Centre for CIVIL SOCIETY

SOCIAL CHANGE THROUGH PUBLIC POLICY

Analysing Vigyan Jyoti Initiative for Girls in STEM

Assessment and Recommendations

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Foreword

"Empowering women in STEM is not just a matter of equality; it is a necessity for the advancement of our society and the realisation of our shared aspirations."

It is with great pleasure and a profound sense of purpose that I introduce this comprehensive report on "Women and STEM" in India, a collaborative effort between my office and the esteemed Centre for Civil Society (CCS). This report stands as a testament to our collective commitment to fostering inclusivity and innovation in the fields of science, technology, engineering, and mathematics (STEM).

I extend my heartfelt gratitude to Shirin Pajnoo, Manasvi James, Rehmat Arora, and Shashank Dev, whose dedication and tireless efforts have been instrumental in bringing this project to fruition. Your passion and diligence have undoubtedly enriched the discourse surrounding women's participation in STEM and laid the groundwork for a brighter, more equitable future.

In a country where women form the backbone of the agricultural workforce, their empowerment in STEM is not merely a matter of opportunity but one of necessity. The application of new technologies in agriculture holds immense potential for enhancing productivity and sustainability, and it is imperative that women have equal access to these opportunities. The statistics presented in this report underscore both the progress we have made and the challenges that lie ahead. Addressing the gender disparity is not only essential for achieving gender equality but also for fulfilling the objectives of the United Nations' Sustainable Development Goal 5.

As we continue to deal with the complexities of the 21st century, it is clear that women's participation in STEM is indispensable to our collective prosperity and well-being. May this report serve as a catalyst for meaningful action and inspire future generations to pursue their passions without limitations. Here's to a future where every woman has the opportunity to thrive in STEM fields, and where our shared aspirations for a better world are realised through inclusivity and innovation.

Dr. Fauzia Khan
Member of Parliament

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Executive Summary

In India, women's representation across various domains of the Science, Technology, Engineering, and Mathematics (STEM) remains disproportionately low compared to men. Addressing this disparity, the Department of Science and Technology, Government of India, announced the Vigyan Jyoti initiative in 2019. This initiative aims to bolster female participation in STEM fields by offering comprehensive support to girl students from class 9 through post-doctorate across 550 districts from 2020-2025. It aims to maintain and grow the talent pool in Science and Technology by motivating more girls to pursue careers in these areas.

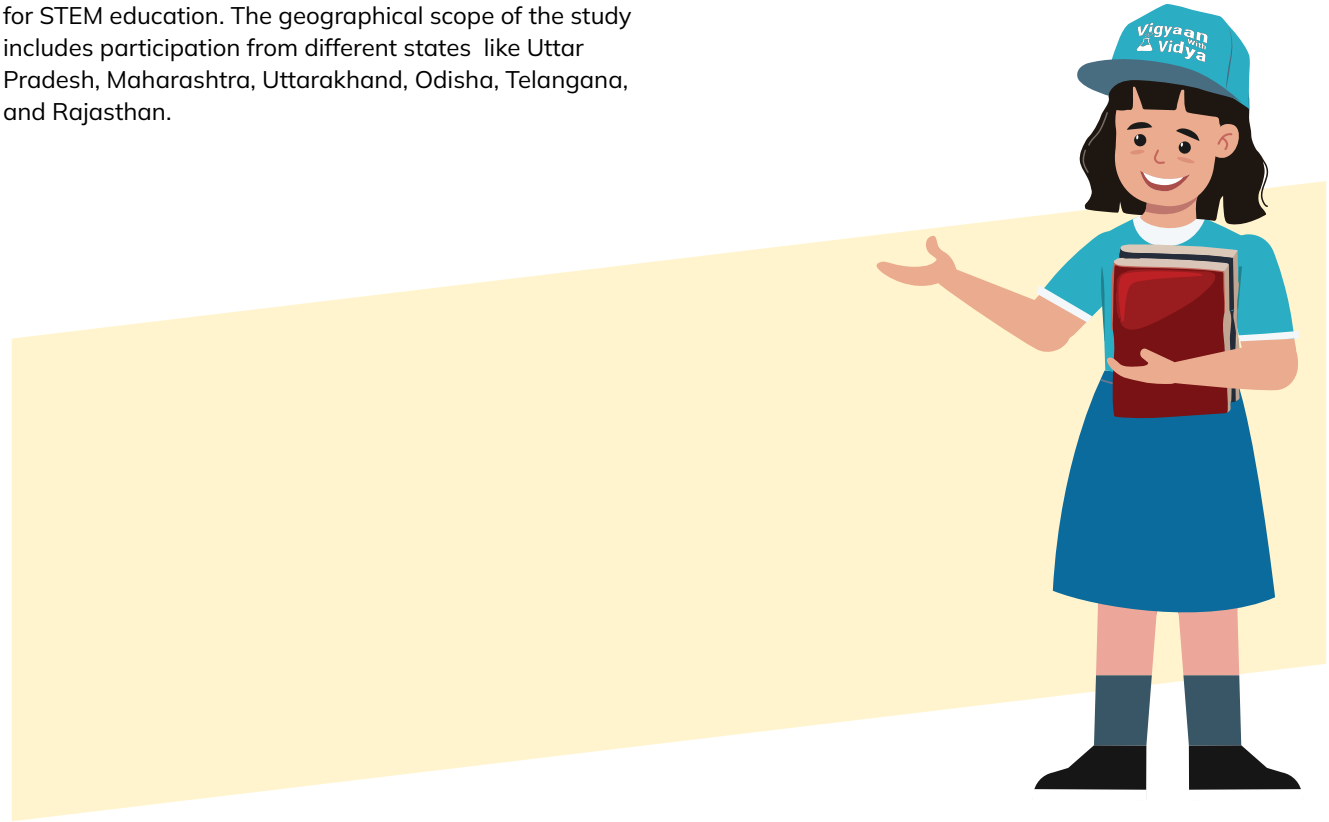
In this report, we conduct an in-depth analysis of the Vigyan Jyoti scheme, employing both primary and secondary research methods. Our analysis covers the initiative's scale, scope, stakeholder experiences, funding mechanisms, feasibility, effectiveness, acceptability, and future potential. Based on our findings, we propose policy recommendations designed to strengthen and expand the initiative's impact.

Implemented in three phases from 2020 to 2023, the scheme has expanded significantly, covering 200 districts and benefiting over 18,000 girl students nationwide. The scheme's components include student-parent counselling, lab visits, role model interactions, science camps, academic support classes, and online resources for STEM education. The geographical scope of the study includes participation from different states like Uttar Pradesh, Maharashtra, Uttarakhand, Odisha, Telangana, and Rajasthan.

A critical research gap exists in evaluating the scheme's impact on women's STEM participation, emphasising the need for rigorous assessments and longitudinal studies to measure its success and inform future enhancements.

To enhance the effectiveness and reach of the Vigyan Jyoti Scheme, the report proposes several recommendations based on insights from partners, stakeholders, and beneficiaries. These include offering training support for STEM educators, integrating the scheme with existing initiatives, publishing disaggregated program data, and strengthening program evaluation and oversight. Additionally, developing guidelines, implementing performance-based funding mechanisms, encouraging state-level budget allocations, and incorporating local cultural contexts and gender sensitization training are suggested to foster a more inclusive and effective STEM education framework.

We are extremely grateful to the stakeholders across India, who shared their detailed insights and experiences of being part of the scheme as knowledge partners, implementation partners, scholars/beneficiaries, etc. Their contribution was invaluable in shaping our understanding of the on-ground realities of the initiative.



Introduction

Women in STEM: An Overview of the Indian Context

According to the World Bank, in India, nearly 43% of total graduates in STEM are women. Maji, Mitra & Asthana (2020)[1] noted that India displays vast gender disparity in the enrolment in STEM disciplines, especially in premier institutes. In 2017, only 8% of the total students that enrolled in STEM undergraduate programmes in Indian Institute of Technology (IITs) all across India were women. In 2018, Indian Institute of Science (Bangalore) ranked first in educational ranking in India, but reported a female-male ratio of 21:79 (Merlin, 2018). In higher education, the situation aggravates. A 2019 study published in Current Science journal reported that women constitute only about 30% of the postdoctoral fellows in India (Godbole, R. M., & Ramaswamy, R., 2019) In terms of leadership roles, only 31 out of 204 professors in IIT Madras and 25 out of 143 professors in IIT Bombay are women (Sharma, 2021).

