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The STEM & Gender Issue

Breakthrough
25 years
RISING AGAINST GENDER-BASED VIOLENCE

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Breakthrough 25 years
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Meet The Contributors

Sohini Bhattacharya

Sohini Bhattacharya is the CEO of Breakthrough Trust who has worked in the development sector for more than 30 years. She also co-founded Sanhita Gender Resource Centre in 1996, and is a founding member of the Coalition for Good Schools Voices from the South – a collection of leading practitioners and influencers committed to delivering access to a safe learning environment for children across the Global South.

Protiva Kundu

Protiva Kundu has over 15 years of experience in the area of public policy research, engagement and capacity building on a wide range of issues at the national as well as the state level. She currently works as the Research Lead at the Centre for Budget and Governance Accountability (CBGA), a think tank based in New Delhi. Her areas of interest include social sector policy, public finance and gender. At CBGA, Protiva works on financing of education, gender and child responsive budgeting, early childhood education, education equity, and child protection. She has a PhD in Economics from Jawaharlal Nehru University, New Delhi.

VigyanShaala

Founded by Dr. Darshana Joshi and Dr. Vijay Venugopalan, VigyanShaala is a community science movement which aims to spread ambition and passion for science through a mentorship driven model. Through its programmes 'Rural Stem Champions', and 'Kalpana She for STEM' Vigyanshala is driving a movement for young people, especially girls, to be interested in STEM. Hands-on science through labs, real time experiments, doing and tinkering are key to Vigyanshala's philosophy.

Shalini

Shalini is a Hyderabad-based researcher who works in neuroscience. She studies the grasshopper nervous system to understand how similar interactions might happen in more complex systems like the human brain. Passionate about science and a believer in learning science the fun way, Shalini's enthusiasm encompasses into her research. She is critical of science's conservative spaces which do not allow for the presence of Dalit Bahujan and Adivasi women. She also questions science's ability to be inclusive to people other than men.

Editor's Note

Sohini Bhattacharya

My aunt spent many years trying to teach arithmetic to Minnie, my cousin. She felt that by breaking down problems into stories, Minnie would deal with numbers with ease and would not develop a fear of maths, common to many girls in India and beyond.

My aunt would start the story with two monkeys in a jungle trying to hatch a plot that needed more 'monkey power'. She would ask, "How many monkeys were in the jungle?"

Minnie would come back with an emphatic "Two!" The story would wind down with a surprise visit by three more monkeys joining them.

"How many monkeys are in the jungle now?" my aunt would ask. Minnie, sensing formula-based rules coming her way, responded with a teary three. The same story played out with other animals and by the time there were five monkeys in the jungle, Minnie would be in tears and the maths lesson would end in a mess. Minnie went on to become a great head teacher in a girls school ensuring her students had a less emotional encounter with maths.

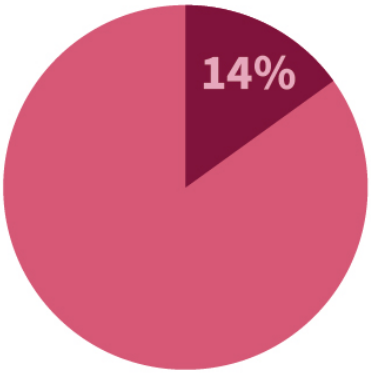
Words like aspirations and career sometimes disappear altogether from their vocabulary in remote rural areas as has been the Breakthrough experience. Toys and games overemphasise a domestic role. This also includes perpetuating the myth that education in science, technology, engineering and mathematics (STEM) is more for the male sex. Within schools, teachers sometimes play a conscious and unconscious role in perpetuating this myth. Early gender stereotyping in schools leads to different expectations from girls.

Boys have more STEM questions directed at them while girls are praised for diligence and hard work than their innate genius or skills. It is normal for girls to end up internalising that maths is dependent more on genius than hard work. Associating girls with "caring" leads them to choose careers that centre qualities like teaching, nursing, etc. The consequences are serious. Even in countries like the United States, despite nearly equivalent levels of achievement in maths between boys and girls through K-12, Bachelor's and Master's degrees, there are large gender differences in doctoral degree completion (less than 27% are female; National Science Foundation [NSF], 2020).

Globally, women constitute 43% of graduates in STEM fields. By contrast, in India, only about 14% of women are employed in STEM roles, according to a recent survey by the World Economic Forum.

