

Role of Women in Engineering

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Abstract

A comparison of facts and statistics from various resources proves the growing contribution of women in engineering and other technical fields across the globe. This paper holds some of the very inspiring women engineers from the past who fought against all the odd circumstances, changed the world with their inventions, and made society think the other way. This paper also covers all the hurdles that women have faced in the past and fought with to achieve their goals. To attain the full potential of a nation, it should improve the participation of more and more women in the fields of technology and engineering. This paper comes up with some of the effective ways that can be used to improve the statistics of women enrolment in engineering. We will also see the initiatives that have been taken by the government to empower women in the fields of technology and engineering.

Keywords- Engineering, Women Engineers, Gender Discrimination, Women Empowerment

INTRODUCTION

If we look at the history of women in engineering, then we find that even before the word “engineering” was coined in the 11th century, women were already contributing as designers and builders of machines all over the world.

Women all over the world faced many issues like male-dominated discipline, society stereotypes, inferior treatment at workplaces, dull images of the profession, etc., but they broke all the stigmas that stopped them from accomplishing their dreams and getting into technology and engineering [1]. We also need to look at how the culture in science and engineering developed and discuss how it can be an obstacle to women’s full participation [2]. It is very interesting to find that the anonymity women faced is finally lifting and

encouraging more women in the fields of engineering.

Data from MHRD has shown that there has been a tremendous increase in the number of females in engineering in India from 1950 to 2019. There were about 2 women to every 100 men in engineering (2%) in 1970-1971. The number of women has increased since then from 30 women to every 100 men (23% women of a total of 130 students) in 2000-2001. According to the All India Survey on Higher Education (AISHE 2010-11), total enrollment in engineering was 14.52 lakh, out of which 70.75% are male, and 28% are females [3]. According to AISHE (2018-2019), the total student enrolment in engineering was 38.52 lakh [4]. The share of male student enrolled in engineering and technology is 71.1%, whereas

female enrolment is 28.9%. These statistics are quite satisfying and reveal the fact that women participation in technical education has increased significantly.

According to the Women into Science and Engineering (WISE) Campaign, enrolment of women into engineering has almost doubled in the last few decades. Engineering being a very diversified and exciting field of study, has started attracting more and more women towards it with an array of thriving career opportunities. It is not only a course that focuses on just technical knowledge; instead, it works on the overall development of the students. Women get a very keen exposure to all the subjects and technologies taught to them during engineering that plays a very important role in deciding their career and their field of interest. Given equal opportunities, women can do wonders in the field of science and technology and contribute to the overall potential of the nation.

RELATED LITERATURE

Some inspiring figures from the past

Let us look at the history of some of the very successful women in engineering that have changed the world [5]:

Margaret E. Knight was a prominent female inventor in the 1800s and has accumulated 26 patents in her lifetime. She was the inventor of the flat bottom bag and also contributed to the advancements of the rotary engine. Margaret never worked for profit, but she was devoted to social well-being. After witnessing an accident in a cotton mill, she designed a solution to prevent the shuttle break in the machines, which saved the lives of her co-workers from getting injured. She created the first flat bottomed paper bag that we

still use today and made a machine to make the production more reasonable and faster. Her invention revolutionized the world and gave a more profound and easy way of production. Margaret faced plenty of preconceptions from many people because she was a female inventor and engineer, but she never let this hold her back and devoted her whole life to inventions.

Ada Lovelace was the “first computer programmer” she was a 19th century English mathematician and has developed the analytical engine with Charles Babbage. She was the first to recognize that machines can have more applications other than just calculations and designed the first algorithm that can be carried out by such a machine. She had a miserable childhood as her father left her when she was just 5 weeks old. She also got affected by various diseases that left her paralyzed for years. She faced so much criticism being a woman engineer, but she overlooked all of them and continued her work. Lovelace was such a dynamic ingenuity and dedicated her whole life to mathematics and sciences.

Katharine Burr Blodgett was born in 1898 and proved to be a blessing in the field of physics. She was a prominent inventor in the field of molecular engineering; she was able to develop films that were only a few molecules thick. She also invented films that significantly reduced the amount of light being reflected by them, which she applied to the lenses used in eyeglasses and cinematography. She also became the first woman in history to receive a PhD from the University of Cambridge. in physics Cambridge University. Katharine’s effort in the field of molecular engineering led to many technological inventions

that we still use today; the non-scratch camera and telescope lenses, Weather balloon technology, the non-reflecting store windows are all the results of Katharine's work.

