

Mitigating the male stereotype of science

The capabilities¹ and effectiveness² of women as scientists continue to be doubted amongst the male-dominated scientific community. There is no scientific basis to these perceptions as research disproves them³. A common perception is that women publish less and that the quality of their work is often questionable. Hasan *et al.*⁴ conclude that the quality of research by female research scholars is at par with that of their male counterparts and the quantum is commensurate with their proportion. Another widely held notion is that women are unable to devote adequate time to research because they have to manage both family and work. Kurup and Maithreyi⁵ demonstrate that more women scientists (47%) than men (34%) devote 40–60 hours per week and that 86% of women scientists can manage both family and work. Subtle, but deep rooted work place gender biases against women scientists seem to be a plausible explanation for the prevalence of such doubts.

Do such biases exist amongst school students? If yes, can they be mitigated to prevent workplace gender issues arising at a later stage when these students become part of scientific establishments? This study examines the perception of school going girls and boys on the participation of women in higher education in science and math and their contributions to science.

The study used a questionnaire-based survey methodology. A questionnaire with seven items referring to various aspects of students' interest towards science and math subjects was developed. The questions (multiple choice questions) referred to different characteristics of students' interest towards these subjects such as their liking for different subjects, wherein the students were

asked to indicate the subjects they liked, perception of gender-based pursuance of higher studies in science and math and the reasons for development of such opinions.

Some questions were framed such that the respondents were asked to give a reason only if they said 'yes' to the earlier question. For example when questioned 'Do you think that fewer girls than boys are interested in higher studies in science and math?', those who responded 'yes' were asked to specify the reason, for which four choices were given, namely: (a) girls are not good at science and math, (b) parents do not want them to study science and math, (c) study of science and math is difficult and girls want to study easier subjects, (d) any other reason (please specify). The students were allowed to give multiple reasons. In case of students' interest in different subjects, the students were given a multiple choice question where all the subjects in their curriculum were listed. The students were allowed to tick as many subjects as they preferred.

The questionnaire was administered in the classroom under personal supervision during the time period May to July 2017. The students answered the questionnaire post a discussion on inspiring stories of some of the Indian women who have made valuable contributions to science, including Anandibai Gopalrao Joshi – the first Indian woman to study abroad and to obtain a medical degree way back in 1886; Anna Modayil Mani – a physicist and a meteorologist who made pioneering contributions in meteorological instrumentation; Sudipta Sengupta – a geologist and one of the first two Indian women to set foot on Antarctica. The confidentiality of the answers was ensured. Hence the names of the schools

have not been disclosed in the study, to safeguard the privacy.

The study was carried out on a sample ($N = 259$) of pupils from four co-ed schools of Dehradun, Uttarakhand. Two of these are government aided (Kendriya Vidyalaya, Central Board of Secondary Education) while the other two are private schools (Council for the Indian School Certificate Examinations). Students from class 8 to 10 were chosen for the study, as this is when they start thinking about their subject choices post-class 10 and some of them choose to enter the field of science. The configuration of independent variables was as follows: 144 boys and 115 girls aged between 12 and 16 years. The main criteria for differentiating the subjects were gender and type of school (government and private).

The sample's representation on type of school and gender variable is given in Table 1.

Is science a male domain: The results indicate that overall greater proportion of boys than girls think that science is a male domain (Table 2). Majority of girls, 60%, do not consider the statement to be true, showing the girls' confidence in their science and math capabilities and the interest of the female gender in these subjects. Boys were much less optimistic about girls taking up higher studies in science and math. Majority of them, 50.7%, responded 'do not know', implying that they did not have an opinion on the issue. Out of the remaining, equal numbers agreed and disagreed with the statement.