India produces a significant number of female STEM graduates - around 40% of STEM graduates in India are women. However, many do not enter or remain in STEM careers. Women lack role models in this area, though there are now increasing examples of women in STEM highlighted by the media. On the whole, by excluding women from STEM, we not only perpetuate gender inequality but also deprive ourselves of

Gender stereotyping begins quite early in life. By the time girls are five or six, they begin to associate lesser and lesser brilliance or genius with their own sex.[1]



Only about 14% of women are employed in STEM roles in India.

unique insights and problem-solving abilities that women bring to the table.

An initial survey of the gender-related STEM landscape shows scant evidence of STEM efforts at the grassroots or local community level. Very little is known about the state of minorities and marginalised communities in STEM. While government initiatives do exist and policy efforts are underway to promote STEM as a whole, there are wider problems to contend with especially in terms of entrenched patriarchal mindsets and casteist attitudes towards science.

All this requires a multi-dimensional approach. To break the cycle of gender inequality in STEM education and careers, comprehensive efforts are needed from teachers, educators, parents, the media, and even from toy and game makers. All have a role to play.

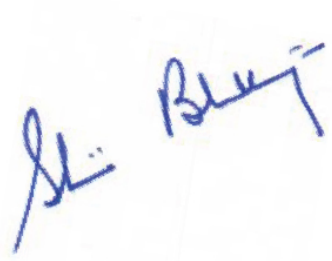
The present issue looks at some of these perspectives. In Issue 4 of Engendering Education, we profile individuals and organisations making a difference through their outlook and who present the possibility of alternatives as well as the larger policy level outlook.

The **Cover Story** by Protiva Kundu is titled 'Women in STEM - Status and Prospects from a Policy Perspective'. Kundu presents a detailed picture of STEM enrolment at the school and university level and explains the multi-pronged challenges that prevent women and girls from enrolling and continuing in science education, as well as the additional hurdles in pursuing science as a career. Kundu works as the Research Lead at the Centre for Budget and Governance Accountability (CBGA), a think tank based in New Delhi.

Our **Close Up** is a profile of VigyanShaala, an organisation promoting community science with mentorship at its core. VigyanShaala works with science students, especially females, who do not have access to guidance, networks,or resources. Through its flagship programmes, 'Rural STEM Champions' and 'Kalpana She for STEM', VigyanShaala ultimately aims "To turn tables into lab benches", and to encourage science students to reach higher levels of scientific and professional achievement.

Engendering Education's **Changemaker** for the issue is Shalini, a Hyderabad-based researcher. Her story features her role models, views on science and caste and vision of change. She works in neuroscience and studies the grasshopper nervous system to understand how similar interactions might happen in more complex systems like the human brain. Shalini's views on science are from a feminist and anti-caste perspective.

In sum, Issue 4 focuses on STEM and gender and the underlying issues of inequality and problems of access. Girls and women continue to be denied opportunities to make their mark in science. For some, getting a foot in the door is difficult while the scope for pursuing a full-fledged career in STEM is even more restricted.



Sohini Bhattacharya
Editor-in-Chief, *Engendering Education*

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Knowledge is power. Information is liberating. Education is the premise of progress, in every society, in every family.

Kofi Annan

Former Secretary-General of the United Nations

Children must be taught how to think, not what to think.