India is aiming to achieve its objective of gender equality and empowerment of all women by 2030, as stated in the Sustainable Development Goal (SDG) 5. Even though the figures are improving, they must translate into essential outcomes towards women-led development. "Towards Equality", a report of the Committee on the Status of Women in India, found the demographic trends of declining sex ratio, disparities in the life expectancy and death rates between men and women and underscored the difficulties involved in women's access to literacy, education and livelihood. According to the Global Gender Gap Report 2023, India has ranked 127 out of 146 countries. The shares of women in senior and technical positions have dropped. Data reported by the National Science Foundation shows that while 52% of women enrolled for STEM courses, only 29% of them were visible in the STEM workforce. In addition, only 3% of women currently hold CEO positions in the STEM industry.

According to the World Bank, in India, nearly 43% of total graduates in STEM are women, which is one of the highest compositions in the world, but only 14% of scientists, engineers and technologists are seen in research institutes and universities. Massachusetts Institute of Technology (MIT) proposed a phenomenon of "leaky pipeline" to explain this. For instance, many women choose not to pursue undergraduate degrees in disciplines like engineering and mathematics. The idea that engineering and mathematics are fields dominated by men is reinforced by the relatively low participation rates of women in these fields (Tilak and Choudhury, 2021). In addition, socio-cultural barriers, lack of support by parents and low number of women in STEM administrative leadership positions also becomes a discouraging factor (S. Stewart & Halsey, L. G., 2021). Further, analysing the Ministry of Education's data from 2007-10, Yusof, Alias and Habil (2012) found evidence of low participation of women in technical courses in higher education. Women represent a higher composition in PhDs, yet they fail to achieve academic positions due to more preference of male-counterparts in research positions (Kulkarni, A., & Mishra, M., 2022). This explains that there is leakage at every educational and career point for a woman (Schmitt, Miriam & Wilkesmann, Uwe, 2020).

India's 2008 National Task Force on Women in Science report says that women scientists constitute "a distinct minority" and that many highly qualified women, such as those with doctorates, "drop out of the workforce, resulting in considerable depletion of resources in science and technology" (National Task Force on Women in Science, Ministry of Science and Technology). The report also states that "there is a drastic drop in the percentage of women from the doctoral level to the scientist/faculty position, suggesting a bottleneck at the employment stage due to recruitment procedures and family responsibilities." As a result, there was a "major paucity" of women at the senior-most administrative and policy making positions in scientific institutions.

An analysis of several articles revealed that STEM education in India fails to integrate and synthesise all the four domains together, and is rather a fragmented concept (Tawbush et al., 2020). The Social Cognitive Career Theory (SCCT) states that selecting a career is an interplay of various factors combined (Krumboltz, Mitchell and Jones, 1976). When this concept is applied to STEM, we can see that a lot of factors like interests, choices, experiences, systemic barriers, and patriarchy are crucial determinants.

1 Maji, S., Mitra, S., & Asthana, M. (2023). "Treading the no woman's land: the gender-STEM dynamics in higher education in premier institutions of India," European Journal of Engineering Education, 48:3, 422-447, DOI: 10.1080/03043797.2023.2168518

Global Literature on Gender Gap in STEM

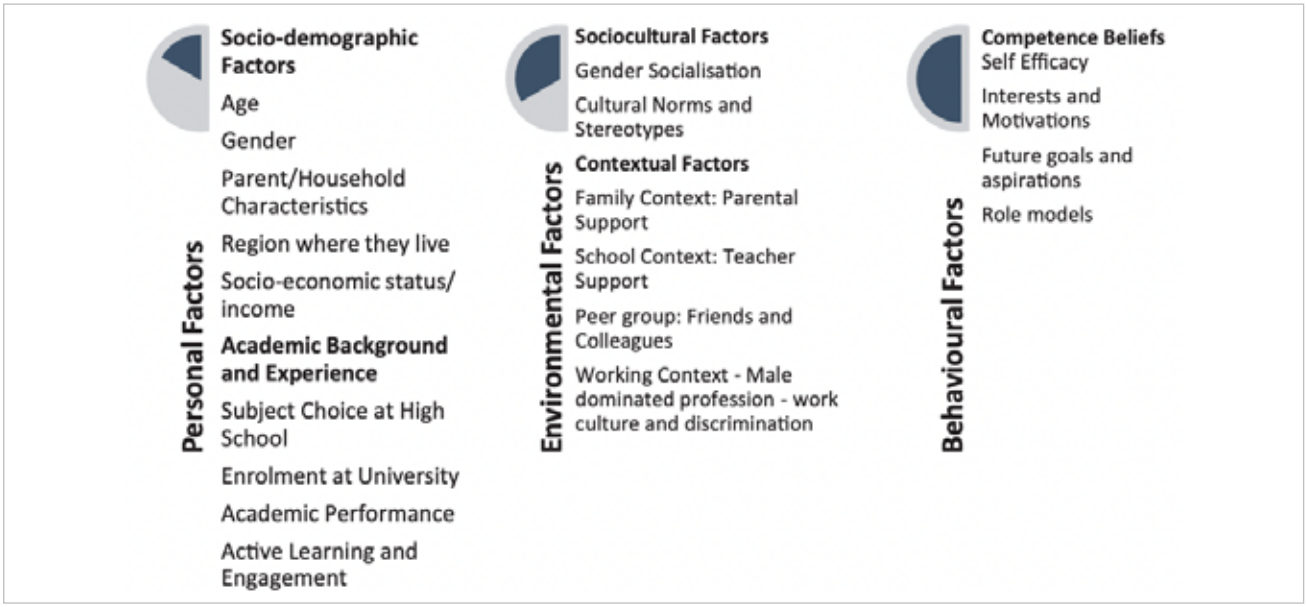
Gender disparities in STEM education and occupations are caused by a variety of reasons that vary by country. According to scholarly publications, the gender gap in STEM education is due in part to preconceptions and socialisation practices that emphasise male dominance and female submissiveness (Stewart-Williams, S., & Halsey, L. G., 2021).

Centre for Civil Society' research experience on the project 'Women in STEM in South Asia' highlighted that the perceived notion of 'what an engineer does' or 'what does a typical scientist' look like, often creates certain stereotypes and notions in individuals. These perceptions may also imply the perceived level of difficulty of being an engineer or becoming a scientist. Their consultation with a telecom engineer from Sri Lanka highlighted that people in Sri Lanka tend to associate the word 'engineer' with only what a civil engineer does. This leads to the perception that the life of an engineer requires field work and manual labour, thus the profession is 'not deemed fit' for girls (Mehta and Saloni 2023). This also reflects in the number of girls opting for engineering in the country. [Sri Lanka has a female population of 52% but female engineers in the workforce come up to 9%]. Research indicates that persistence in STEM fields is influenced by the extent to which individuals develop a science identity (Perez et al., 2014).

Gender socialisation practices in childhood also contribute to the perpetual exacerbation of the gender gap issue in STEM (Dodgers, S., Cordoba, S. & Coe, J., 2023). Furthermore, in most countries, female students show lesser enthusiasm and self-confidence in STEM than male students, and they do worse on standardised STEM assessments. As a result, women are less likely to get STEM degrees and pursue STEM employment (Merayo, N., Ayuso, A., 2023).

