encourage students to create their own mnemonics to help them recall various facts and ideas in their studies and everyday lives. Needless to say, my teaching approach might not appeal to every student – getting to know your audience is important when teaching. Because of the diverse student population, not every student listens to Jay-Z or gets a pop culture reference that I associate mathematical objects with. Thus, as I tailor more mnemonics for the courses that I teach, I have to find a balance so that the references are fun and inclusive, yet formal enough not to threaten the rigour and structure in mathematics.

I hope that by sharing my innovative journey of creating fun and entertaining mnemonics to slightly improve the students' first-year experience with mathematics courses, I might inspire other instructors, especially new ones, to try the same. I completely understand how it is to teach a subject that students find difficult, coupled with the usual constraints of fixed course curriculum, large classroom sizes, and diverse student backgrounds. Perhaps my most important message to my colleague instructors is the following -- in spite of all constrains imposed on your classroom instruction, there is still space for small (in mathematics, my mantra for small is "epsilon"), but significant and meaningful, changes. Not only will your teaching become more enjoyable and gratifying, but it will also resonate with your students, who will appreciate your genuine, innovative, and creative efforts. Students will notice that you care and are trying to help them through their, often challenging, journey. In the near future, I plan to reconstruct how I host my office hours. It will be a dedicated time and space where students will gather to work together on homework questions in my presence as a facilitator and will share their studying tips, and of course, the mnemonics they use or have created themselves. I strongly believe that there are many benefits of a "human" approach when teaching. At the end of the day, my objective as an instructor is to make first-year mathematics (which is not fun, and often an ordeal for many students) fun!