Margaret Mead

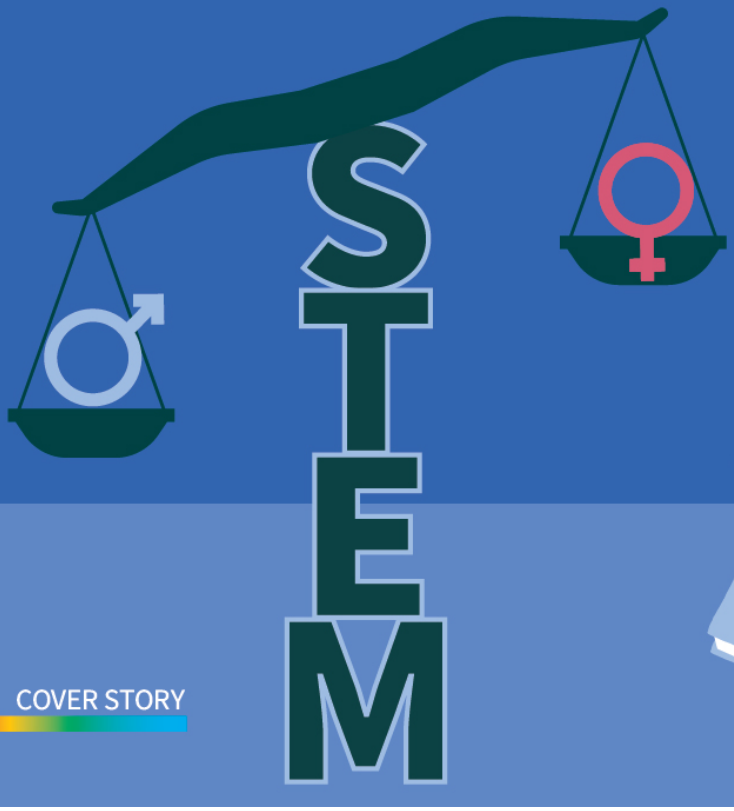
American Anthropologist

Women in STEM – Status and Prospects from a Policy Perspective

Protiva Kundu

Since its inception in 1901, the Nobel Prize has been awarded to just 65 women against 905 men.[2] The gender gap among Nobel laureates is even more stark in medicine, chemistry, and physics where women represent merely 6 per cent, 4 per cent and 2 per cent of the fraternity respectively.

The representation of women in scientific excellence is equally skewed in India.



3% or only 17 women out of 548 awardees have been the recipients of the Shanti Swarup Bhatnagar Prize for Science and Technology between 1958-2023.

The award, instituted by the Council of Scientific and Industrial Research (CSIR), is given to researchers in various categories in science.

Under-representation of women in STEM (Science, Technology, Engineering and Mathematics) is not restricted to the domain of awards, but resonates across education and career choices and has its roots in secondary schooling.

According to the ASER Report 2023 on education across Indian households,[3] girls enrolled in STEM comprise only around 28% of students in Class XI or above with a higher enrolment rate in private institutions. A recent analysis[4] of Class XI board examination results across 25 school boards showed that in 2023, girls comprised 45.5% of the total students who passed science examinations. This was higher than the corresponding figure of 32% in 2010.

The figures improve at the university level. According to the government's All India Survey on Higher Education 2021-22,[5] female students outnumber male students in the science stream for undergraduate, postgraduate, MPhil, and PhD programmes. However, of the total enrolment in STEM, female students are only 42% because of their relatively lower representation (30%) in engineering and technology. It is a matter of concern that female students continue to remain under-represented in institutions of national importance, including the Indian Institutes of Technology (IITs), Indian Institutes of Management (IIMs), the All-India Institutes of Medical Sciences and India's highest ranked universities.

Roots of the problem

Invisible norms and expectations dictating gender roles in society impacts education as well. The notion that boys are better than girls at science is a commonly held belief among both parents and teachers. A recent study in the UK found that 57% of teachers[6] have subconscious gender biases around STEM. Parallel narratives of feminine incompetence also shape women's perceptions and aversion to science.

STEM education is considered vital for economic prosperity and productivity, and critical for the 21st century job market. However, the pursuit of such education comes at a heftier cost compared to other subjects. Therefore, when it comes to spending on education, households prioritise STEM education for boys over girls. Even where access is equal, girls often face implicit hurdles of unequal access to uninterrupted study time, digital assets and skills which are irreplaceable for STEM education.

Socio-cultural and psychological obstacles for girls are not specific to the pursuit of STEM. However, larger constraints like inadequate policy measures, systemic bottlenecks and limited resource allocation further shrink the scope of women's participation.

Gender, Education and STEM: The policy environment

Girls have been long under-represented in STEM in India. Historically, several policies and programmes have tried to address these issues. The latest is the National Education Policy (NEP) 2020 which

emphasises integrating STEM education into the curriculum to foster students' critical thinking, problem-solving skills, and innovation. However, infrastructure requirements to implement such a measure are substantial and subsequent policy pronouncements on infrastructure have been largely silent or inadequate.

Where can policy makers invest in order to make STEM education more equitable and accessible? A review of existing policy measures of school education and the higher education sector shows us possible pathways.

School Education

Despite some progress, the current state of STEM education in schools presents a mixed picture. The foremost challenge is a lack of schools offering the science stream as an option of study at the secondary level. For instance, in Delhi the national capital, science is taught to Class XI and XII students in only one-third of government schools.[7]

Even where schools offer STEM, many are not equipped for properly teaching these subjects. For example, access to science labs is critical for providing students with practical and hands-on learning and interest building in science. The total number of secondary schools in 2021-22 was 276,840. Out of these, only 54% of schools have integrated science lab facilities. Information and Communication Technology (ICT) labs face a similar situation. The ICT lab scheme was launched in 2009 by the Ministry of Education to provide upper primary schools with access to computers and software. However, as of 2021-22, out of 3.89 lakh government schools with upper primary, secondary and higher secondary sections, only 14%[8] schools have a functional ICT lab. Further, only 24.2% government schools[9] have an internet connection. The metrics are worse for states like Bihar, Odisha and Uttar Pradesh at 5.9%, 8.1% and 8.8% respectively.

