

Gender Diversity in Physics in India: Interventions So Far and Recommendations for the Future

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Abstract. Several governmental policy initiatives have already taken shape in India during the last few years to address the gender imbalance in the sciences. These initiatives and the barriers to gender inequity that persist in physics are summarized. Recommendations that build upon the positive impact of these initiatives and address the gaps are outlined. Several of the inferences presented use data for the sciences in general when physics-specific data are not available.

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There is growing recognition that diversity and inclusiveness in science practice are essential to maximize productivity and achieve excellence. However, gender diversity in both education and research in India, especially in the natural sciences, is far from satisfactory. The percentage of girls studying science at the college level has plateaued to significantly below 50%, albeit with large regional variations. The small rise between the undergraduate and master's levels notwithstanding [1], there continues to be a drastic drop in the fraction of women upward of the PhD level, and also a severe paucity of women at the senior-most policy- and decision-making levels [2].

INTERVENTIONS SO FAR

The practice of physics research and teaching in India largely occurs in institutions and universities funded by the government. Recently, there has been a significant number of governmental policy initiatives toward gender diversity in education/academia in general, and in the natural sciences in particular [2]. They include the following:

- A fellowship, which was instituted in 2003, for female scientists who take a break in their career: More than 850 fellowships were awarded as of March 2010, with approximately 200 in physics; approximately 30% of all awardees have obtained permanent employment in science.
- Skill-enhancement workshops for women: About 15 workshops have been organized countrywide so far.
- Infrastructure funding for innovative research in women's universities: This involves three-year grants awarded to five universities.
- Enactment of a national Task Force for Women in Science: The Task Force set up an information portal (indianwomenscientists.in) and commissioned (1) a biographical archive of female scientists and (2) an audit of science textbooks for gender bias. Its report analyzes available statistics, reports, surveys, and interviews of female scientists, and a comprehensive set of policy recommendations [3].

The Indian Academy of Sciences also established a Women in Science panel, which undertook several initiatives. In collaboration with social scientists, a survey was commissioned in which, for the first time, a significant number of scientifically trained but unemployed women were included.

Interestingly, it was found that as compared to women employed in science research as well as women with science training but employed in non-research areas, higher percentages of the unemployed scientifically trained women reported not only having young (0 to 5 years old) children and not receiving help with child care, but also having spouses with doctoral degrees working in science and in the same field as they are. In addition, they reported

that difficulty in finding jobs or advisors was the reason for breaks in career [4]. The report questions the myth of “one size fits all” and highlights the need for a multipronged approach to address gender imbalance.

The Women in Science panel also undertook a culture-building initiative in the form of *Lilavati's Daughters*, a volume of autobiographical essays from approximately 100 female scientists from a wide range of scientific disciplines and working environments [5]. The book has received much attention both nationally and internationally, in academia and in the media, with 7,000 copies distributed or sold. It has been translated into at least two regional languages, Marathi and Gujarati. In addition, some essays are being translated into Kannada, Hindi, Malayalam, and Tamil, and also serialized in regional newspapers. It is part of a program to gender sensitize policymakers. A shorter, somewhat different version has been brought out as *The Girl's Guide to a Life in Science*, which is directed toward younger readers who are on the threshold of choosing a career in science.

All of these initiatives are laudable efforts with very tangible outcomes, the result of the government responding to a vocal few from within the community of scientists. Future efforts need to build upon their positive impact.

PERSISTENT BARRIERS

Several barriers to achieving equity in physics persist, however. First, despite the stark gender imbalance of numbers in the community there is a widespread lack of acceptance that there exists gender inequity within science practice, and the imbalance is entirely attributed to society “outside” of it. Second, there are gaps between the intent and implementation of governmental initiatives; for example, the “skill building workshops only for women” clearly miss the important point that women lag behind not because of lack of caliber, but because they are discriminated against. Third, the negative impact of patrilocality in family decision making with regard to choice of subjects of study and of careers [6] continues to be significant. Finally, it has been argued that there may be paradigms embedded or hidden in the practice of science that contribute to gender inequity [7].

RECOMMENDATIONS FOR THE FUTURE

In order for interventionist policies to be effective, it is extremely important that diverse players are involved in both their design and their implementation. All the above barriers have cultural roots; therefore, cultural change must be the long-term goal. It follows that gender sensitization of male and female scientists, especially at the managerial levels, is critical, perhaps through regular and mandatory workshops. Accountability and transparency in institutional governance will help free governance of stereotyping and prejudice, and will thus automatically address gender bias. The long-term consequences of policies on the cultural gender divide need to be rigorously assessed, which particularly implies looking critically at initiatives that merely seek to “level the playing field.”

Finally, social scientists should be deeply involved in the evaluation of both processes as well as outcomes, and physics institutions should be opened to mechanisms that explore hidden detrimental paradigms within institutional practice. The time is also ripe to attempt gender mainstreaming (i.e., mandatory assessment of all policies to ensure that they are freed of hidden biases) to complement current initiatives. It is strongly recommended that a committee be established to evaluate the interventions undertaken so far and to suggest ways to implement the above steps. It is also important that the Indian physics community puts in place mechanisms to implement the resolutions of the IUPAP, and also initiates surveys of physics practice in India.

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