Having to work so hard that semester and develop a thick skin for feeling stupid all the time in a math course really helped me in my career. I don't think mathematics was ever "easy" for me again after I got to college; it was always a struggle. College math courses were all hard, graduate school was hard, and researching and writing my thesis was hard, too. But at each step, it was a struggle that I loved working through. I didn't mind being stuck and feeling dumb. I knew I could get through it if I kept plugging away. In today's language, I would say that I was lucky to have formed a "growth mindset" about learning math—I was willing to work on hard problems to find success—rather than a "fixed mindset," where I judged myself harshly when I didn't know something. To this day, I still benefit from this mindset, and I've basically made a career out of trying new things that I don't know anything about. It's in the process of making mistakes and figuring out how to make progress where the real fun begins.

Laura Taalman

Credits

Author photo is courtesy of Laura Taalman.

The Unnecessary Struggle of Self-Mandated Isolation

Alicia Prieto-Langarica

Graduate school is hard. Most people will agree with that statement. However, what makes graduate school hard can vary from student to student. I was very fortunate to be immersed in mathematics from a very young age. I was a participant in the Mathematical Olympiad since the age of thirteen. Throughout my time at the Olympiads, I was exposed to formal mathematics, the kind that one learns in most undergraduate programs. The Math Olympiad training sessions were demanding and many times very hard. After high school, I was admitted to one of the most intensive programs in mathematics in my home country of Mexico. The kinds of classes I was taking there look a lot more like graduate-level classes in many other institutions. So when making the transition to a mid-level PhD program, everything seemed to indicate that the struggle had passed.

I was lucky to be able to pass the first two preliminary exams before starting my PhD program, which allowed me to start doing research during my first semester for the first time in my career. Research is so different from classes. During my first research meeting, my advisor and his collaborator started describing a program that would act as a simulation for a biological system. They talked among themselves and discussed what they expected the program to do and how the simulations should look. Then my advisor turned to me and asked: Do you have any questions? I realized then that *I was supposed to come up with this program*!

Since I had never done research, I had a million questions, but I asked nothing. I nodded and went to my office. It was a Wednesday. In my mind, I convinced myself that research was like class, so when given an assignment, one has a week to complete it. That's how it works, right? The only problem was that I had never programmed. I wasn't even sure what "Matlab" looked like or where to find it. So, as a lot of people my age were starting to do at that time, I asked Google. I did not sleep too much that week. I spent 12–14 hours every day in front of the computer trying to teach myself how to program so I could turn in my "assignment" on time. I questioned all my life choices and wondered whether I was cut out for this.

I tried and tried and by the end of the weekend, I had nothing good. Since I had taken this as an assignment, I assumed I could not ask anyone for help and that my advisor had assigned this work because I was expected to be able to do it. You would think that since I was doing well in my classes I would not question my capacity, but you would be wrong. Impostor syndrome has wonderful ways of sneaking up on you when you least need it. It was a very long and short week. I cried a lot and worked a lot. I made a lot of mistakes that week, but none greater than isolating myself. Neither my friends, professor, family, nor my then-boyfriend knew I was going through this. I was too ashamed to admit that this was hard, and I was struggling.

By the next Wednesday meeting, I had a very terrible version of what my advisor and collaborator had been describing—pretty much a cartoon of what they wanted. I was so ashamed and nervous to show the program to my advisor. I was sure he was going to drop me as a student. Much to my surprise, when I presented my progress, they were both impressed and told me what I could change to make it better.

I have learned since then that research is not like a class and that research progress is just that: progress. It's not an assignment that you are supposed to finish from week to week. But more importantly than that, I have learned to ask for help, to admit when I am struggling, and to lean on my

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professors and peers. Because—you want to know a secret? Everybody struggles. Even when you see them doing well in class, or publishing papers, or succeeding in any way, that success was most probably built on tears and sweat.

Currently all my research projects are collaborations. Even most of my undergraduate student research happens in groups of students that I advise. I work with a wide variety of researchers and students in many different disciplines. We take advantage of each others' strengths to make up for each others' weaknesses. Many of my collaborators have also become my friends and they advise me in other areas of my professional life, such as teaching, mentoring students, and university service. I am (mostly) not ashamed of asking for help now or admitting that I don't understand something. My collaborators make me a better researcher, and I hope that my students learn about the power of collaboration as I have.

Alicia Prieto-Langarica

Credits

Author photo is courtesy of Alicia Prieto-Langarica.

A View of Mathematics from Behind the Veil

Robin Wilson

If we think of mathematics as a neutral science that is free of bias, it might be hard to comprehend how there is any other explanation for some groups' lack of success in mathematics other than the fact that they are less capable. But when we investigate how privilege plays out over the course of history, over one's lifetime, and over the course of one's day, we can see how one can be placed in a position to either access or be denied access to an equal chance at participation in society. And societal participation includes participation in the mathematical community. In her 2017 *Journal for Research in Mathematics Education* article "The Culture of Exclusion in Mathematics Education and its Persistence in Equity Oriented Teaching," Nicole Louie describes what she calls the "culture of exclusion" in the mathematics classroom:

> The restrictive and hierarchical culture that has historically dominated American mathematics education limits all students' access to rich and meaningful mathematics learning experiences and further limits many students' opportunities to develop identities as mathematically capable learners and thinkers.

One of my first memorable experiences with the culture of exclusion in the mathematical sciences happened in my transition from middle school to high school. My mother, being the proactive mom that she was, engaged me early on in extracurricular activities around mathematics and science. For instance, she enrolled me in a science-themed summer program in elementary school. Later, when I was in middle school, she got me involved in the Mathematics, Engineering, Science Achievement (MESA) Program. The summer after I took pre-algebra in eighth grade, my mom placed me in a self-paced algebra class that was offered at a local college and taught by a college instructor. I struggled through the course the entire summer and suffered the experience of always being the slowest one, but I survived the long days in class and the long bus rides home. When I went to my high school for the first time to meet my guidance counselor, who happened to be a middle-aged white person, he looked first at me, then at my record, and placed me into pre-algebra again. Despite my summer spent learning algebra, he convinced me that it was in my own best interest to repeat the pre-algebra course. My mother, on the other hand, upon learning about my schedule, marched up to the school the next day to demand that I be placed in the appropriate mathematics class—algebra.

It wasn't until I was an adult that I was able to reflect on the significance of this experience. If I hadn't been given the opportunity to take algebra as a freshman, I wouldn't have been able to take calculus in high school, and I'm not sure where I would be today. I'm sure it's possible that I would still have gone on to become a mathematician, but I would have followed a different path with more obstacles. What's of much bigger concern to me, though, is the realization that there have been many other students, like me, who were placed in mathematics courses below their ability level by this same counselor or by other staff in similar positions of power. These gatekeepers were unintentionally (or perhaps intentionally) underserving the education of so many students. Multiply that number across all the high schools in my home town of Sacramento, the state of California, and the country, and the impact is staggering.

My high school was a public one and was exposed to its share of violence; more than a handful of my peers were victims of gun violence and the prison-industrial complex. For these students, having greater access to mathematics

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