PHYSICS

Supporting Undergraduate Women in Physics and STEMP Fields Now and Throughout Their Careers

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Imposter syndrome, gender bias, socioeconomic disadvantages, racism: These are all big issues that carry with them a lot of negative connotations. When I think about physics, I like physics because it is an objective discipline. There is a right answer and it can be found using the right equations based on logical reasoning. Tackling a complex social problem such as the low percentage of women in STEMP (science, technology, engineering, mathematics and philosophy) is very different from the types of problems I am used to solving as a physicist. It seems like imposter syndrome, gender bias, socioeconomic disadvantages and racism are out of my scope of expertise and shouldn't have any place in a physics classroom, but unfortunately the opposite is true. These issues are amplified in STEMP fields, especially physics (i.e. less than 20% of physicists are female (Figure 1) and around 75% of physicists are white (Figure 2)). The failure of physics and other STEMP disciplines to diversify creates barriers for some of our students. Sadly these issues are not confined to the classroom, they linger and continue to dog certain groups throughout their career. I have learned of females who get internships or work on group projects in their graduate classes that are often given menial tasks such as cleaning up the workspace or recording the group's data, which do not help further their intellectual growth and decrease their interest in the subject material. These problems need to be tackled within the discipline because our majors need to be prepared both intellectually, socially and spiritually for the careers that await them. We in the physics discipline need to foster kinship and solidarity amongst our majors.

Jesuit education seeks more than just intellectual learning, focusing on the development of the "whole person." Apart from supporting students in acquiring knowledge in their disciplines, I believe that preparing students for their future by caring about their personal endeavors is an essential task. "Cura Personalis" is an important mission of the Jesuit education. I would like to support those of disadvantaged status who experience imposter syndrome, gender bias, socioeconomic disadvantages and racism. Although I have no solutions to end the struggle or even level the playing field, I have tried to forewarn our students so that they can forearm themselves.

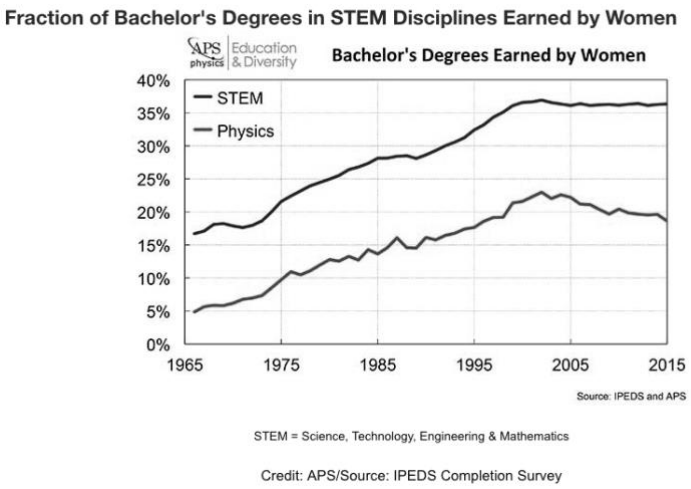

Figure 1. Until 2003 females obtaining physics degrees were on the rise, but since then the trend has reversed due to unknown factors. [1]

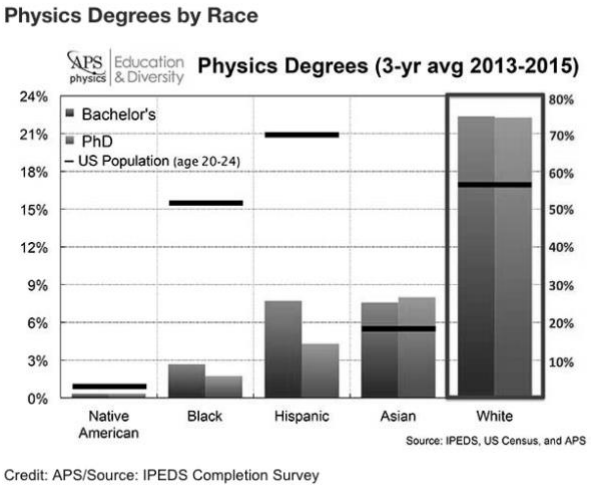

Figure 2. About 75% of physicists are white, which is far above the overall US population's percentage of people identifying as white. [1]

The first step in tackling these issues is to make our students aware that these issues exist and can affect them and/or their peers. In order to do this, I am part of a group of faculty in the STEMP (Science, Technology, Engineering, Mathematics and Philosophy) disciplines that arrange for guest speakers, plan workshops and accompany students to women specific conferences. Within this group, I took the lead on writing a grant proposal entitled "Xavier Pilot Program to Support Female Students in Science, Technology, Engineering, Mathematics, and Philosophy (STEMP)" to the Women of Excellence funding group at Xavier University. The project was funded for us to carry out activities throughout the 2017 academic year. Our main goal was to promote inclusivity and to encourage undergraduates, especially females, in disciplines with low female representation to remain in their chosen discipline and to succeed in their future careers

This past semester the #MeToo movement has brought a lot of attention to the treatment of women in business. It has been great for our society to finally bring attention to the abuse of power and how it disproportionately affects women. Recently on XU campus, the Gallagher Student Center has an art installation called "Racism, Sexism, Stereotypes: Then and Now," and the Ethics/Religion and Society (E/RS) Program has had several timely talks in the 2017/2018 academic year. It is beneficial to give students multiple opportunities to attend such talks. However, I think in some instances it is more impactful for students to attend an event hosted by their disciplines because they can then see how it relates to their chosen career path.