A. Lalitha, born on 27 august 1979, is the first woman engineer of India [6]. She was barred from basic education in her childhood, whereas her brothers were taught to be engineers. She was married at the age of 15 and had her first child at 18. In few weeks, her husband died, and she decided that she will do something for her child rather than mourning her whole life and depending on others. After graduating from the University of Madras, she joined the Associated Electrical Industries and executed various programs. Lalitha assisted her father, who was an engineer to many of his inventions.

Her achievements were soon recognized globally, and she was invited to the First International Conference of Women Engineers and Scientists (ICWES) in New York. She is well known for her contribution to the electrical generators of the Bhakra Nangal Dam. She became a full member of the Council of the Institutions of Electrical Engineering (IEE)

Marissa Mayer is an American software engineer who is the first female engineer to join Google and very soon climbed the positions and became the vice president of Google search products. She declined a very high paying job to take a position in Google and became its 20th member in 1999. Her major contributions include the design of the Google homepage, Gmail, Chrome, etc. Later she joined Yahoo being its CEO, during this time; she became the first female CEO of a Fortune 500 company. She was ranked 6th under the 40 list and the 16th most powerful businesswoman globally.

Kalpana Chawla was born in 1962, Haryana, India; from her childhood itself, she was very fascinated by planes and flying [7]. She completed her bachelor's degree in aeronautical engineering from PEC Punjab and moved to the US for her further studies in 1982. There she acquired a dual Master's degree and then completed her PhD in Aerospace Engineering in 1988. She joined NASA Ames Research Center, where she researched vertical short take-off and landing concepts. After joining the NASA Astronaut Corps in March 1995, she was selected for her first flight in 1996. In 1997 she became the first Indian Women to fly in space. In 2001 she got her second flight, STS-107 crew.

She has been awarded various prestigious honors after her death in her second space travel. She made the world believe that women can do anything they wish to, and they should not be denied the opportunities. She opened the doors to many women by motivating them towards science and technology.

Padmasree Warrior, born in Andhra Pradesh, India, completed her bachelor's degree in chemical engineering from IIT Delhi in 1982, later she got her master's in chemical engineering from Cornell University in the US [8]. She joined Motorola in 1984 and worked there for 23 years, becoming the executive vice president in 2005.

In 2019 she started her entrepreneurial journey, Fable and is currently the founder, President and CEO of her venture, which is focused on improving cognitive fitness. Warrior has been awarded the title "Queen of the Electronic Car Biz" by Forbes magazine. She ranks 71 in the 100 most powerful women in the world.

All these personalities have struggled a lot, but their struggle and the prejudice that they faced never became a barrier to their dreams.

The hurdles women faced

We have seen the statistics that there has been an increase in the number of females in engineering since 1950, but the ratio to male and female engineers is not quite impressive. There are many reasons that have led to less enrolment of women in engineering, and we need to address them so that we could get the 100% out of a nation's potential [9]. Let us see some of the reasons that are addressed below:

- a) Male-dominated discipline
- b) Dull images of the profession
- c) Inferior treatment at workplaces
- d) Low wages
- e) Lack of inspiring models
- f) Early marriage of girls

When it comes to engineering, it has always been told that it is a man's thing women has nothing to do with that. This gender stereotype has contributed mainly to the under-representation of women in engineering. The demeaned representation of women in undergraduate programs ultimately leads to the underrepresentation of women in the scientific fields because undergraduate programs are considered as "the latest point of standard entry in scientific fields". There is an unconscious stereotype that also has a negative impact on the performance of women, which is revealed by The Implicit Test Association (IAT) [10]. As per the results of the IAT, more than half a million people from all over the world serendipitously connect men with science and women with arts. Even after entering into engineering, women face this

discrimination of inferior behaviour by the co-mates or the male faculties [10].

Women are expected to be less competent than men when it comes to performing "masculine jobs". Women are also paid less at the workplaces, are given more responsibilities and less appreciation than men. Women should be allowed a fair chance to do what they want. Research shows that even after completing engineering, most women do not go for higher education or offices to work. A major factor is a work-family conflict that leads to women leaving off their jobs and studies because some women find it very difficult to re-enter the field of engineering after having a break to raise their children or family [11].

Early marriages for women were a major cause for women not being able to participate in these fields. By the time women were just able to understand what was going around, they were married and burdened with lots of responsibilities which ultimately strangled their dreams [11].