Gender inequalities in STEM may be caused by personal variables and family demographics such as parents' education level and marital status, family size, and socioeconomic position. Individual personality qualities, academic background and experience in terms of institution attended, and academic success are all considered as plausible factors for gender disparities in STEM. Researchers have also used academic achievement and abilities to support the gender gap in STEM. While Filippi and Agarwal (2017) have observed that practical STEM teaching methods are difficult to execute in India due to the "lack of technological resources" and lack of required skills of the teachers to utilise these resources efficiently; Severiens and Ten Dam (2012) ascribe poor STEM enrollment to gender inequalities in learner characteristics, as well as environmental and institutional issues.[2]

Image 1: Conceptual Framework of STEM Education disparities



Note: The dependent variable of the model is enrolment in STEM and Non-STEM degrees at the University. The independent variables are personal, environmental and behavioural factors

Source: *Adapted from various frameworks: Herrera et al. (2012) and Master and Meltzoff. Tandrayen-Ragoobur, V., & Gokulsing, D. (2022)*

2 Tandrayen-Ragoobur, V., & Gokulsing, D. (2022). Gender gap in STEM education and career choices: what matters?. Journal of Applied Research in Higher Education, 14(3), 1021-1040.

Indian Policies Aimed at Promoting Girls in STEM

To tackle the issue of under-representation of women in STEM, the Department of Science and Technology, Government of India, introduced various initiatives. These include, the SERB Women Excellence Award, CURIE, BioCARe, Vigyan Jyoti Scheme, Pragati scholarship, GATI, and the Indo-U.S. Fellowship for Women in STEM[3]. These initiatives aim to address gender disparity in funding and lower participation of women scientists in research activities. Despite 16.6% of women researchers engaged in R&D activities, factors such as family issues and career breaks contribute to lower participation. The government has also launched the "SERB-POWER Initiative" to support women scientists in research activities.

Institutions such as the Indian National Science Academy (INSA) has been advocating for a 'gender-neutral' approach to address inclusivity in STEM fields. The Department of Biotechnology is implementing the Biotechnology Career Advancement and Re-orientation Programme (BioCARe) to promote women scientists in biotechnology research. The Council of Scientific & Industrial Research (CSIR) is giving a five-year upper age relaxation for women to pursue doctoral and postdoctoral research. The Ministry of Earth Sciences has introduced the 'National Award for Woman Scientist' in 2018. The Indian government also launched the Women in Engineering, Science, and Technology (WEST) initiative in September 2022.[4]

The goal of these several government efforts in India is to increase the representation of women in STEM fields and to encourage more girls to pursue careers in science, thereby contributing to the overall advancement of the country`s scientific and technological capabilities. While there is certainly a problem of leaky pipeline and gender gap in STEM, is there truly a need for numerous government initiatives all aiming to promote women in STEM? What is the impact of these initiatives? Who are the stakeholders involved in these initiatives, and what are their experiences like? Very little research exists on this.

Thus, in this report we delve deeper into one such government initiative—'Vigyan Jyoti'. It is a scheme for meritorious girl students of Class 9th to 12th to encourage them to pursue education and a career in science and technology, particularly in the areas where women are underrepresented.

3 BRIDGING THE STEM GAP: GOVERNMENT INITIATIVES IN INDIA
https://womenforstemindia.org.in/bridging-the-stem-gap-government-initiatives-in-india/

4 Indian Government's Initiatives for Promoting Science Among Women
https://static.pib.gov.in/WriteReadData/specificdocs/documents/2023/feb/doc2023217160101.pdf

Features, Objectives and Geographical Scope

The first phase of Vigyan Jyoti Scheme was introduced in 2020. As per the website, the scheme has been initiated "at the school level wherein meritorious girl students of Class 9-12 are being encouraged to pursue higher education and career in STEM field" (Department of Science and Technology). It supports girl students studying in class 9 or above who are planning to pursue a career in any of the STEM fields, until their post-doctorate. However, secondary and primary data of this study suggests interventions only for girls till class 12.

The following instruments have been adopted for use within the scheme: Rs 2000 scholarship amount, student-parent counselling, visit to labs and knowledge centres, role model interactions, science camps, academic support classes, resource material distribution, and tinkering activities. Online academic support to students includes streaming of video classes, study materials, daily practice problems and doubt clearing sessions is also provided.

To help students better comprehend concepts and principles, additional curriculum-based experiential learning sessions are being held. These sessions are called Sparkle series for females in classes XI–XII and C-STEM for girls in classes IX–X. In certain cases, the program includes access to the Atal Tinkering Labs (ATLS) in addition to the tinkering activities. Additionally, science quizzes, codeathons, cyber security workshops, PyCode sessions, and flip books of "Science & Mathematics Projects" for hands-on experimentation for classes XI–XII have been planned. Furthermore, a specialised website called "vigyanjyoti.dst.gov.in" has been launched to facilitate knowledge exchange and program administration. Additionally, a select group of females are given the chance to tour adjacent scientific facilities and businesses. For enrolled girls, a quarterly newsletter called "STEMPORIUM" has also been launched as an educational tool[5].

"The objectives of this programme are:

1. To balance low representation of girls in different streams of Science and Technology (S&T) from the beginning
2. To facilitate a conducive/enabling environment from School level to College level and from research level to job level.
3. To enhance girls' ratio in underrepresented areas at UG level and ensure gender parity.
4. Feeder to increase the gender parity in STEM at successive levels (UG, PG, PhD, Post Doc).
5. Easy access to S&T information and knowledge in association with Knowledge Partners (KPs). " (Sansad, n.d.)

5 https://sansad.in/getFile/loksabhaquestions/annex/1711/AU2518.pdf?source=pqals

Table 1: State-wise details of girl scientists who have benefited from Vigyan Jyoti during 2020-23[6]

State/UTs	Phase-1 (2019)		Phase-II (February 2021)		Phase-III (2022)	
	Districts	No. of girl students	Districts	No. of girl students	Districts	No. of girl students
Andaman and Nicobar	-	-	1	100	1	100
Andhra Pradesh	-	-	3	298	7	692
Arunachal Pradesh	1	50	1	95	4	276
Assam	2	100	4	399	11	935
Bihar	3	150	5	499	8	671
Chandigarh	1	50	1	100	1	99
Chhattisgarh	2	100	4	385	8	779
Dadar, Nagar Haveli, Daman & Diu	1	50	2	200	2	200
Delhi	1	50	1	99	2	197
Goa	1	50	1	100	1	97
Gujarat	1	50	4	400	10	797
Haryana	1	50	3	297	6	586
Himachal Pradesh	2	100	4	400	8	733
Jammu and Kashmir	-	-	2	134	5	378
Jharkhand	2	100	4	399	9	644
Karnataka	3	150	5	500	9	891
Kerala	2	100	3	302	7	690
Ladakh	-	-	1	96	1	88
Madhya Pradesh	2	100	5	493	10	977
Maharashtra	3	150	5	496	11	1038
Manipur	1	50	2	200	4	271
Meghalaya	1	50	2	200	3	222
Mizoram	-	-	-	-	1	43
Nagaland	1	50	1	95	1	54
Odisha	2	100	4	400	8	778
Puducherry	-	-	1	100	4	400
Punjab	-	-	4	394	7	683
Rajasthan	4	200	6	599	10	967
Sikkim	1	50	1	100	2	200
Telangana	2	100	3	299	5	493
Tripura	-	-	1	100	3	213
Uttarakhand	3	150	5	494	7	671
Uttar Pradesh	4	200	8	797	14	1279

6 https://thewire.in/the-sciences/a-year-since-launch-of-govt-scheme-for-women-in-science-what-has-happened

State/UTs	Phase-1 (2019)		Phase-II (February 2021)		Phase-III (2022)	
	Districts	No. of girl students	Districts	No. of girl students	Districts	No. of girl students
West Bengal	2	150	4	399	10	940
Total	**50**	**2500**	**100**	**9869**	**200**	**18082**

Source: *Ministry of Science and Technology, Department of Science and Technology, Lok Sabha, Unstarred Question no. 4674*

The table above presents a state-wise breakdown of girl students who have benefited from the Vigyan Jyoti scheme across three phases during the period 2020-23. The scheme, designed to encourage and support female students in pursuing STEM fields, has been implemented in various states and union territories.

In Phase-1, several states and union territories show the initiation of the scheme with a varying number of districts and girl students. For instance, Arunachal Pradesh had one district with 50 girl students, Assam had two districts with 100 girl students, and Bihar had three districts with 150 girl students.

