Assessing the Effectiveness of Vigyan Jyoti in Promoting STEM among Girls for Navodaya Vidyalaya Schools of Western Region

(An Impact Study of the Vigyan Jyoti Program on STEM Motivation, Self-Efficacy and Career Aspirations among Girls of Jawahar Navodaya Vidyalayas in Madhya Pradesh and Chhattisgarh.)

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Acronyms

Sl.	Acronym	Expanded Form
1	ANOVA	Analysis of Variance
2	CG	Chhattisgarh
3	df	Degrees of Freedom
4	DMS	Demonstration Multipurpose School
5	DESM	Department of Education in Science and Mathematics
6	DST	Department of Science and Technology
7	F	F-statistic
8	FGD	Focus Group Discussion
9	GoI	Government of India
10	JNV	Jawahar Navodaya Vidyalaya
11	M	Mean
12	MD	Mean Difference
13	MP	Madhya Pradesh
14	NCERT	National Council of Educational Research and Training
15	NVS	Navodaya Vidyalaya Samiti
16	p	Probability Value / Significance Value
17	RIE	Regional Institute of Education
18	SD	Standard Deviation
19	STEM	Science, Technology, Engineering and Mathematics
20	t	t-statistic
21	U	Mann–Whitney U statistic
22	VJ	Vigyan Jyoti
23	VJP	Vigyan Jyoti Program
24	χ^2	Chi-square

Executive Summary

The present report examines the effectiveness of the **Vigyan Jyoti Program** in promoting **Science, Technology, Engineering and Mathematics (STEM)** engagement among girl students enrolled in selected **Jawahar Navodaya Vidyalayas (JNVs)** of **Madhya Pradesh** and **Chhattisgarh**, falling under the western regional jurisdiction of the **Regional Institute of Education (RIE), Bhopal**, a constituent unit of the **National Council of Educational Research and Training (NCERT)**. The study is situated within the wider national and educational concern that, although girls' access to formal schooling has expanded considerably, their sustained participation in advanced STEM education and STEM-related careers remains disproportionately limited. In this context, the study sought to examine whether participation in the Vigyan Jyoti Program was associated with higher levels of STEM motivation, self-efficacy, critical thinking, problem-solving orientation, and stronger inclination towards STEM subjects and STEM-related career pathways.

The **Vigyan Jyoti Program** may be understood as a gender-responsive and developmentally oriented intervention intended to strengthen girls' engagement with STEM during the formative years of adolescence. The program includes multiple components such as academic enrichment in science and mathematics, mentoring through women role models, exposure to STEM institutions and professionals, and guidance concerning future educational and occupational pathways. The conceptual premise underlying the program is that sustained engagement with these support structures can contribute to increased interest in STEM, enhanced confidence in one's academic abilities, stronger perceptions of competence, and a more positive orientation towards long-term participation in STEM education and careers.

The present study adopted a **quasi-experimental comparison-group design** within a broader evaluative and mixed-evidence framework. Since the program had already been implemented in the field, random assignment of participants was neither feasible nor educationally appropriate. Accordingly, the study used a **cluster sampling approach**, with the school serving as the unit of sampling. In addition to student-level quantitative evidence, the study also drew upon the perspectives of **teachers, teacher coordinators, principals, alumni, and the nodal officer**, thereby enabling a broader and more contextualised interpretation of program impact. The study covered selected JNVs over the period **2020–21 to 2024–25**. The achieved sample included **701 girl students from Vigyan Jyoti schools** and **583 girl students from comparison schools**. One non-Vigyan Jyoti school in Chhattisgarh did not provide responses. The study also recognises its methodological limitations: because group assignment was non-random and some evidence relied on self-reported data and stakeholder ratings, the results are interpreted as indicating **program-associated influence rather than definitive causal effect**.

Key Findings

The principal findings emerging from the study are presented below:

1. **The impact of the Vigyan Jyoti Program was meaningful, though not uniformly**

distributed across all dimensions and contexts. At the aggregate level, the overall difference between program participants and comparison-group girls on the combined STEM-related constructs was not found to be statistically significant. This indicates that program effects are not equally visible when all groups and contexts are examined together.

2. **Disaggregated analysis revealed stronger program effects by class level and state.** A more refined analysis showed that the program demonstrated stronger outcomes among girls with **longer duration of exposure**, especially those studying in **Class XII**. This suggests that the impact of the program is cumulative in nature and becomes more visible over time.