Greater proportion of both girls and boys in private schools, compared to the respective gender in government schools think that science is a male domain. 28.4% of boys in private schools think of science as a male domain as against

Table 1. Sample's representation on type of school and gender variable (number of boys and girls)

Class	Government aided				Privately owned			
	School 1		School 2		School 1		School 2	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
8th	–	–	–	–	41	18	40	44
9th	15	13	21	19	–	–	–	–
10th	9	7	18	14	–	–	–	–

Table 2. Responses to the statement ‘Fewer girls than boys are interested in higher studies in science and math’

Percentage responding	Boys			Girls		
	Overall	Government	Private	Overall	Government	Private
Yes	23.6	17.5	28.4	13.9	9.4	17.7
No	23.6	27	21.0	60.0	52.8	66.1
Do not know	50.7	55.6	46.9	26.1	37.7	16.1

Percentages for Boys – Overall and Boys – Private do not add up to 100, as 3 boys from private schools did not answer this question. In other columns totals may not add up to exact 100% due to rounding off to first decimal place.

Table 3. Reasons given by students for their opinion that fewer girls than boys are interested in higher studies in science and math

Percentage of students responding yes to the questions in table 2, and giving	Boys			Girls		
	Overall	Government	Private	Overall	Government	Private
Reason 1	11.8	0	17.4	0	0	0
Reason 2	52.9	45.5	56.5	43.8	20	54.5
Reason 3	38.2	54.5	30.4	31.3	60	18.2
Not giving any reason	5.9	0	8.7	25	20	37.5

Figures in columns do not add up to 100 because students were allowed to give multiple reasons.

Reason 1: Girls are not good at science and math.

Reason 2: Parents do not want them to study science and math.

Reason 3: Study of science and math is difficult and girls want to study easier subjects.

Table 4. Percentage of students liking science and math subjects

Subject	Boys			Girls		
	Overall	Government	Private	Overall	Government	Private
Math	66	65.1	66.7	57.4	50.9	62.9
Physics	68.8	60.3	75.3	40.9	34	46.8
Chemistry	48.6	52.4	45.7	39.1	30.2	46.8
Biology	37.5	23.8	48.1	59.1	45.3	71

Figures in columns do not add up to 100 because students were allowed to give multiple likings.

17.5% boys in government schools. The corresponding percentages for girls are 17.7% and 9.4%.

Majority of the ‘yes’ respondents, i.e. students who perceived that fewer girls than boys are interested in higher studies in science and math – boys 52.9% and girls 43.8% – opined that parents did not want girls to do so (Table 3). Significant proportion of girls and boys, 31.3% and 38.2% respectively, believe that the study of science and math is difficult and girls want to study easier subjects. In government schools the most common reason cited is reason 3 – 54.5% of boys and 60% of girls. In private schools reason 2 has been cited as the most common reason – 56.5% of boys and 54.5% of girls. What is striking is that 60% of the girls in the government schools, who think that science is a male domain, think that study of science and math is difficult

and girls want to study easier subjects, whereas the figure is only 18.2% for private schools.

Do subject likings depend on gender: Greater proportion of boys than girls like math, physics and chemistry, whereas the reverse is true for biology (Table 4). It is interesting to note that a significantly greater proportion of girls in private schools, compared to girls in government schools, like science and math subjects. This indicates that the girls in private schools are more motivated towards science and math than those in the government schools. Similar trend is noticed for boys except in chemistry.

The survey results show that the male stereotype of science starts taking root, even before students enter the specialized streams of science, commerce and humanities. This is reflected in less than a quarter of the boys having a favourable

perception of women opting for higher studies in science and math as against girls, a majority of who have a positive view. However, as more than 50% of boys and more than 25% of girls have not yet formed an opinion, addressing this issue at school can help bring about a significant positive change in the male stereotype of science. Making boys aware of the capabilities and interest of girls in science and math can make them more accepting of girls in the study and practice of science and math. Over a period of time this could create a generation of male scientists who have a welcoming and accepting approach towards female scientists, helping address many of the workplace gender biases at the male-dominated scientific institutions. Girls are more confident of their abilities in science and math, and this should be positively reinforced, to further improve

Table 5. Students' response to statements related to contributions of women in science

Percentage of students opting for	Boys			Girls		
	Overall	Government	Private	Overall	Government	Private
Statement 1	80.6	87.3	75.3	75.7	86.8	66.1
Statement 2	49.3	54.0	45.7	48.7	50.9	46.8
Statement 3	60.4	71.4	51.9	73.9	71.7	75.8

Figures in columns do not add up to 100 because students were allowed to tick multiple statements.