Moving to Phase-II, the implementation of the Vigyan Jyoti scheme expands, with an increased number of districts and beneficiaries. States like Gujarat and Karnataka demonstrate notable growth, with 4 and 5 districts respectively, and a significant increase in the number of girl students, reaching 400 in both states. The cumulative impact of Phase-II across the country is reflected in the total of 100 districts and 9,869 girl students.

Phase-III further extends the reach of the scheme, encompassing 200 districts and benefiting 18,082 girl students nationwide. The states with higher numbers, such as Uttar Pradesh, Maharashtra, and Rajasthan, highlight the increasing impact of the Vigyan Jyoti scheme. Uttar Pradesh, for instance, has 14 districts and has benefited 1,279 girl students, underscoring the substantial scale and outreach of the program.

Notably, certain states, like Mizoram and Nagaland, show no reported data in Phase-I and Phase-II, but actively participate in Phase-III, emphasising the evolving nature of the scheme's implementation across different regions.

The cumulative totals for all phases showcase the expanding reach of the Vigyan Jyoti scheme, with 200 districts and a total of 18,082 girl students benefiting from the initiative during the specified period. The data presented in the table offers valuable insights into the geographical distribution and broader quantitative impact of the scheme, forming a foundation for further analysis and policy evaluation.

With the exception of Tamil Nadu and Lakshadweep, the Vigyan Jyoti Programme is currently being implemented in 200 Districts across 34 States/UTs. Below is the list of districts, broken down by state and union territory, where the Vigyan Jyoti Program has been implemented in March 2023.

Table 2: **State-wise number of Districts where Vigyan Jyoti is being implemented**[7]

S. No	States/ UT	No. Of Districts (For Year 2019-2023)
1	Andhra Pradesh	7
2	Andaman and Nicobar	1
3	Arunachal Pradesh	4
4	Assam	11
5	Bihar	8
6	Chhattisgarh	8
7	Chandigarh	1
8	Dadra & Nagar Haveli & Diu	2
9	Delhi	2
10	Goa	1
11	Gujarat	10
12	Haryana	6
13	Himachal Pradesh	8
14	J&K	5
15	Jharkhand	9
16	Karnataka	9
17	Kerala	7
18	Ladakh	1
19	Madhya Pradesh	10
20	Maharashtra	11
21	Manipur	4
22	Meghalaya	3
23	Mizoram	1
24	Nagaland	1
25	Odisha	8
26	Punjab	7
27	Puducherry	4
28	Rajasthan	10
29	Sikkim	2
30	Telangana	5
31	Tripura	3
32	Uttar Pradesh	14
33	Uttarakhand	7
34	West Bengal	10
	Total	**200**

During 2021 (Phase II) the programme was extended to 100 districts (including 13 aspirational districts) of 33 states/ UTs of the country. 100 Jawahar Navodaya Vidyalayas have been set up as Vigyan Jyoti Knowledge Centres. Some special interventions during 2021 included a Memorandum of Understanding (MoU) with IBM, a dedicated online portal for the programme, and a virtual science camp called 'Science Utsav' for 5000 girls and career-counselling for young girls.

7 https://sansad.in/getFile/loksabhaquestions/annex/1711/AU2518.pdf?source=pqals

Budget Allocation for the Scheme

The 2017 Ministry of Science and Technology budget allocation included the introduction of the Department of Science and Technology's (DST) Vigyan Jyoti plan coupled with a 2,000-crore purse (Padma, T.V., 2018).

The funding mechanism of the Vigyan Jyoti Scheme remains largely opaque, as there is little transparency regarding how the funds allocated to the Department of Science and Technology are specifically utilized for this initiative.

Based on publicly available data it is known that since its inception in 2020, the program has distributed a total scholarship amount of Rs 5841.08 lakh. The disbursement amounts per year are as follows: Rs 600 lakh in 2020-21, Rs 971.52 lakh in 2021-22, Rs 2178.96 lakh in 2022-23, and Rs 2090.60 lakh in 2023-24. All that is known is that, for the life of the program, each deserving student covered by the initiative will receive a scholarship worth Rs. 2000 per month.

Further, based on our consultation with a private partner, it was found that IBM provides some financial support to the initiative as part of its corporate social responsibility (CSR) project IBM-STEM for Girls.

In a reply by the Minister of Science and Technology to an unstarred question in the Lok Sabha, he said that during 2019-20, over 50 districts were covered under the scheme and the total funds sanctioned were Rs. 1,000 lakh. The state-wise fund allocation in the year 2019-20 was as follows:

Table 2: Funds sanctioned for vigyan jyoti scheme in 2019-2020

S N	States and UTs	Numbers of Districts	Fund Sanctioned (in lakh)
1	Arunachal Pradesh	1	20
2	Assam	2	40
3	Bihar	3	60
4	Chandigarh	1	20
5	Chattishgarh	2	40
6	Delhi	1	20
7	Dadar & Nagar Haveli	1	20
8	Goa	1	20
9	Gujarat	1	20
10	Himachal Pradesh	2	40
11	Haryana	1	20
12	Jharkhand	2	40
13	Karnataka	3	60
14	Kerala	3	60
15	Madhya Pradesh	2	40
16	Maharashtra	3	60
17	Manipur	2	20
18	Meghalaya	2	20

S N	States and UTs	Numbers of Districts	Fund Sanctioned (in lakh)
19	Mizoram	1	20
20	Nagaland	1	20
21	Odisha	2	40
22	Rajasthan	3	60
23	Sikkim	1	20
24	Telengana	2	40
25	Uttar Pradesh	3	60
26	Uttarakhand	3	60
27	West Bengal	3	60
	Total	50	1000

Source: *Ministry of Science and Technology, Department of Science and Technology, Lok Sabha, Unstarred Question no. 3135*

More recently, as per a question answered by Dr. G. Ranjith Reddy in the Sansad in February 2024. The budget of Rs. 47.37 crore is allocated for Phase-IV of the Vigyan Jyoti programme in the financial year 2023-24 and the share of Telangana is Rs. 1.46 crore (Sansad, n.d.).

The DST has implemented an umbrella scheme called "Women in Science and Engineering-KIRAN (WISE-KIRAN)" which includes various programmes, including Vigyan Jyoti, to encourage women in the fields of Science & Technology and Research & Development. According to a reply by the Minister of Science and Technology to an unstarred question in the Lok Sabha, the budget allocation for WISE-KIRAN Scheme was Rs.95 Crore in 2020-21, Rs. 100 Crore in 2021-22 and Rs.125 Crore in 2022-23. It was reported that more than 30,000 girls of Class IX-XII from 200 districts across the country have availed the benefits of the Vigyan Jyoti programme.

In 2018, some of India's premier institutes, such as the IITs, organised on-campus camps for girl students over two weeks, as required by the government, as pilot tests. The students were provided with Rs. 5000 after the completion of the programme. Senior women scientists attended the camps as role models to encourage the students to pursue careers in science. Similarly, around 35 meritorious girl students of class 11 took part in the Vigyan Jyoti programme, held at IIT Hyderabad campus from 12th May, 2018 to 29th May 2018.

It is unfortunate that granular funding allocation information, by district and by phase, is not publicly available on the official website of the initiative and thus only a limited analysis of the budget was possible as part of this study.

Design and Evaluation: Progress and Prospects

Prior to the introduction of the policy, data compiled by the DST shows that "females comprised 24% of the total pass-out students in STEM subjects in engineering, 22% at the postgraduate level, 28% at MPhil and 35% at the PhD level." The second phase of the programme was launched in 2021, and the third phase came in 2022 and phase four was recently announced.

As of February 2022, around 1820 tribal girls[8] from states across the country have benefited from the Central government's Vigyan Jyoti Programme (Press Information Bureau 2022). Meghalaya accounts for the largest number of tribal girls who have taken advantage of the central government programme and benefited from it, as informed by Minister of State for Earth Sciences and Science and Technology Jitendra Singh in a written reply to the Lok Sabha.

