Pioneering Minds: Indian Women in Mathematics

Dr. Indushri Patgiri

Abstract

An essential component of Indian intellectual tradition, mathematics is ingrained in both ancient writings and philosophical ideas. But in popular portrayals, women's contributions to this field have frequently been underrepresented. From historical pioneers to current research leaders, this article examines the accomplishments of early Indian women mathematicians. In order to honor their contribution to the development of mathematics in India, the article will highlight their hardships, innovations, and lasting contributions. These stories not only dispel historical gender stereotypes but also act as potent motivation for upcoming generations of female mathematicians.

Keywords: Women Mathematicians, Mathematics, Gender equity.

1. Introduction:

Mathematics, often hailed as the "Queen of Sciences," has long held a place of reverence in ancient Indian thought, with its profound beauty celebrated even in the sacred verses of the Vedas. Throughout history, India has been home to many brilliant minds who have significantly shaped the world of mathematics.

While the contributions of male mathematicians are widely acknowledged, it is equally inspiring to recognize the immense impact Indian women have made in this domain. Although women mathematicians in India only began to gain broader recognition in the twentieth century-and their numbers remain relatively the landscape is gradually evolving. Today, more and more women are stepping into the mathematical spotlight, making notable contributions across various subfields.

Interestingly, the presence of women in Indian mathematics is not just a modern development. Historical records reveal that a few exceptional women achieved prominence in mathematics even in ancient times, with their influence continuing into the nineteenth and early twentieth centuries. Their accomplishments serve as powerful reminders that, despite the historical and societal constraints placed upon them, women have long been part of India's mathematical heritage.

Overcoming barriers such as restricted educational access, social expectations, and systemic challenges, these pioneering women forged their own paths in a male-dominated field. Their remarkable contributions not only advanced mathematical knowledge but also paved the way for future generations of women scholars.

In this article, we bring to light the stories of some of these extraordinary Indian women whose passion for mathematics and dedication to research have left a lasting legacy. Their journeys continue to inspire, reminding us that with determination and intellect, no dream is too distant.

2. Historical Background:

The history of mathematics in India is full of depth and originality, with ancient thinkers making substantial contributions to disciplines like number theory, algebra, and geometry. Although the majority of historical narratives highlight the contributions of male mathematicians, there is evidence to show that women have been engaged in mathematical endeavours for ages. Social conventions in ancient and medieval India prevented many women from pursuing formal education, yet some succeeded, frequently in extraordinary ways. In the nineteenth and early twentieth centuries, educational reforms and nationalist organizations began to advocate for women's rights, resulting in a slow but considerable transition. This created limited but critical chances for women to pursue higher education, particularly in mathematics.

3. Some Prominent Indian Women Mathematicians:

3.1. *Shakuntala Devi:*

Shakuntala Devi, born in 1929 in Karnataka, India, was a renowned Indian mathematician known as the "human computer" due to her ability to perform extremely complex calculations in her head at a speed surpassing that of a modern computer. For example, she can multiply two 13-digit numbers in just 28 seconds! She wrote numerous books, including novels and works on mathematics and memory techniques. Some of her popular books are *Puzzles to Puzzle You, Super Memory: It Can Be Yours*, and *Mathability: Awaken the Math Genius in Your Child*. Besides math, she also explored astrology, crime fiction, and even entered politics. She openly supported LGBTQ rights. In her 1977 book *Figuring: The Joy of Numbers*, she shared some of her mental math methods.

At the age of 83, Shakuntala Devi passed away on April 21, 2013, leaving a legacy that motivates new mathematicians.

3.2. *Dr. Mangala Narlikar*

Mangala Narlikar, born in 1943 in Bombay, had a strong interest in mathematics and was an excellent student from an early age. In part, she chose to pursue an M.A. in mathematics since it gave her the freedom to pursue other interests like reading and painting. But the more she studied, the more she realized that although she loved pure mathematics, she was not familiar with its applications.