3. **The program appeared to have stronger effects in Madhya Pradesh than in Chhattisgarh.** In Madhya Pradesh, Vigyan Jyoti girls in **Class XII** showed stronger outcomes than Vigyan Jyoti girls in **Class IX** across the four principal constructs of **interest, self-efficacy, problem-solving, and critical thinking**. This pattern indicates that program outcomes may vary depending upon context, continuity, and implementation quality.

4. **The strongest gains were observed in the motivational and aspirational domains.** The program appeared particularly effective in strengthening girls' **self-belief, confidence, and STEM-related aspirations**, even where differences in cognitive measures were not equally pronounced. This suggests that Vigyan Jyoti contributes significantly to the affective and aspirational foundations of STEM participation.

5. **Stakeholder perceptions strongly endorsed the educational value of the program.** Teachers, teacher coordinators, and principals consistently reported that girls participating in Vigyan Jyoti demonstrated greater interest in science and mathematics, higher confidence in learning STEM subjects, improved classroom participation, and stronger orientation towards future STEM study and careers. The consistency of these responses across multiple stakeholder groups lends additional interpretive strength to the findings.

6. **The program appears to function more as a reinforcing mechanism than as an initial generator of STEM interest.** The study found that inclination towards STEM subjects after Class XII was already high among Vigyan Jyoti girls and tended to increase with continued participation. However, similar high levels of subject interest were also observed among comparison-group girls. This suggests that the program may be more effective in reinforcing and sustaining existing STEM inclination than in creating such interest de novo.

7. **A clearer program effect emerged in relation to STEM career aspiration.** Interest in pursuing **STEM-related careers** showed a more distinct difference between Vigyan Jyoti girls and comparison-group girls. Longer exposure to the program was associated with stronger career aspirations in STEM, and this difference was particularly evident in the **Madhya Pradesh dataset**, where it attained statistical significance.

8. **Alumni evidence, though limited, offered encouraging indications of longer-term program relevance.** The available alumni responses suggested that all responding alumni were pursuing **STEM-related higher education pathways**. Although the number of alumni responses was limited, this evidence provides supportive indication that the aspirations fostered by the program may, in some cases, translate into actual continuation in STEM education beyond the school stage.

9. **The program was found to be educationally relevant and developmentally appropriate for adolescent girls.** The intervention appears particularly suitable for girls at a stage when academic identity, subject preferences, and career aspirations begin to assume greater clarity and stability.

10. **Program effectiveness appears to be influenced by implementation quality and contextual conditions.** The observed variation across states and class levels suggests that the quality, continuity, and local context of program implementation play an important role in shaping outcomes.

Major Recommendations

On the basis of the findings of the study, the following recommendations are proposed:

1. **The Vigyan Jyoti Program should be strengthened as a structured and sustained multi-year intervention extending from Class IX to Class XII.** The findings indicate that the effectiveness of the program is closely linked to duration of exposure. It should therefore be conceptualised as a developmental continuum rather than as a short-duration intervention.

2. **A standardised core package of program components should be ensured across all participating schools.** Such a package may include academic enrichment, mentoring, role-model interaction, exposure visits, STEM awareness sessions, and educational and career guidance to ensure greater consistency in program delivery.

3. **Greater emphasis should be placed on strengthening girls' confidence and academic self-efficacy in STEM.** Since the program demonstrated notable gains in self-belief and motivational orientation, these dimensions should remain central to future program strengthening.

4. **Critical thinking and problem-solving should be more systematically integrated into program design and implementation.** These are foundational competencies for sustained participation in STEM and should be embedded in enrichment activities, pedagogical interactions, and mentoring processes.

5. **Career guidance and pathway awareness should be intensified, particularly in Classes XI and XII.** Since the program showed a relatively stronger association with STEM career aspiration, greater attention should be given to helping girls understand academic routes, professional possibilities, and entry pathways in STEM fields.

6. **Mentoring by women STEM professionals should be institutionalised as a regular component of the program.** Sustained interaction with women role models in STEM can make career pathways more visible and attainable, while also strengthening confidence and aspiration among adolescent girls.

7. **Program activities should be better aligned with the regular teaching-learning processes of schools.** Closer integration with classroom instruction would improve the educational relevance, continuity, and long-term effectiveness of the program.

8. **Capacity building of teachers and teacher coordinators should be accorded priority.** Teachers and coordinators should be supported to provide gender-sensitive academic

guidance, encourage sustained STEM participation, and strengthen the local implementation of program objectives.

9. **Monitoring, documentation, and implementation tracking should be significantly strengthened.** Since the effectiveness of the program is mediated by context and implementation quality, systematic records of participation, mentoring, program exposure, and school-level execution are essential for both program improvement and future evaluation.