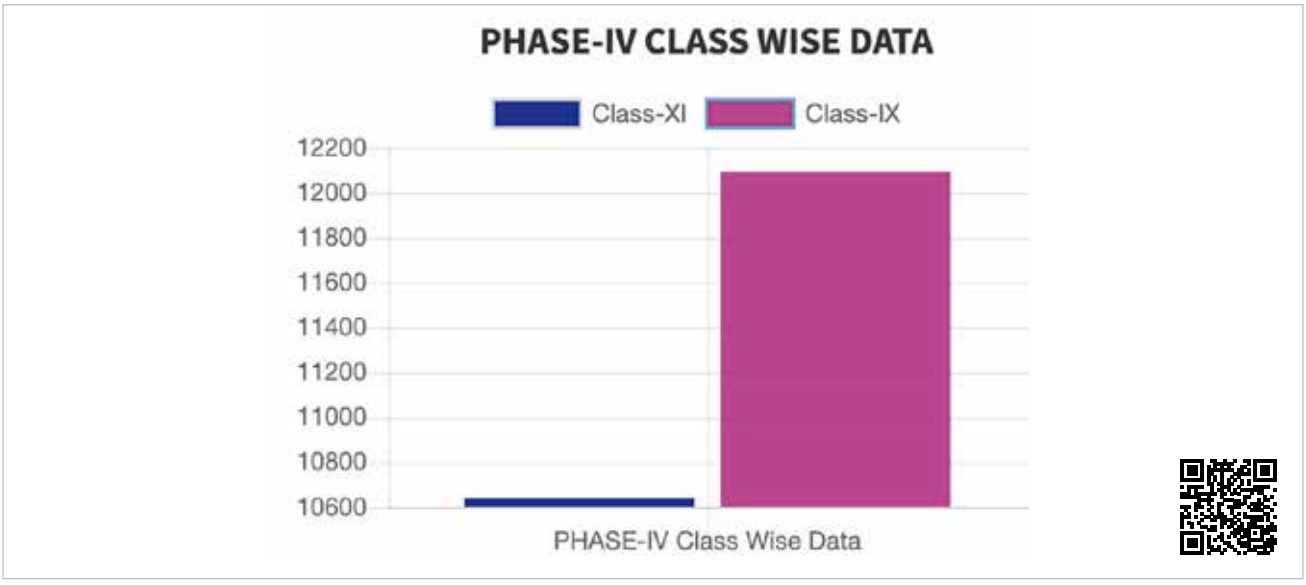
Unavailability of Disaggregated Data

Transparency and open data access are essential for any government program to enable public assessment of its successes and areas for improvement. Currently, the Vigyan Jyoti Scheme would benefit from more detailed, disaggregated data on key indicators, such as the number of female enrollments, scholarships awarded, and the cumulative amount of support provided. Ideally, this data should be reported for all phases of the scheme.

At present, the official dashboard primarily displays aggregated data, showing only the total number of students involved in the program across India. However, more granular information—such as district-level enrollments and scholarships awarded—has not been made publicly available. Additionally, data on the distribution of study materials, training sessions by knowledge partners, and field visits could further enhance the program's evaluation.

Making such data accessible would greatly support a comprehensive understanding of the program's reach and impact, fostering greater accountability and helping stakeholders assess its effectiveness.

Image 2: **Aggregated Data of Phase-IV Class Wise**

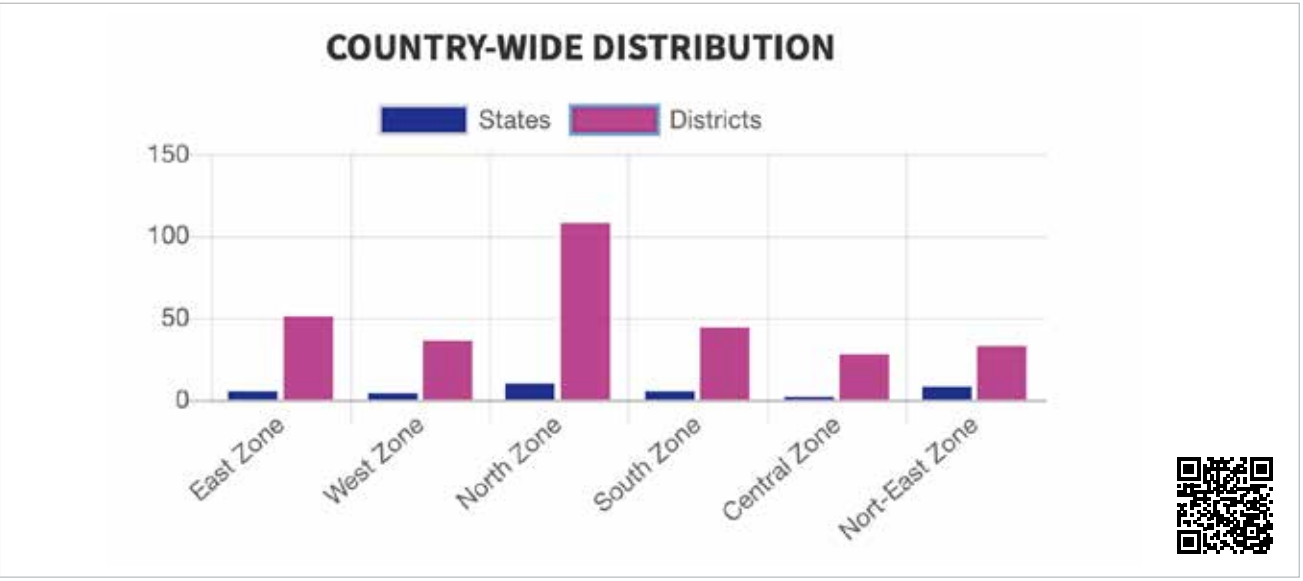


Source: *Vigyan Jyoti Dashboard (Scan QR code for link)*

Note: The dashboard lacks disaggregated data for girls in districts where the programme has been implemented in various phases.

8 AU3135.pdf (sansad.in)

Image 3: **Country-wide distribution**



Source: *Vigyan Jyoti Dashboard (Scan QR code for link)*

Note: The data shows the outreach of the programme as an aggregated figure in states and districts divided on the basis of zones. It lacks clarity in terms of the number of districts covered in each state and the data should further be segregated into urban and rural areas in order to get a clarity of the outreach of the programme to the underserved.

Image 4: **Number of Jawahar Navodaya Vidyalaya covered under Vigyan Jyoti scheme in India**

Source: *Vigyan Jyoti Dashboard (Scan QR code for link)*

Program Evaluation and Internal Metrics

Employing robust metrics is crucial to gauge the program's effectiveness accurately. One knowledge partner emphasised the importance of "utilising a multi-pronged approach for evaluation, including surveys, assessments, tracking program completion rates, and monitoring scholars' career trajectories." However, another interviewee noted that while the knowledge centres themselves evaluate the program, there is limited emphasis on making this data readily accessible to the public. While internal assessment is valuable, external scrutiny through public data access is equally critical for fostering transparency and promoting accountability.

Scalability and Implementation Challenges

The concurrent status of education in the Indian constitutional framework creates challenges for the expansion of schemes like Vigyan Jyoti. Both the central government and state governments possess legislative authority over educational matters. Each state can have its distinct policies, priorities, and implementation mechanisms for education. Expanding the Vigyan Jyoti Scheme across different states necessitates coordination between central and state authorities.

We hope assessments or evaluations of the outcomes and impact of the Vigyan Jyoti program in its initial 50 districts would have been critical for understanding the program's initial effectiveness. However, the same remains unclear due to lack of available information from official sources. Identifying key learnings and successes from the first phase can inform decision-making for the expansion of programs such as Vigyan Jyoti. Moreover, while expansion of the Vigyan Jyoti program to more districts has happened, it remains unclear what measures were in place to ensure sustainability and plans for scaling up or replicating success in other regions. Exploring the criteria used for selecting additional districts for the program's expansion and ensuring uniformity and quality in implementation across these districts is crucial.