After becoming a research associate at the Tata Institute of Fundamental Research (TIFR), she departed to marry, prioritizing marriage in order to meet her parents' expectations. She embraced being a

housewife, which she adored, after she and her husband got back from Cambridge. This gave her a great opportunity to resume her studies after her spouse became a professor at TIFR. After starting to take lecture courses, she eventually joined the Analytic Number Theory group of Prof. Ramachandra.

She earned her Ph.D. in 1982, despite the difficulties of caring for her elderly in-laws and her small daughters. Later, she taught part-time in the Pune Department of Mathematics, worked as a pool officer at TIFR, and gave guest lectures at the University of Mumbai. She wrote a book to support her goal of helping youngsters overcome their phobia of mathematics since she was passionate about making the subject approachable and fun.

At the age of 80, Mangala Narlikar lost her life to cancer on 17 July 2023.

3.3. *Raman Parimala:*

Raman Parimala, born in 1948, grew up in a supportive and progressive family. From her school days, she showed a strong interest and talent in mathematics. She decided early on that she wanted to pursue a career in this field. At that time, most women were expected to become teachers or doctors, but her father encouraged her to follow her passion. She studied B.Sc. and M.Sc. from Madras University and Ph.D. from University of Bombay under the supervision of Prof. R. Sridharan. She completed postdoctoral research from the Ramanujan Institute. She went on to make important contributions to algebra by using number theory, algebraic geometry, and topology.

In 1987, Raman Parimala received India's highest science honor, the Shanti Swarup Bhatnagar Prize, in recognition of her outstanding contributions to mathematics. Parimala, a well-known member in the nation's mathematical community, is particularly renowned for her groundbreaking contributions to algebra. Her work on the quadratic analogue of Serre's conjecture, the triviality of principal homogeneous spaces of classical groups over fields of cohomological dimension 2, and the μ -invariant of p-adic function fields earned her the 2005 Academy of Sciences for the Developing World Mathematics Prize. At the Tata Institute of Fundamental Research (TIFR), she held the position of Professor. More women are now participating in mathematics because of her innovative efforts and inspiring leadership.

3.4. *Neena Gupta*

An accomplished mathematician, Neena Gupta was born in 1984 in Kolkata and later became an Associate Professor at ISI (Indian Statistical Institute) Kolkata's Theoretical Statistics and Mathematics Unit. Her exceptional contribution to algebraic geometry has earned her recognition. A well-known mathematician named Oscar Zariski proposed the Zariski Cancellation Problem in 1949. This conjecture would prove to be a difficult task for many years to come. She put an end to this 70-year-old conjecture in

2014. In 2014, Neena Gupta was honored by the Indian National Science Academy with the Young Scientist Award for her outstanding solution. In 2019, the Government of India granted her the coveted Shanti Swarup Bhatnagar Prize for her groundbreaking contribution to algebraic geometry. She was the only woman to receive this honor in the field of mathematical sciences and the youngest recipient overall. She also received the first Saraswathi Cowsik Medal from the TIFR Alumni Association in 2013 for her efforts. The Ramanujan Prize was given to Neena Gupta in 2022, making her the second Indian woman to receive it. She received the Nari Shakti Puraskar that year as well.

3.5. *Aparna Higgins*

A native of Mumbai, Higgins earned her Ph.D. from the University of Notre Dame in 1983 after graduating from the University of Mumbai in 1978. She has a reputation for encouraging undergraduates to do mathematical research. Although she specializes in universal algebra, she has recently turned her attention to graph theory, which includes line graphs and graph pebbling. She wrote research articles in graph theory and abstract algebra. She received the Deborah and Fraklin Haimo Award for Distinguished College or University Teaching of Mathematics in 1995, and the Mathematical Association of America recognized her contributions to undergraduate research with a Distinguished Teaching Award.