I also believe that the best way to minimize the disadvantaged status of females is to educate male colleagues and students about the issue. We, therefore, invited both female and male students/colleagues to join in all the events that we arranged in order to promote "Solidarity & Kinship." Our invited speakers helped us raise awareness regarding women/minority issues in the workplace and society to a broader audience. From these events, I learned that students benefit from conferences where they can meet other women who currently are having the same experiences they are and from hearing speakers talk about their past experiences and how they persisted to eventually be successful in their chosen careers. This is an example of "kinship," where our students can readily identify with the speakers and learn from them. It is also important to include in the audience both males and females in and outside the STEMP fields. The goal is not to preach to the choir but to get everyone, most especially white men, to understand the issues of imposter syndrome, gender bias, socioeconomic disadvantages and racism so they can become part of the solution. This is an example of "solidarity", bringing everyone together in a common cause.

The WOX experience also allows me to take on leadership/management roles such as arranging for food and honorariums for all of our guests, setting the schedule and working out the agenda for our group meetings. I personally invited three of our the speakers to campus, helped arrange one of the workshops, supervised a female undergraduate in creating the group website and I accompanied a student to the Conference for Undergraduate Women in Physics where I served as a panelist on the Imposter Syndrome and Underrepresented Groups panels (Figure 3). As a group we have accompanied students to 3 conferences, invited 7 speakers who came to talk to students on campus, held 1 workshop and created a group website (https://www.xavier.edu/women-in-stemp/) over the past 18 months.

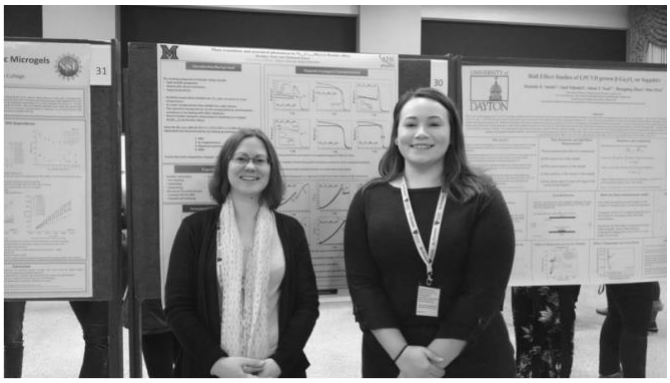

Figure 3. Dr. Wessels (left) from the Dept. of Physics and Brianna Lyons (right), a physics major, attend the poster session at the Conference for Undergraduate Women in Physics in Toledo, OH on Jan. 14th, 2018.

Most of the talks went well, with both female and male students in attendance. The feedback received was overwhelmingly positive. Seminar topics such as "imposter syndrome", "work/life balance", "how to handle difficult situations at work", and "when hard work is not enough", seem to resonate well with young undergraduates and faculty members alike. Sometimes faculty members who are not members of our group also attended the talks, leading to even more meaningful discussions of the topics with the invited speakers.

Students who attended the workshops and guest lectures and those who attended the conferences have expressed their gratitude. After the talks, some students approached the invited speakers to introduce themselves and make use of the opportunities to contact and build their networks. Some students who started working part time have personally communicated with the faculty how certain topics resonate with their work experiences and help them better cope with certain difficult emotions, as shown in the following examples of student testimonies. I am happy that I have provided outside classroom opportunities for students to learn and prepare for real life issues, and that the "Cura Personalis" and "Solidarity & Kinship" approaches have produced positive outcomes for our students.

> "*I just wanted to say how much I enjoyed the WOX seminars throughout the year. The Imposter Syndrome and Stereotype threat seminar was extremely interesting because I had never really heard about those topics before. I also enjoyed hearing about Work-Life balance and getting tips that will benefit me years down the road. The events were always insightful and I am grateful that I got a chance to attend these seminars. I know I have only mentioned a few of the seminars offered but really all of them were amazing and I really enjoyed having the opportunity to attend them*."

> "*Thank you for helping put together the work life balance talk. I found it very helpful*!"

"*I was wondering if you had the speaker's email. I would love to send her an email and thank her for speaking with us*."

"*I really enjoyed the conference! It was neat to hear talks given by successful women in physics because they aren't cookie cutter. I liked that some were working in corporate, some were working in academia, some had families, some didn't, etc. I also really appreciated them talking about what professors look for in graduate students and they also pushed REUs (Research Experience of Undergraduates) which is something I hadn't heard of before the trip and now I'm doing one this summer! Honestly, the event would be beneficial to any undergrad in physics but it was extra uplifting and motivating for women*."

"*The CUWiP conference is extremely helpful and eye opening. Before going there I was only aware of a few career options within the physics world, and afterward attending for the first time I decided to change my major into the Engineering Physics as I learned that I enjoyed that much more. The second time attending I was able to appreciate and understand the research that some of the other attendees were presenting and learn what others are doing in the field of physics. It's a great way to network early on and learn all about what is out there in order to make the best decision about your career. The seminars and talks are all very interesting and helpful, and the panel is always happy to answer any questions that you may have. I would absolutely recommend any young woman in the field of physics to attend this. It's very inspiring to see other successful women in physics. I've not been disappointed for the past two years that I've attended and can't wait to attend next year*."

All these experiences get incorporated into my advising and teaching, primarily through office hours when I have one on one contact with the students. When I recall the Courageous Conversations two day workshop that I attended in August of 2017, I found that the information I received was primarily introspective. It helped me to gain insight into how other people's experiences within similar social settings differed from my own. Since I have different experiences to draw from, I have found that my role to hear them out and try to direct the students to resources that may be helpful. Information for contacting our invited speakers, a list of resources available on our group's website, and material from our workshops, all become tools that I can use to better support my students moving forward.

[1] Physics Graphs & Statistics(2013-2015). Retrieved from: https://www.aps.org/programs/education/statistics/