As per the dashboard on the Vigyan Jyoti website, 300 districts have been covered in the initiative as of July 2024, while the goal of the initiative at the time of announcement was to cover 550 districts by 2025. With less than 1.5 years remaining it seems unlikely that this goal will be achieved.

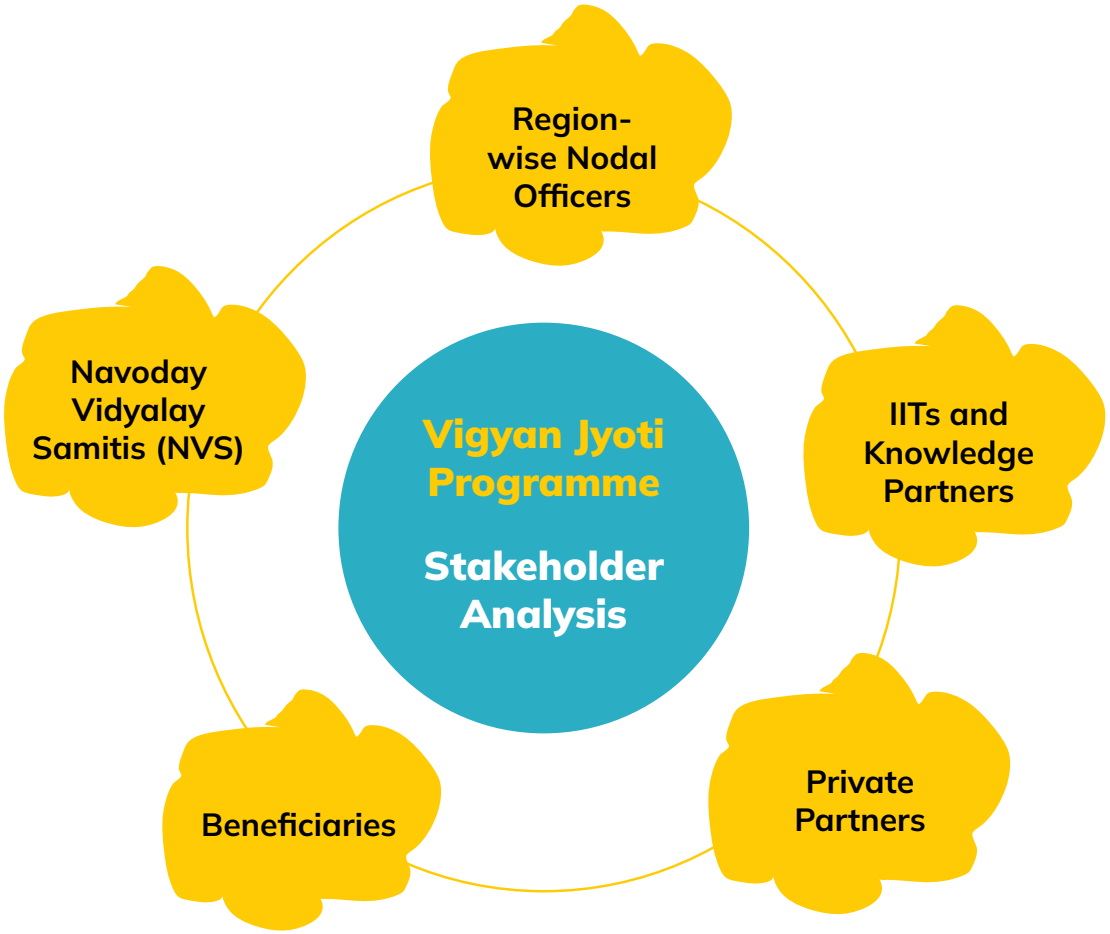
Table: Number of districts covered across regions by Vigyan Jyoti scheme as of July 2024

Region	Number of Districts
East	51
West	36
North	108
South	44
Central	28
North-East	33
Total	300

Source: *Vigyan Jyoti Dashboard (Scan QR code for link)*

An essential aspect of evaluating the success of ambitious initiatives such as Vigyan Jyoti, is understanding their long-term impact. We hope the intended inculcation of sustained interest and involvement of girls in STEM throughout their academic and professional journeys, as well as the long-term career outcomes for program participants, will be explored in the future. Moreover, conducting a longitudinal study to assess the long-term impact of the Vigyan Jyoti program on the career trajectories and success of participating girls can also prove to be useful.

Stakeholder Discussions and Analysis



In this section, we will elaborate on our research findings from semi-structured interviews with all key stakeholders of the Vigyan Jyoti programme. Our analysis cuts across five different stakeholders, including Navoday Vidyalaya Samitis (NVS), Region-wise Nodal Officers, IITs and Knowledge Partners, Private Partners and Beneficiaries. The stakeholders were spread across in the cities of Amethi, Bhagalpur, Bhopal, Bhubaneswar, Bhilai, Una, Kangra, Bangalore, and Dhanbad.

While the overarching theme of the questionnaires remained the same, they were also however customised according to the role of the stakeholders. The primary focus was on the effectiveness and experience of the scheme. There are also major gaps identified in information availability thus making it difficult to comprehensively assess efficacy of the scheme, despite four years of operation. This section aims to present the findings and analysis of the primary data, and to gauge whether it merges or diverges with the existing literature. We have divided the section into four themes, namely; Gender and Inclusivity, Funding, Accessibility, and Skills.

Gender and Inclusivity

The scheme rests on the idea of gender equality, and promoting women in STEM. Our interviews explore how the intersection of gender and inclusivity play out in the scheme.

- **Ensuring Inclusivity:** In order to increase diversity, stakeholders mentioned that the schools partner with various organisations to customise the instruments of the Vigyan Jyothi scheme. For instance, mentorship programs and workshops

are allocated in a way to ensure diversity by choosing mentors from diverse backgrounds for a personalised experience. The scheme also ensures to take into consideration cultural context sensitivity, and include cultural content in their syllabus as well.

A private partner of the scheme mentioned that they are sensitive to different social identities and create a strong work ethic which is open to all. They do this through the operation of the 'Gyanarpan Program' wherein their students go as mentors to teach the students in nearby villages. While diversity is taken into consideration, however, some respondents believe that the presence of female faculty and staff plays a key role in promoting this scheme. This factor was not uniform across all regions. He further added, *"Having female faculty and staff might make our female students more comfortable and at ease while dealing with their coursework. It could be something which is employed more often, to ensure students can easily reach out and communicate with them."*

A student beneficiary mentioned that sometimes girls drop out due to unforeseen circumstances and are left with no support. She mentioned that the scheme could also be catered to school drop-outs for financial support and resources aid.

- **Gender Sensitisation:** Sensitising all the key stakeholders towards or the lack of gender equality helps in creating a base for further promoting gender equitable ideas. It leads to behaviour modification and helps in identifying stereotypes that can be tackled.

Only two out of ten respondents mentioned that they have a dedicated team for gender sensitisation training for facilitators. One respondent also stated the need to review course material for gender bias. Facilitators actively seek mentors or role models for girl students, especially for the students in underserved areas. Role model methods have also been stated to be effective by student beneficiaries. Facilitators mentioned that sometimes it becomes tough because STEM has predominantly been a male dominated field, and hence they try their best not to bring gender biases in their daily activities and also give training for the same. However, gender sensitisation training is also imperative for students.

Funding and Resources

Our research underscores the critical role of sustainable funding in the success of the Vigyan Jyoti scholarship program and highlights areas where additional support and innovative approaches are needed to maximise its impact on young girls in STEM.

