Vigyan Vidushi 2020

A TIFR advanced program in physics for first-year MSc women students

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The gender gap in science, technology, engineering, and mathematics (STEM) fields is a matter of global concern. Recent data from the United Nations Educational, Scientific and Cultural Organization (UNESCO) from 2014 - 2016 reveals that only around 30% of all female students select STEM-related fields in higher education and that globally, female students' enrollment is particularly low (∼5%) in natural sciences, mathematics and statistics. In India, studies have revealed that the problem of gender imbalance in physics is acute. While some programs have been initiated by various science academies and governmental departments dealing with science and technology, the problem is complex and needs a multipronged approach. The Indian Physics Association has formed a Gender in Physics Working Group (GIPWG), to work toward achieving gender parity in physics research in India.

Tata Institute of Fundamental Research (TIFR), a premier research institute in India, recently started the "Vigyan Vidushi" (which translates to "learned woman scientist" in English) initiative, to address this problem at the point where women students are about to complete their first-year master's program in physics. These students are at the threshold of deciding whether or not to continue research towards their PhD, to look for other opportunities based on their education, or to leave their scientific pursuits altogether. It is a critical time to provide exposure to these students to advanced physics topics and research opportunities, and to encourage them to take up research in physics as a career option. The students in this program would have the opportunity to be taught, inspired, and mentored by successful women scientist role models.

The Vigyan Vidushi (VV) program was conceptualized by the physicists at TIFR, Mumbai, and Homi Bhabha Centre for Science Education (HBCSE), a center of TIFR that focuses on research in science education and is also the nodal centre for the science and mathematics olympiad activities in India. Originally planned to be a three-week residential program at HBCSE, VV2020 had to be converted to an online program at short notice (due to the Covid-19 pandemic). In this first year of the program, more than 650 applications from all over India were received, out of which 51 students (from 47 Indian institutions) were selected for participating in an interactive manner (over Zoom), while 335 were allowed to participate passively over YouTube live streaming. Questions by both sets of students were addressed during the lectures as well as later in the Question-Answer Forum.

The program was held from June 1-20, 2020. Five physics courses were taught: two long core courses (Quantum Mechanics, Statistical and Condensed Matter Physics) and three short topical courses (Introduction to Astronomy and Astrophysics, Experimental Techniques, Introduction to Nuclear and Particle Physics). A large percentage of each course was devoted to tutorials and problem solving. There were also seven Special Lectures by women physicists, with eminent researchers like Bimla Buti and Rohini Godbole among the speakers. The success of the public lectures may be gauged by the observation that these lectures have had an average viewership of about 1000 each on YouTube so far, and the numbers are rising.

In addition to the advanced physics courses during the day, there were sessions in the evenings devoted to special activities. These sessions introduced the students to

physics education research, and to future opportunities through career discussion sessions. The latter involved two interactive workshops outlining the opportunities and challenges in research careers as well as gender-specific issues. The interactive sessions with mentors were held in smaller groups (6-8 persons) to facilitate one-to-one discussions.

Apart from faculty members, postdocs and students from TIFR and its centers, many former women students of TIFR, currently pursuing research elsewhere (in India or abroad), also participated as tutors or mentors. It should be noted that the percentage of women involved in all of the academic as well as administrative aspects of the program was around 50% or sometimes even more.

The main feature of VV2020 was that it was held completely online; there were 110 Zoom sessions, with 57 live YouTube streams (including 8 public events). This was perhaps the first time such a summer school in basic sciences was held completely online, at least in India. Therefore, it was essential to create a new online infrastructure and processes. A Moodle platform was created for continuous interaction with the students, including the sharing of pedagogic material and answering questions even after the lectures. Procedures were adopted to encourage questions and feedback during the lecture. This included the presence of an academic coordinator and a technical coordinator during each lecture. The Moodle platform also provided a seamless connection to Zoom. Detailed guidelines were prepared and training sessions were held for instructors, tutors, academic coordinators, and technical coordinators. Connectivity of every student to the Zoom classroom was tested individually before the school began. The experience of holding this summer school should be useful in conducting regular teaching programs (such as the TIFR graduate school coursework) online, as may be necessary under the prevalent pandemic situation in the country.

Although an online program cannot replace a residential program (and the plan is to continue the VV series in future years as a residential program), the response of the students was quite encouraging. There were many physics questions during the lectures and tutorials, and there was strong feedback that the willingness of the instructors to answer questions was a major factor that was unfortunately often missing from general MSc teaching. In addition, many students expressed that the mentoring sessions helped them become more confident. Several of those students, who were earlier uncertain about their career after receiving their master's degrees, said that the career discussions with mentors of all ages have made them more inclined toward continuing for PhD studies.

The feedback from the students, organisers and other individuals involved in VV2020 suggests the need for continuing, expanding, and strengthening the Vigyan Vidushi program in future. We hope that, taking inspiration from this program, similar programs are initiated in other subjects, as well as in other institutions.

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