Shortage of teachers in schools is a chronic problem in India and the problem is more acute for science teachers in secondary schools. For example, in Bihar,[10] the subject-wise Pupil Teacher Ratio (PTR) at the secondary level is 552 for maths and 570 for science while the average PTR across all streams is 54. According to ASER 2023,[11] over 9% of teaching positions in STEM subjects have remained vacant, worsening up to 25% for states like Jharkhand and Assam. Moreover, existing teachers lack the necessary training and exposure to modern pedagogical approaches, cutting-edge technologies, and innovative teaching methodologies specific to STEM subjects. While these gaps impact STEM education in India generally, it disproportionately impacts[12] girls as they are primarily dependent on public provision of school education.

Samagra Shiksha Abhiyan (SMSA), the key flagship scheme for school education, focuses on improving STEM education in schools. This includes provisions for setting up STEM labs, recruiting specialized STEM teachers, teachers' training and leveraging technology for effective teaching. However, the programme has been under-funded since its inception.[13] Moreover, the unit cost proposed for specific interventions under SMSA including construction of science labs and ICT labs is very low and hence funds have remained largely unutilized.[14]

Some other initiatives by Government of India to improve education and promote scientific learning include Atal Tinkering Labs under the Atal Innovation Mission by NITI Aayog; Vigyan Jyoti to encourage high school girl students to opt for STEM and Pradhan Mantri Innovative Learning Program (DHRUV). The latter is a scholarship programme for talented students in science, mathematics, and performing arts. However, only meager budgetary support is available to make such objectives meaningful.

Higher education

Empowering women in science and technology and ensuring their full and equal participation is a core objective mentioned in the Science and Technology Policy (2003) of the Government of India. Accordingly, a number of schemes have been introduced, mostly in the form of government scholarships. The INSPIRE Fellowship, Fellowship for Higher Education offered by the Department of Science and Technology and the M K Bhan Young Researcher Fellowship Programme and the DBT-Junior Research Fellowship by Department of Biotechnology are a few such interventions. However, evidence[15] suggests that while enrolment of girls in STEM has improved over time, scholarship cover and budgetary support has witnessed a steady decline.

To encourage more female students in technology and engineering, the scheme of supernumerary seats for women continues to ensure a steady increase in the number of girls in the IITs. Enrolment has reached 20% in 2022-23[16] from 14% in 2018-19.

In addition, policy measures have been implemented to create an enabling environment for women students and faculties pursuing STEM. A few such examples are 'Consolidation of University Research for Innovation and Excellence in Women (CURIE)' for developing infrastructure and research facilities for women and Gender Advancement for Transforming Institutions (GATI) programme to transform institutions towards gender-sensitive approaches. To help working women, the UGC has proposed a Sakhi Niwas scheme that provides hostels for working women on university campuses for better educational and employment opportunities.

Degrees do not convert into careers

While girls are outperforming boys in academics, only a small percentage of women who do pursue science convert their education into careers. The number of women faculty members in academic and research institutions is not commensurate with the number of PhD holders. As per the report[17] of the National Task Force for Women in Science, only 15% of the Indian research and development workforce are women, while the global average is 30%.

Women are under-represented, underpaid and often unrecognised for their scientific achievements. Entrenched patriarchy in society often holds women

Only 15% of the Indian research and development workforce are women.

back from pursuing careers in science. By default, women are expected to assume the dual burden of managing home and work. While taking a career break for maternity, for example, they lose touch with cutting-edge research. This makes it difficult for women to make a comeback in scientific careers. Patriarchal attitudes in hiring practices or in the award of fellowships and grants etc., is also a widely prevalent phenomenon. A male-dominated work environment and gender insensitivity in the workplace are additional factors that women scientists deal with.

While a few government schemes have started offering incentives through maternity leave, age

relaxations in research positions or a gap year to accommodate women's requirements, these remain largely isolated efforts. To make the country's scientific ecosystem equitable, the representation and participation of women in public and scientific domains should be made a national priority.

Closing the gap from school to career advancement

Women-friendly policies for mainstreaming gender in STEM cannot be ignored any further. To increase the number of women in STEM and to build resilient societies in future, investing in young boys and girls is the first step.