- **Diversification of Funding Sources:** Institutions reported that they recognize the importance of diversifying funding beyond government grants. Partnerships with private organisations, philanthropic foundations, and corporate social responsibility initiatives are seen as crucial for stability.
- **Impact Assessment for Resource Allocation:** There is a consensus on the necessity of rigorous impact assessments to guide resource allocation. By measuring outcomes, funds can be directed where they have the most significant effect, optimising impact.
- **Collaboration Enhances Efficiency:** Collaboration among institutions is viewed as essential for enhancing efficiency. Sharing resources, best practices, and costs can lead to improved outcomes and scalability.
- **Insufficient Funding for Certain Activities:** While the current funding sustains essential program functions, there are areas where additional resources are needed. Expansion into remote and underserved regions, as well as providing financial support like scholarships, is highlighted as areas for improvement.
- **Innovative Funding Models Required:** Respondents stress the need for innovative funding models to address funding challenges. Public-private partnerships with STEM-focused companies and leveraging alumni networks for fundraising and mentorship programs are proposed as potential solutions.
- **Unmet Needs for Teachers' Training:** While teachers are involved in the program, there is a gap in funding for their training and development. Respondents emphasise the importance of conceptual-based training, particularly for science and maths teachers.
- **Accessibility and Adaptability of Resources:** While the provided format and resources, especially the study material, are deemed accessible and adaptable to their needs, there is a suggestion for more prompt delivery to allow students ample time to familiarise themselves with the material and plan accordingly

Accessibility

The Vigyan Jyoti Scheme is dedicated to supporting young women students from economically weaker sections in STEM fields. Accessibility is a critical component of this program, ensuring that resources are available to all beneficiaries, regardless of their backgrounds or locations. The following points highlight the highs and lows of how the initiative fares on accessibility of resources:

- **Provision of Study Materials:** To maximise the benefit of the resources provided, study materials and resources are distributed well in advance. This allows students ample time to engage with the content, facilitating thorough preparation and deeper understanding. However, a scholar mentioned that they have no choice over which books are provided to them for the competitive exams. She reported that though some books are helpful, a direct benefit transfer of the equivalent amount will allow her to choose a higher quality study material based on her choice. Moreover, a former scholar highlighted that all scholars in Class XI in her school received books of all STEM subjects, irrespective of whether they opted for the medical or non-medical stream. She highlighted that scholars ended up not using the books of the subjects they did not opt for. These resources could have instead been allocated to other students who were unable to get access to any resources whatsoever.
- **Awareness and Outreach:** The program emphasises the importance of raising awareness among students from various schools and regions. Efforts are made to ensure that information about the scheme reaches a wide audience, including those in underserved areas. Initiatives like the Gyanarpan program involve current scholars teaching students from nearby villages, thereby increasing awareness and promoting the scheme.
- **Cultural Sensitivity and Adaptability:** Stakeholders tailor the experiential learning components to cater to the diverse cultural backgrounds of the beneficiaries. This involves incorporating culturally relevant content and involving local subject matter experts in curriculum development. Flexible learning formats, including both in-person and virtual options, are offered to accommodate various preferences and needs.
- **Personalised Mentorship:** Each scholar is assigned a mentor who understands their individual aspirations and challenges. This personalised guidance helps address specific needs and provides a supportive environment for the students. A former scholar interviewed for this study mentioned that this component was the most helpful of the various parts of the initiative.
- **Overcoming Technological Barriers:** Recognizing the limitations of internet access in some regions, the program develops offline learning materials and explores alternative delivery methods to ensure no student is left behind. This approach helps bridge the digital divide and ensures continuous learning.
- **Gender Sensitivity and Support:** A dedicated team focuses on gender sensitivity training for facilitators to create an inclusive and supportive learning environment. Scholarships and flexible learning options further enhance accessibility for all students.
- **Collaborative Knowledge Sharing:** Knowledge centres and partners are encouraged to share best practices and successful strategies through online platforms and workshops. This fosters a collaborative learning environment and continuous improvement in the program's implementation.
- **Monitoring and Evaluation:** The effectiveness of the program is assessed through various metrics, including enrollment trends, feedback from beneficiaries, and success stories. This continuous evaluation helps in refining the program and addressing any emerging challenges. As per the private partner interviewed for this study, the evaluation in the first phase was at a very nascent level and was slowly refined over time.
- **Future Expansion and Sustainability:** The program aims to significantly expand its reach, with the goal of having one-third of girl students enrolled in engineering and technology streams within the next five years. This ambitious plan involves partnerships with leading institutions and the development of scalable online modules and mentorship resources.

Skills

The Vigyan Jyoti scheme has been instrumental in encouraging meritorious girl students from Class 9-12 to pursue higher education and careers in STEM fields. To further enhance the impact of this initiative, a few improvements can be integrated into the program. These enhancements will bridge the gap between government and private school students and also ensure that the beneficiaries are well-prepared for the dynamic demands of STEM careers.

Incorporation of 21st Century Skills: To prevent government schools from lagging behind their private

counterparts, it is crucial to integrate essential 21st-century skills into the curriculum. By including skills such as coding, data analysis, digital literacy, and problem-solving in the regular curriculum, students will be better equipped to handle advanced STEM concepts and technologies. This will aid students who might otherwise need to seek these skills outside the school environment.

Leveraging Online Forums, Workshops, and Conferences: Interviewees highlighted the importance of using online platforms for knowledge sharing. Online forums, workshops, and conferences can serve as invaluable resources where knowledge partners can share best practices and address common challenges. This will provide students with up-to-date information and innovative learning techniques and provide networking opportunities with professionals and peers.

Improved Resource Allocation and Training for Competitive Exams: To prepare students for competitive exams, there needs to be a strategic reallocation of resources and enhanced training programs. Providing access to quality preparatory materials, mock tests, and specialised coaching can significantly improve the students' chances of success. By providing students with the necessary tools and guidance, they can compete more effectively for seats in prestigious institutions like IITs and AIIMS.

Broadening Support Beyond IITs and AIIMS: Many beneficiaries noted that students were trained predominantly for IITs and AIIMS, often excluding those aiming to enter other institutions. Comprehensive guidance and resources should be provided for other fields and institutions to include a broader range of colleges and universities. Such support will help students make informed decisions about their future careers, irrespective of their chosen institution.

Personalized Mentorship and Bias Reduction: To enhance activities like workshops, one-on-one discussions and role model sessions, the program should incorporate regular reviews and assessments to identify and eliminate any gender or cultural biases. Personalised mentorship can be particularly effective in addressing individual student needs and aspirations. This would ensure a more inclusive and equitable environment for all participants.

Policy Recommendations

Teachers' Training Support: The initiative can look to additionally incorporate teachers' training and development to ensure sustained impact on the current and future students, particularly in conceptual-based training. This could be done by establishing partnerships with teacher training institutions to ensure the availability of high-quality training programs for STEM educators.

Integration with Existing Initiatives by Civil Society Organisations and Corporates: While the scheme has included some private and non-profit partners for funding and implementation support, many civil society organisations and corporations have girls in STEM initiatives across the country. Collaborations and systemic knowledge sharing among these organisations can be facilitated, including integration of some of the initiatives with the Vigyan Jyoti scheme.

Publish Disaggregated and Publicly Accessible Data:

- As a nation-wide initiative, it is imperative to **establish guidelines and standards for data collection, validation, and reporting** to ensure consistency and reliability across different implementation agencies and knowledge centres involved in the initiative.
- As identified in the report, it is important to **publish publicly available aggregated and disaggregated program data,** including key indicators such as enrolments by districts, scholarship disbursements, funding from non-state partners, and program completion rates.
- Development of **a centralised online platform or dashboard** can be considered that presents the program data in a user-friendly and interactive manner, allowing stakeholders to access and analyse the information. The analysis mentioned in the report showcases the existence of a basic dashboard which requires considerable enhancements.

Strengthen Program Evaluation and External Oversight:

- It would be beneficial to formalize **a comprehensive program evaluation framework** that adopts a multi-pronged approach, incorporating surveys, assessments, tracking completion rates, and long-term monitoring of the career trajectories of scholars. This would provide a clearer picture of the program's impact and areas for improvement.
- Constituting an **independent external evaluation committee**, or engaging third-party evaluators, would ensure impartial and objective analysis of the initiative. A positive step towards this took place in May 2024 with the "Call for Expression of Interest (EOI) for Impact Assessment of the Vigyan Jyoti Programme" (Department of Science & Technology 2024).
- Public dissemination of evaluation reports and findings should also be prioritized to allow for constructive feedback and necessary course corrections. For instance, the monthly and annual reports published by DST currently lack consistency in reporting. *For example: Department of Science & Technology, Monthly Report, December, 2022 reports "Under the Vigyan Jyoti Programme of DST for empowering girls in different fields of Science and Technology, Engineering and Mathematics many classes, lab activities, science camps, workshops and career counselling sessions were organised for Vigyan Jyoti Scholars"* (DST 2022). This example uses the word "many" without stating details of where these activities happened, how many, what was the outcome, etc. In contrast, *Department of Science & Technology, Monthly Report,. July, 2021* reports a much more detailed and specific account of the activities conducted (DST 2021).