3.6. *Bhama Srinivasan*

Born in 1935, Bhama Srinivasan is well-known for her contributions to the representation theory of finite groups. She earned her Bachelor of Arts degree in 1954 and her Master of Science degree in 1955 from the University of Madras. She went to study for her doctorate in England. She led the Association for Women in Mathematics from 1981 to 1983 and was named the Noether Lecturer in 1990. Her position at the University of Illinois at Chicago is that of Professor Emerita. Five of her students have earned PhDs. In the fields of modular representation theory and Deligne–Lusztig theory, she and Paul Fong have co-authored several publications. In 2012, she received recognition as a Fellow of the American Mathematical Society. In 2017, five years later, she was one of the first people to be named a Fellow of the Association for Women in Mathematics. Her accomplishments also won her a spot in the Association for Women in Mathematics' special deck of playing cards honoring notable female mathematicians.

3.7. *Prof. Ajit Iqbal Singh*

Ajit Iqbal Singh was born in 1943. She received her B.A. and M.A. degrees in mathematics from the University of Delhi in 1965. She later earned a Ph.D. from the University of Cambridge. After earning her doctorate, she returned to India and became a faculty member at Hindu College, University of Delhi.

In addition to her teaching obligations, she was actively involved in research, particularly in the domains of functional and harmonic analysis. Throughout her academic career, she has held teaching and research posts at various notable institutions, including the University of Delhi, the University of Oregon in Eugene, the National Research Centre in Munich, and the University of Ohio.

As an Indian National Science Academy (INSA) Honorary Scientist, Ajit Iqbal Singh researched Quantum Information Theory. She also held several administrative positions on committees for the Department of Science and Technology (DST), the INSA, and the Council of Scientific and Industrial Research (CSIR). Her main scientific interests were linear operators, harmonic analysis, functional analysis, and Banach algebras. In 1999, she was made a Fellow of the Indian National Science Academy, as well as a Fellow of India's National Academy of Sciences. She was honored with various awards for her academic efforts, including the Rai Bahadur Brij Mohan Lal Saheb Gold Medal and the Ravi Kanta Devi Prize from the University of Delhi.

4. Future Scope:

The future is incredibly bright as the number of Indian women in mathematics keeps growing. These days, young women are more prepared to pursue professions in mathematical sciences thanks to increased access to high-quality education, research funding, mentorship, and international collaboration. An inclusive research environment is being promoted by initiatives by government agencies, professional associations, and university institutions.

When given the proper backing, Indian women may lead globally significant research, as seen by the experiences of women like Neena Gupta and Raman Parimala. The gender gap can be further closed by fostering role models, developing gender-sensitive academic policies, and increasing education at the local level. Indian women are positioned to influence the global mathematical discourse in the ensuing decades, in addition to being able to participate in it.

5. Conclusion:

The achievements of Indian women in mathematics are evidence of their determination, enthusiasm, and intelligence. These pioneers broke down barriers and made significant contributions to the mathematical sciences in spite of social pressures and historical constraints. Their stories are about bravery, determination, and the transformational potential of education, not simply about statistics and theorems.

It becomes essential to keep promoting a culture that values and encourages women in mathematics as we pay tribute to their legacy. By doing this, we guarantee that the next generation of

mathematicians, regardless of background, can dream large and accomplish even more, and that skill and curiosity are never hampered by gender.

Works cited:

Khanna, R. A journey of Indian women mathematicians. 2024

Sinha, N., & Mishra, N. A study on mathematicians of ancient India and their contributions. *International Journal of Humanities, Engineering, Science and Management*, *4*(2), 76-82. 2023

Sarkar, P., & Howlader. M. Women in mathematics: a study of the gender gap. *International Research Journal of Modernization in Engineering Technology and Science, India*. *4*, 1307-1312.

Shakuntala Devi strove to simplify Maths for students, The Hindu, 2013.

List of Fellows of the American Mathematical Society, 2013.