The government should step up investment to create an enabling environment for girls to pursue STEM in schools and provide them with role models. It is important to create a supportive environment that spurs women to remain in STEM careers. There is an immediate need to invest in supporting infrastructure, incentivising institutions to promote gender equity, transparency in decision making etc., to bridge the persistent gender imbalance in STEM subjects. Gender-responsive budgeting and gender audit of institutions, scientific organisations etc., should be made compulsory to identify key bottlenecks and support resultant policy changes. This would ensure an enabling environment for women to pursue their dreams and would also enrich science in the long run.

*Protiva Kundu is with Centre for Budget and Governance Accountability (CBGA), New Delhi. She can be reached at protiva@cbgaindia.org.

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Turning Tables into Lab Benches

VigyanShaala

A quiet scientific revolution is being sparked in the lush, sprawling hills of Uttarakhand. Three remote towns (bordering Nepal) - Berinag, Champawat and Pithoragarh - are emerging as community science hubs through the efforts of VigyanShaala, an organization promoting community science with youth as the focus.

The labs are dedicated spaces in the premises of local colleges, allowing students who rarely have access to scientific infrastructure to tinker, experiment and create. The labs form the heart of the 'hands-on science' mission on which VigyanShaala is based. The fellows known as 'Rural STEM Champions' are young women and men being groomed as the innovators of the future.

VigyanShaala began with Dr. Darshana Joshi and Dr. Vijay Venugopalan as co-founders. The duo, both with PhDs in physics, began the organisation as a student-led volunteer group to bring hands-on science to classrooms.

Darshana is a first generation learner from Almora in Uttarakhand. She received scholarships and mentoring from Udayan Care, a Delhi-based NGO for higher studies , to pursue her PhD at the University of Cambridge, UK.

Darshana says : “We began with a fundamental concern about inequitable access to science.

> ***Approximately, two-thirds of women pursuing a STEM education do not end up in the workforce.***
>
> **Dr. Darshana Joshi**
> Co-Founder, VigyanShaala

Moreover, 60 per cent of colleges are in rural areas where students do not get a chance to conduct hands-on experiments due to lack of infrastructure and human resources.” The founders were cognizant that a masculine STEM culture, lack of practical knowledge and socio-cultural challenges prevent girls from embracing their full potential in STEM.

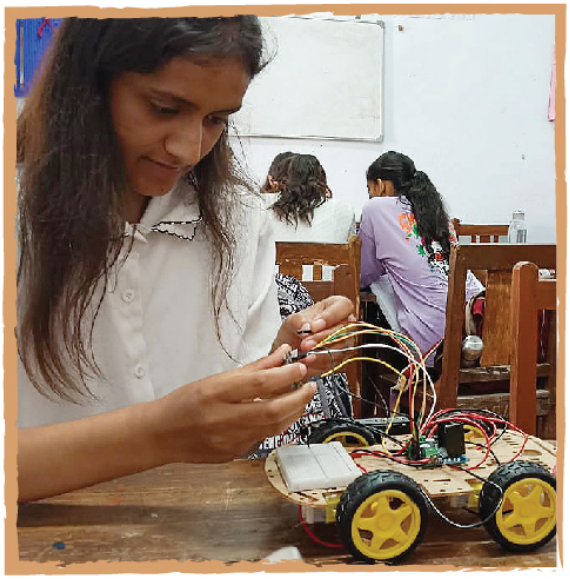
Registered in 2019, the organisation made its mission to spread interest and passion for STEM through online and physical spaces. VigyanShaala attempts to bring about change by aiding and supplementing government efforts in STEM education and plugging the gaps. In particular, it has made its impact felt in Uttarakhand and Telangana where it has partnered with the government in taking an ‘ecosystems approach’ to achieve impact at scale for bringing the most marginalised in the STEM workforce.

Such an approach bridges decision-makers and key stakeholders including government, corporates and technology partners with education practitioners such as universities, educators, students and also their families.

VigyanShaala’s approach and methodology for designing transformational programmes is rooted in data-driven solutions that make STEM opportunities free and accessible. VigyanShaala’s founders spent a year extensively researching STEM education disparities across India, visiting over 300 schools and 50 colleges. They met students, teachers, NGOs, government agencies and institutions working to promote science.