Ways to Nurture more Women in Engineering

There are many ways we can improve the participation of women in the engineering field. Some of which are mentioned here:

- **Encourage more girls to participate in science fields:** It has been observed that women who are interested in science have a higher possibility of taking admission in engineering. And this has to be done from the base level itself by spreading awareness among women who are in the schools and developing their interest in these fields by informing them of the scope of engineering and motivating them towards this [12].

Regular counselling of women should be done from the school level itself, which can be done by organizing various awareness campaigns in the schools by the engineering institutes and making students aware of the potential of engineering and its benefits.

- **By showcasing the works or projects done by women to society:** This can be a very powerful way to empower girls in engineering; by showing their work and promoting their projects, we can gather confidence among women. This will also motivate other women in the field to keep moving forward. When the projects or works of women get showcased, they get motivated to do more, and more and it also helps them in identifying their true passion and potential.
- **Providing a friendly and hygienic environment at colleges and workplaces:** The underrepresentation of engineering itself among women is a major cause of less enrolment of women. It can be avoided by providing a friendly environment to women where they can cherish their dreams. We need to make women believe that the environment at engineering colleges and workplaces are friendly and healthy.
- **Effective addressing of harassment issues at colleges and workplaces:** Many institutions have already built women cell to address these issues, but their functioning is limited. The addressing of these issues should be at a speedy rate, and women should be made comfortable with the environment. The effective addressing of these issues will also reduce further harassments and make women feel comfortable with their environment and more productive.

- **Leveraging resources to promote women engineers:** Women participation can also be increased by providing them various resources, like financial support to women students, reserving seats for women in engineering institutes and establishing more women colleges in our country [13]. The Indian government is already doing a lot in this area by providing funds and scholarships to women and encouraging them to pursue higher studies. The Department of Science and Technology (DST) India helps the researchers and students financially and supports open access to all the scientific knowledge originated from the public-funded research in India. It also supports various researchers to attend conferences abroad and helps in their scientific experiments.

CONCLUSION

At present, women have already impoverished the stigmas and hurdles that stop them from achieving their dreams. Still, there is an initiative to be taken to make women aware of the technical fields in order to increase their participation. The world today has already stridden towards by taking various steps to improve the participation of women and spread awareness among them. There are many programs that are being launched internationally that aim to spread awareness among women and increase their participation in technical fields by offering them various opportunities where they can build their career.

Our country is vigorously launching schemes to do so; various IITs and NITs have reserved their seats for women so we can have more women in engineering. Not only IITs but other engineering colleges of the country have reserved seats for

women, have provided a friendly environment to women where they can groom their dreams [13]. In the last decade, there have been concerted efforts by the government of India to recognize and encourage women in the technical fields. There are a number of schemes that are undergoing since then. Some of which include:

- **Support to Training and Employment Program for Women (STEP):** This scheme has been administered by the ministry of India since 1986 and aims to provide skills that give employability to women and increase their competencies to become self-employed. Such schemes are eminent as these are provided to girls aged 16 or above and make them aware of the opportunities that can be availed [14].
- **Nari Shakti Puraskar:** This scheme was launched in the year 2015 to confer Nari Shakti Puruskaar to eminent women and institutions in recognition of their service towards the cause of women empowerment. That encourages women to participate in technical fields and make them believe that women are no less than men and can attain all heights [14].
- **Working Women Hostel:** This scheme aims to provide safe and conveniently located accommodations to those women who leave off their homes in search of work in other cities. This program promotes the safety concerns of women in their workplace cities and also provides daycare facility to their children wherever possible [14].
- **Mahila Shakti Kendra Scheme:** This scheme has been approved by the government of India for implementation during 2017-2018 till 2019-2020 to empower rural women by

making them capable with the help of various training programs and vocational skillset practices. This scheme mainly focuses on the 115 most backward districts of the country as part of the MSK block-level initiatives. This scheme provided an opportunity for volunteers to take part in the development process by bringing change in their own societies by ensuring that women are not left behind and are able to contribute equally to the nation's development.

- **Rajiv Gandhi Scheme for the Empowerment of Adolescent Girls:** It is an initiative launched in 2012 that target to empower adolescent girls. This scheme offers a complete package of assistance to girls aged between 10 and 19 by providing various services to help women become self-reliant, including nutritional supplementation and education [14].

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