Statement 1: This was the first time someone spoke to me about women scientists and their achievements.

Statement 2: Before this session, I did not realize that women scientists have contributed so much to science.

Statement 3: After this session I want to learn more about other women scientists.

on their healthy presence in higher education in science.

Survey responses highlight the important roles that schools and parents have in encouraging more students, specially girls towards science. Parents need to be sensitized to be more supportive of their daughter's interests in science and math.

The differences in the responses of students from government and private school, for both boys and girls, indicate that the school and perhaps the socio-economic background of the students play an important role in shaping the students' perception of women in science. Having a more encouraging environment towards science at school can help mitigate male stereotype of science, as well as encourage more students to take up higher studies in science and math.

The positive outcome that can be achieved by sensitizing school children on the achievements and contributions of women in science is corroborated by the students' response to the discussion on inspiring stories of some of the Indian women scientists (Table 5). Almost half of the students, 49.3% of boys and 48.7% of girls, indicated that before the

interaction, they did not realize that Indian women scientists had contributed a lot to science. 60.4% of boys and 73.9% of girls were keen to learn more about women scientists, showing that the students respond well to awareness interventions in an interactive format. Currently this is not happening in a systematic manner. 80.6% of the boys and 75.7% of girls responded that this was the first time someone spoke to them about women scientists and their achievements.

To summarize, the survey results showed that the gender stereotype of science starts taking root at the school level itself, especially amongst boys. Girls are much more confident of the capability and interest of their gender in pursuing higher education in science and math. However, the silver lining is that the rather intuitive and simple solution of spreading greater awareness on achievements of women scientists amongst school students can help address the stereotype. A good starting point for this could be to make the study of contribution of women to science through discussions and project work, a compulsory

part of the school curriculum in middle school.

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Ethulia gracilis Delile (Asteraceae), a new weed record for India

Asteraceae is the second largest angiosperm family after Orchidaceae with *ca* 1,623 genera, *ca* 24,700 species¹. Many species of Asteraceae are weeds in cultivated fields as well as forest areas. Some of them are aggressive invasive weeds, viz. species of *Acanthospermum* Schrank, *Ageratum* L., *Ambrosia* L., *Bidens* L., *Chromolaena* DC., *Eupatorium* L., *Parthenium* L., *Synedrella* Gaertn., *Wedelia* Jacq., etc. Many of them seriously affect the native or local plant biodiversity, human health and crop productivity.

Genus *Ethulia* L.f. (Greek *aitho*, *aithen* means 'to light up, to burn blaze' or *ethos* means 'habit usage manner' and *oulios* means 'baneful or destructive')² probably originated in Asia, but its centre of diversification is Africa³. It has about 19 species with 15 of them endemic to Tropical Africa⁴. So far in India, it is represented by two species *Ethulia conyzoides* L.f. distributed in Arunachal Pradesh, Assam, Sikkim and West Bengal⁵ and *Ethulia megacephala* Sch. Bip. ex Miq., distributed in Eastern Himalaya

and North-East India⁶. *Ethulia gracilis* Delile is distributed in North Cameroon, Central African Republic, Chad, Sudan, Ethiopia, Uganda³ and China⁷.

During our survey of plants of Karnataka, we collected some interesting specimens of *Ethulia* L.f. from Nippani-Chikkodi road, Belgavi district. A critical study of these materials, could identify the same as *E. gracilis* Delile. The identity was further confirmed by M. Gilbert (Royal Botanic Gardens, Kew, UK). This is recorded for the first time in India.