The organisation also undertook a comprehensive study in Uttarakhand to understand the main challenges in STEM education in state government schools and colleges. The survey included over 1500 students and 500 teachers from 150 schools and over 20 colleges. The results were worrying. Darshana elaborates: "There is an intergenerational fear of mathematics. It is acceptable for a majority of girls (more than 75%) to choose home science over mathematics at the class IX level. But this disadvantages them from building critical quantitative skills imperative for building a career in STEM.”

STEM Champion in Uttarakhand learns about drone technology



Fellows explore physics and robotics through hands-on experiments

Following the study, VigyanShaala followed up with the 'Rural STEM Champions' programme in Uttarakhand in 2021. Mentorship forms a core part of the initiative. Fellows are typically in the age group of 18-21 years, with selection taking place through an entrance examination, interviews and home visits to understand the socio-economic context and background of students to provide all-round support. A separate cut-off exists for economically weaker sections.

Fellows are encouraged to spend time in labs and immerse themselves in various experiments and STEM experiences. They receive laptops and stipends, mentoring by scientists to build cutting edge STEM skills, guidance to apply for Master's degrees in reputed colleges and STEM engagement training to share the joy of science with school students in their communities and villages. The 'Rural Stem Champions' programme has had 170 students since its inception with 118 females and 52 males and engaged over 5000 local school students with hands-on workshops. VigyanShaala also plans to support students with transport to their labs. Co-founder Vijay Venugopalan says: "Through culturally sensitive on-ground research, we observed that parents of female students hesitate to let their daughters participate in co-educational spaces such as our labs. To address this, we try to foster pride in their daughters' achievements, particularly when selected for a competitive fellowship that awards a laptop and monthly scholarships. These interactions help us build trust and reinforce the value of empowering young women in STEM."

Voices from VigyanShaala

24-year-old Diksha from Pithoragarh became part of the 'Rural Stem Champions' pre-programme pilot during the COVID-19 pandemic in 2020. Diksha hadn't decided on a career and was financing her studies by tutoring others. She was then studying for a Bachelor's degree in biological sciences.

The rural STEM initiative provided Diksha with grounding and direction as she interacted with various mentors and received guidance during monthly and weekly calls. She also attended the pilot cohort of 'Kalpana: She for STEM', an online programme that brought together 60 girls from 6 states.

"I learned how to use LinkedIn and how to make my CV. I also began conducting experiments in VigyanShaala's labs, learned soft skills and was introduced to coding," Diksha says. After her Bachelor's degree, guided by her mentor Dr Hemant Tripathi, Deeksha secured a yearlong paid internship with Dtime.ai (now rebranded as Dtechtive), a London-based climate think tank.

The first in her family to pursue a Master's degree; Diksha is currently pursuing an MSc in Conservation Practice from Ashoka Trust for Research in Ecology and the Environment (ATREE) in Bangalore.

Growing up in Uttarakhand, Diksha became aware that girls seeking opportunities in science have several hurdles to contend with. She says: "English language proficiency is not as good as the cities. Society tends to be hierarchical and patriarchal. Girls are expected to pursue home sciences and humanities and get married. They are pulled into household chores rather than being encouraged to pursue science practicals." Through her mentoring of younger students with VigyanShaala, Diksha is determined to change this and thus embodies empowerment and independence.

Diksha volunteers with the organisation's work in Uttarakhand. She also speaks to parents to convince them to allow their daughters to pursue science and attend practical experiments at VigyanShaala's labs.

She recounts how even a laptop in the house can bring gender dynamics into play. "Sometimes, brothers in the family end up using it. If the girls need to make a powerpoint presentation, I encourage them to do it on their own instead of taking help from the male members of the family."

She also helps out with the organization's 'Kalpana She for STEM' programme where she talks to young girls and helps them navigate their education and careers. This is her way of giving back to the organisation with whom she desires a lifelong bond.

Arohi Srivastava, a PhD in microbiology, provides online mentoring to the Rural STEM fellows. A part of her work involves encouraging students to embrace lab tools and lab-based projects. Having received mentorship late in life, Arohi points to the importance of early mentoring. "It is very valuable to receive the right guidance at the right time. Mentoring students in the age bracket of 19-25 gave me an opportunity to understand their needs as well," Arohi says.

In general, getting more students to participate in science is an uphill task in Uttarakhand. Power cuts, hilly terrain and commuting expenses deter students from pursuing science. Boys have to confront norms and conditioning such as tending to agricultural work at home or playing cricket till late in the evening. "When it is harvest or cropping season, they skip coming to labs. For them, the focus is still government jobs which carry social prestige," she adds. VigyanShaala plans to expand the initiative to other Himalayan states such as Jammu & Kashmir and Arunachal Pradesh.

