Education in an International Community Is a Solution: A Journey Inspired by Researchers on Different Continents

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I first fell in love with light when I was an undergraduate student at the Universidad Nacional de Colombia in Medellín. It was my third year in Physics Engineering. I wanted to combine my passion for scientific research with giving back to marginalized communities with less access to education. Then, only 37% of youth in Colombia attended university, and 50% of these did not finish their undergraduate degrees. (In the US, 64% of youth attend university, and 56% of these complete their degrees.) Yet, Colombia is a country with one of the world's highest primary and secondary school completion, and literacy rates; people there are renowned for research, resilience, and ingenuity. I knew, from my own experience growing up in a small town just outside of Medellín, the crucial importance of outreach to inspire high school students and their families to apply to university. I also knew how important mentorship—to complete university and to imagine a future career—is to young people born and raised in a country deemed in the 1990s as one of the most violent in the world. And, as in many places around the globe, this university outreach is especially important regarding science. I have come to realize that outreach is important not only to inspire young people to believe they can become scientists. It is important to open worlds of scientific research across institutional and geographical borders. When I began scientific research as an undergraduate, I already felt lucky to work in a corner of my desk on a theoretical question because I found it fascinating. My collaborations with scientists and institutions in five countries have since revealed to me that our research, especially when done in diverse global teams, has possibilities for groundbreaking science that can also improve human life and the natural environment in the 21st century and beyond.

At the beginning of my career, the words "optics" and "photonics" had no larger meaning to me than a particular view of Maxwell's equations (and the common relation to opticians). I wondered how it is possible to have so many worldwide organizations on this apparently narrow topic.

The first insight about a possible answer came from my first optics professor: Dr. Román Castañeda. In his lectures, he combined history, literature, poetry, and science. In the very first lecture he said: "At the end of this course, you will understand how it is possible to obtain darkness by adding light." He was referring to one of the most beautiful experiments in optics, performed by an almost forgotten scientist (and priest): Francesco Maria Grimaldi. Between the Italian Plague and the decline of the city of Bologna, he described (or not?) the first observation of interference. My professor's inspiring teaching opened worlds I otherwise would not have known existed, let alone had access to or believed I had the ability to enter. The beauty of light phenomena captivated me. It inspired me to find deeper explanations and farther frontiers. I was motivated by the opportunities provided by scientific societies.

Through optics, I had the chance to travel outside my country for the first time. I attended the SPIE Optics and Photonics conference in 2010 as the president of the SPIE student chapter at my university thanks to a student travel grant. Since that eye-opening conference, I have been fortunate to work in optics research, publications, and outreach in four languages and countries: Colombia, Germany, France, and the United States.

Building my network has been a pillar for the scholarships that enabled me to continue my research. Under a European Erasmus Mundus scholarship in Optics in Science and Technology (OpSciTech), I could see the differences and common ground among optics researchers in Germany and France, and the importance of bridging these differences and commonalities for research in a field that has global possibilities and implications. My master's research in each country enabled me to define a research

topic that requires this kind of bridging in what I had since learned is a huge field with many inter- and intra-disciplinary possibilities. Integrated optics, particularly silicon photonics, attracted my attention as a key enabling technology that has the potential to dominate the circuit industry in the coming years.

I had opportunities to be trained in experimental optics by some of the finest French researchers I know, in particular, Prof. Nicolas Dubreuil, Prof. Eric Cassan, and Dr. Laurent Vivien. From them, I have learned to appreciate the importance of failing: failing at experiments, failing at grant applications, and failing at visa paperwork. There is something very noble in defeat—to learn how to lose and to learn from the loss. We obtained world-class results that overshadow all of the failures that came from them. Stubbornness, perseverance, and discipline is the message I learned and want to transfer to my students. Stand firm when the hard times come.

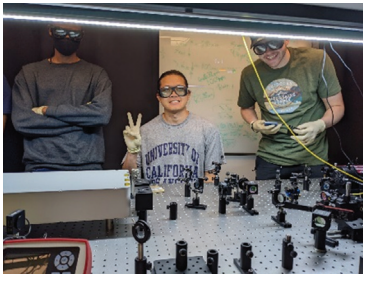
Since coming to the US, I have had the chance to work in one of the most prestigious universities, MIT, and to live in the rich academic environment that the US Northeast offers. Here, I reinforced my idea that our optics and photonics community is ready to face the challenges that this new century is bringing. A challenge that requires a new form of education connecting with "the Other." An education that requires fact checking and involves hands-on experiments.

Finally, and as a proposal, I want to highlight the unique bachelors' program in Photonics and Optical Engineering I have been co-building with great colleagues at Bridgewater State University (BSU) for three years. It is the first photonics-related engineering program in a public university in Massachusetts and one of the few in the country. I invite every researcher and student to contribute to a new education model for new technologies, where everyone belongs.

Core to my teaching is also inspiring youth and adults to believe they can be scientists, including doing research in photonics. I especially focus on organizing classes where

people who have traditionally had the least access to higher education in general and science/photonics in particular. This includes people of color, immigrants, low-income students, first-generation students, women, people who have lived through war, with diverse abilities, and who identify as LGBTQ+. Usually, these students are alight with passion for science and work with me to apply to university study and/or professional work in science. Little by little we are building a small and mighty diverse cohort of scientists studying photonics at BSU with the invaluable support of the SPIE community.

Joint bootcamp in integrated photonics between BSU and MIT with grads and undergrads from both institutions. Photo taken at the BSU Photonics and Optical Engineering labs.



Technician students from the joint program between Bridgewater State University and Stonehill College in a visit to one of the Optical Parametric Oscillators in the Photonics and Optical Engineering lab.