Fostering Collaborative Governance and Harmonization:

- To facilitate better coordination and implementation, it may be worthwhile to develop a national framework or set of guidelines that outlines **common objectives, priorities, and minimum standards** for the Vigyan Jyoti Scheme. These guidelines could still allow flexibility for states to adapt and customize their strategies based on local needs and contexts.
- Encouraging states to **share knowledge, build capacity, and disseminate best practices** can foster harmonization and effective implementation across diverse regions. Additionally, **exploring performance-based funding mechanisms or incentive structures** that reward states for active participation and achieving milestones could enhance the scheme's overall effectiveness.
- States could also be encouraged to allocate dedicated budgets and resources, fostering a sense of ownership and commitment. Recognizing and showcasing successful state-level initiatives may promote healthy competition, inspiring others to replicate effective strategies.

Sensitivity and Inclusivity:

- It would be helpful to **contextualize the program's curriculum and activities** to ensure they are culturally sensitive and inclusive. This could be achieved by integrating local cultural contexts into the syllabus and promoting diverse perspectives within the program.
- Conducting **periodic gender sensitization training for all stakeholders and facilitators** is essential to foster sensitivity and eliminate gender biases in teaching practices. Such efforts would help break down stereotypes and biases within the traditionally male-dominated STEM fields, creating a more equitable and supportive environment for all participants.

Appendix

Methodology

This study employed secondary and primary research methods. Secondary research involved a thorough review of academic literature and credible sources to establish a foundational understanding and identify research gaps. A question bank was designed based on insights from the literature review and piloted for clarity and relevance. The interview questions and interviewer training were prepared in advance by professionals from the Centre for Civil Society. Subsequently, semi-structured interviews were conducted with ten participants- 5 from IITs and Knowledge Partners, 2 Region-wise nodal officers and NVS , 1 from Private Partner and 2 Vigyan Jyoti Research Scholars from five stakeholder categories. These five stakeholder categories were identified based on their key roles in the implementation and accessibility of the scheme. The stakeholder categories were as follows: Navodaya Vidyalaya Samiti (NVS), Region-wise Nodal Officers, Principals at Knowledge Centres and IITs, Private Partners, and Beneficiaries. These semi-structured interviews were conducted between January and April 2024. Qualitative data from the questionnaires was analysed using thematic analysis. Ethical considerations were paramount throughout the research process, ensuring informed consent and confidentiality.

Questionnaire

Aspect	Questions
Allocation of Responsibilities	What is the role of [the stakeholder] in the implementation of the Vigyan Jyoti programme?
Experience	How do stakeholders measure the impact of experiential learning opportunities (internships, workshops, mentorship) on enhancing STEM interest and capabilities among Vigyan Jyoti Scholars, especially considering their diverse backgrounds?
	How are the experiential learning components of the Vigyan Jyoti Scheme tailored to address the unique needs and aspirations of young women from diverse backgrounds, ensuring inclusivity and maximising engagement?
	What strategies are institutions employing to ensure the sustainability and scalability of experiential learning opportunities under the Vigyan Jyoti Scheme, and how are these experiences integrated into scholars' long-term career pathways in STEM? Can you share specific success stories or notable achievements of individuals who have benefited from the Vigyan Jyoti Scheme?
	As the implementation partner, what challenges or obstacles have you faced during the scheme's implementation, and how have you addressed them?
Funding/ Feasibility	How can knowledge institutions optimise resource allocation to ensure sustainable funding for the long-term success of the Vigyan Jyoti Scheme, especially in extending its reach to underserved regions and demographics within STEM fields?

Aspect	Questions
	What innovative funding models can be developed to enhance the scalability and impact of the Vigyan Jyoti Scheme, ensuring it remains adaptable to the evolving needs of women and girls in STEM education and careers?
	To what extent has the Vigyan Jyoti Scheme been effective in attracting private sector funding for STEM education in India, and what aspects of the scheme appeal most to private partners?
	Are the current funds allocated to the Vigyan Jyoti Scheme adequate for carrying out its planned events and activities? If not, what adjustments are needed, and why?
	How can the Vigyan Jyoti Scheme be adapted to different educational and regional contexts to enhance its overall feasibility and effectiveness?
Effectiveness	How do knowledge centres evaluate their contributions to the Vigyan Jyoti Scheme in enhancing female participation in STEM fields, and what evidence-based metrics are used to assess effectiveness?
	Are there longitudinal studies or feedback mechanisms in place to track the progress and career trajectories of Vigyan Jyoti Scholars after completing the program?
	Are there platforms or forums where knowledge partners share best practices, success stories, and challenges to foster collaborative learning within the Vigyan Jyoti Scheme?
	How effective has the Vigyan Jyoti Scheme been in promoting STEM education and career choices among girls in India, based on available data and feedback?
	What aspects of the Vigyan Jyoti Scheme have been most successful in motivating girls to pursue STEM education and careers, and how is this effectiveness measured through beneficiary feedback and outcomes?
Unintended Effects	How have knowledge centres identified and addressed unforeseen challenges or negative impacts during Vigyan Jyoti Scheme implementation, and what measures are in place to mitigate these effects in future iterations?
	In what ways have the involvements of IITs, ICAR, and ICMR in the Vigyan Jyoti Scheme unintentionally affected their existing educational or research programs, and how have these institutions balanced their contributions to the scheme with their primary missions?
	How effective has the Vigyan Jyoti Scheme been in promoting STEM education and career choices among girls in India, and what evidence-based metrics are used to assess its effectiveness?
	Can you share key success stories or examples of girls who have significantly benefited from the Vigyan Jyoti Scheme?
	Have there been any unintended effects reported by beneficiaries or stakeholders due to the scheme, and how can these be addressed to improve its impact and outcomes?

Aspect	Questions
Acceptability	How do stakeholders ensure gender sensitivity and address accessibility issues to broaden the acceptance of the Vigyan Jyoti Scheme among a diverse audience?
	How do knowledge centres ensure that the curriculum and teaching methods in the Vigyan Jyoti Scheme are culturally relevant and acceptable to diverse student groups?
	How do students perceive the Vigyan Jyoti Scheme, and what are their impressions regarding its relevance to their needs and interests?
	How do parents and educators perceive the Vigyan Jyoti Scheme, and what factors influence their acceptance or resistance, especially concerning its continuation for their daughters?
Allocation of Responsibilities	How do stakeholders like IITs, ICAR, CSIR, and ICMR coordinate and allocate responsibilities within the Vigyan Jyoti Scheme to leverage their unique expertise in promoting gender parity in STEM fields?
Future of the scheme	What specific strategies can stakeholders employ within the Vigyan Jyoti Scheme to create a more inclusive environment that both attracts and retains female students in underrepresented STEM fields?
	How do stakeholders plan to expand the reach and impact of the Vigyan Jyoti Scheme over the next five years, particularly targeting underrepresented regions and communities in STEM?
	What innovative approaches or partnerships could be explored to strengthen the Vigyan Jyoti Scheme and enhance its impact moving forward?
	How can private partners be more actively involved in shaping the future direction and success of the Vigyan Jyoti Scheme?
	Looking ahead, do you believe the Vigyan Jyoti Scheme should continue beyond its initial five-year timeframe? If extended, what changes would you suggest to improve its effectiveness and sustainability?

Note: Semi-structured stakeholder interviews were conducted using this question bank. It was used to interact with the different stakeholders, partners and beneficiaries who participated in the study.

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