She for STEM

'Kalpana She For STEM' is VigyanShaala's other important initiative and flagship programme which was started during the COVID-19 pandemic. It was envisaged as a pan-India community of girls in STEM who were connected with global mentors for guidance and direction.

The initiative has reached 8,000 plus female students enrolled from across the country and 300 plus global mentors. 'Kalpana She For STEM' enhances women's access to scientific opportunities and exposure to a wider range of role models and careers.

Students from roughly 15 South Asian and African countries have also been participants in 'Kalpana She for STEM', which is currently a two-stage program. In the incubator phase, large groups receive 25 plus hours of live mentoring. There are additional pre-recorded sessions and assignment feedback sessions as well as AMAs (ask me anything) sessions geared at career readiness. This is followed by the accelerator phase where fellows receive over 100 hours of personalised mentoring and project-based internships.

The mentoring curriculum is designed and delivered by global scientists and STEM professionals in active partnership with the mentees. With a blend of mentoring, career coaching, self-efficacy strengthening, interactions with global women leaders in STEM, and real-world project internships, VigyanShaala is helping young girls realize their dreams of building fulfilling STEM careers. The organization has been able to enlist support from a number of donors to fulfill its objectives.

> ***The vision is to scale up to 100,000 girls and 10,000 mentors and turn tables into lab benches and bring in at least 1000 rural colleges onto the research map of India.***
>
> **Dr. Darshana Joshi**
> Co-Founder, VigyanShaala

Science Can be Fun but is a Conservative Space

Shalini

Shalini “a Hyderabadi at heart” is currently a researcher in a neuroscience lab and studies the grasshopper nervous system to understand how similar interactions might happen in more complex systems like the human brain. She is especially interested in the shape, structure, connectivity and function of neurons in the grasshopper’s brain and understanding how these neural circuits affect their behaviours. Shalini’s views on science are from a feminist and anti-caste perspective.

What got you interested in studying science and who were your role models or inspirations?

In Telugu families, biology or maths is usually pre-decided as a career even when the child is a newborn. I was supposed to be the science/biology student at home. My father taught me maths and my mother taught me biology. My interest in biology started with picking flowers, drawing and filling colours as a child with my mother. I learned to draw, make rangoli, stitch embroidery, and cook with my mother and her sisters. All this art which I learned at home is also filled with patterns from nature/biology, like plants, leaves, flowers, animals, and humans.

I was good with numbers. I had a good computer science teacher. He would encourage me if I completed tasks like printing a calculation using computer commands. I would then be encouraged to do the same program in fewer steps the next time. We learned different ways of printing numbers, squares and series. All this was a lot of fun.

My house was filled with people who supported and encouraged my education. I was inspired to study biology at home and by my school teachers. My school taught me how to think and ask questions. There was no unnecessary mugging.

Then, while doing BSc, I had a few good teachers for microbiology and genetics. These teachers motivated me to think, imagine, and do better.

> ***Science is fun. It brings the excitement of solving puzzles.***
>
> **Shalini**

What drew you towards neuroscience?

After Class XII, I got around to thinking about a specialisation I would like to follow or pursue. Friends and classmates who wanted to pursue MBBS (medicine) wanted to study specialisation of eyes or the heart.

Around then, I was thinking about the themes of the brain, mind and heart. I realized that there aren't enough people who work on the brain. But there were no undergraduate courses for neuroscience.

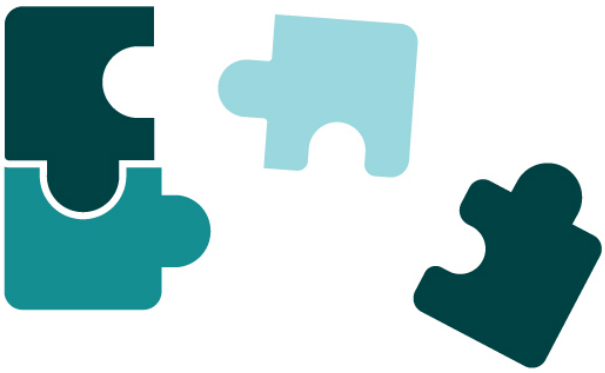
I opted for the next best thing at the time - microbiology, genetics and chemistry. All adults in my family have genetic issues like diabetes, hypertension, etc. It was very natural for me to want to understand genes.

At the Master's level, there were still no courses in neurosciences. So, I studied biochemistry instead. Microbiology, genetics and biochemistry together form the basics of biotechnology, which is a great knowledge-based skill to have.

Finally, after my master's, I could enter the field of neurosciences for research. I began working in labs where I learned how genes affect neurons and how these neurons in turn affect behavior. This was eye-opening and spectacularly interesting for me.

Why study grasshoppers?

I study grasshoppers because no one has ethical clearance to dissect and study human and vertebrate nervous systems. But this can be done with insects. Grasshoppers become adults very fast, in almost a month. They're easy to maintain and breed in the lab. The grasshopper serves as a good model organism to study insect behaviours and the function of neurons using electrophysiology techniques.



Also, why explore simpler systems? Because we assume that our own brains have evolved from these simpler systems. Representations of the same network are much more complicated in a human brain than in a grasshopper's brain.

I love exploring human interactions and communication and I also wonder how the brain behaves during these behaviors. I want to look at the same questions using insect nervous systems.

What were the various barriers that you had to tackle to hold your own in the field?

I had the barrier of interdisciplinary experiences. People say they are approachable but when you ask them, you are already expected to know things. Asking doubts is a little difficult.

They say knowledge should be free. But is it really the case? I have to outsmart other people without access to resources and networks. They always say they want someone who is already trained. People shouldn't be demonised for not knowing. The assumption is that if you are Dalit you cannot do anything. There is also immense pressure of time and competition.

If you really think we can't do anything, like speak in English or have good manners, then just arrange to send marginalised children to the finest finishing schools.

> ***You carry along a burden of identity wherever you go.***
>
> **Shalini**

The weight follows you wherever you go. It was tough to pursue neurogenetics in Hyderabad.

What are your hopes for the future and yourself ?

First, the basics must be right. Universities should have basic infrastructure for students to meet the high bar they expect. Housing, toilets and drinking water are basics and a must for students who shouldn't have to constantly adjust. Food, transport, hygiene, health facilities and a nurturing environment are needed at the very minimum. Our fellowship dues also must come on time. This itself will make an exponential change in the kind of research that will be produced in India.

But I am also a dreamer and have bigger dreams. Despite all my fears, I came so far. I also dream for my friends. The harder you try the luckier you get. I want people to know how special they are. One has to go beyond self doubt, be self-motivated or find the support that motivates you to try.

I love to daydream, watch movies and TV series, take pictures and videos and converse with friends in the presence of plants, sky, music and water bodies. It would be a dream come true to become a self-sufficient and happy constant learner, communicating and creating things, and simplifying the spectacular magic of life forms with everyone.

In your article The Production of Science for EPW (2017), you write that science bears a socio-economic connotation of masculinity. Can you explain?

I don't know if I'm a woman who will be acceptable in science. How many openly Dalit Adivasi Bahujan women scientists do we know in science? I'm not like regular women. I'm very loud and assertive. I speak my mind. People may think that I'm going to be messy and hard to work with.

Suppose if I cry, will it be ok? There is no room for emotions. If there's no room for emotions, you're asking [for] a manly woman to be working in this space. And a manly woman is not going to be understood socially as a very nice person. She will be called unwomanly. And then you're going to be given derogatory comments for not being a womanly woman. So it's a double-edged sword.

Science is a very conservative space. Traditional role models of women in science are of those who surrender themselves completely to the field.

The assumption is that I cannot be interested in anything other than science if I want to be a successful woman scientist. I cannot have a life of my own beyond this.

They expect a hundred per cent efficiency. What if I'm interested in other things as well?

What kind of a woman is acceptable in science and how do we imagine them?

What kind of women and persons do we imagine in science? Because thus far it's a certain kind of people who are doing it according to me. Will science be inclusive of all kinds of people?

There are multiple reasons to not openly say that you're a marginalised woman in these spaces because of the discrimination you might face. I don't know if I can declare that I'm a Dalit woman scientist. I want equal opportunity. You better give it to me. I feel I'll have to fight for it.

I am someone who can actually take on that fight. But what kind of a person do I become in this process? I'm more worried about that. I feel that maybe this is something which demotivates women from wanting to become scientists. I say this because you no longer have the energy to be so competitive and also deal with the task of solving scientific questions and research.

Notes

Bittu Karthik Kondaiah, Shalini Mahadev, Maranatha Grace Tham Wahlang (2017). The Production of Science. Bearing Gender, Caste and more. Review of Women's Studies. Vol. 52, Issue No. 17, 29 Apr. Economic and Political Weekly.

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