10. **Future evaluation efforts should incorporate stronger longitudinal and implementation sensitive designs.** Tracking student trajectories over time and documenting variation in program intensity would enable more robust understanding of how and under what conditions the program produces meaningful outcomes.

Concluding Remark

The present impact study concludes that the **Vigyan Jyoti Program constitutes a promising and strategically important intervention for promoting girls' participation in STEM education**. Its most visible contributions lie in strengthening girls' confidence, aspirations, and orientation towards future STEM pathways. Although the findings are not uniform across all contexts and do not support simplistic causal claims, the cumulative evidence suggests that when the program is implemented with seriousness, continuity, and institutional support, it can enable girls to move from **interest to confidence, from confidence to aspiration, and from aspiration to sustained engagement in STEM education and related futures**. In this sense, Vigyan Jyoti may be regarded not merely as an enrichment initiative, but as a significant **gender-responsive educational strategy** with important implications for **equity, talent development, and the long-term strengthening of India's STEM participation base**.

Chapter 1

INTRODUCTION & CONTEXT

1.1 Introduction

During the 21st century, the prevalence of advances in science and technology, coupled with increased globalization and competition for resources has resulted in a need for countries to focus on developing their scientific infrastructure and human resources. A nation's ability to foster scientific advances will depend in large part on the education systems they have developed, specifically whether or not their education system promotes scientific thinking skills such as inquiry, evidential reasoning and problem-solving skills within a diverse population. As an important part of a nation's ability to be successful from a social perspective, gender equity in Science Technology Engineering and Mathematics (STEM) must be viewed as an imperative when creating the conditions necessary for innovation; and to develop a prepared workforce; and to promote sustainable development globally. STEM education in current policy and research discourse is not limited to subject content area mastery but rather the importance of developing learners' critical thinking, higher-order reasoning, problem solving, and other related cognitive competencies; and developing learners' motivational dispositions such as curiosity, persistence, and self-efficacy to enable them to tackle the real-world complex problems that exist today. Even though girls are having greater success in completing their education through various stages of their schooling; the same level of success has not occurred with respect to girls participating in tertiary education in STEM, selecting STEM-intensive career paths & occupations, or serving in leadership positions in STEM-related fields. The pattern of declining participation by girls in an education and career transition is commonly referred to as "the transition gap".

Although the transition gap has been attributed in part to structural barriers limiting girls' access to STEM careers and to their participation in STEM-related programs, there are many factors that influence progress in STEM fields. These include, but are not limited to, the interaction of sociocultural expectations regarding gender with other factors such as the limited access to enriching experiences in STEM, the lack of STEM role models and mentors, as well as the development of psychological and cognitive constructs that affect how girls make their academic decisions. Among these constructs, STEM interest, STEM self-efficacy, critical thinking/problem-solving orientation, perceived competence, and career aspirations are particularly important because of their role as proximal mechanisms through which educational interventions may affect long-term participation in STEM fields.

This stage of development is characterized by the increasing stability of academic identity, perceived ability to succeed, and career goals among adolescents. Given that adolescent interventions provide a strategic opportunity to support girls' entry into STEM, the Department of Science and Technology, Government of India launched Vigyan Jyoti (school component) to encourage

and inspire talented school girls to pursue higher education and careers in STEM. The Vigyan Jyoti scheme is being implemented at select Jawahar Navodaya Vidyalayas (JNVs) that are run by the Navodaya Vidyalaya Samiti (NVS) in the Ministry of Education, Government of India. The JNV system provides a residential, merit-based, and relatively standardized academic environment in which to deliver systematically to the program and to evaluate the program in a systematic manner.

This report represents a systematic impact evaluation of the Vigyan Jyoti scheme implemented in some JNVs in Madhya Pradesh (MP) and Chhattisgarh (CG) in the Western Region of India. Using an evaluation framework based on sound program evaluation principles, this study aims to assess the extent to which the Vigyan Jyoti scheme has influenced STEM motivational and cognitive outcomes for girls, and influenced their academic and career aspirations. In this chapter, the study's conceptual and contextual foundations are developed, the evaluation purposes and research questions are articulated, the overall scope of the report is defined, and the rationale for the impact evaluation is provided.

1.2 Context of the Impact Study

1.2.1 Gender and STEM Participation in India

Girls continue to experience disparity compared to boys within STEM professions despite improvements in access for girls to participate in STEM during primary and secondary school. Participation in school is not proportional to advanced educational programs, research fields and/or occupations in these areas (Eccles & Wigfield, 2002). Researchers have found there is a variety of other variables that affect a child's motivation to choose an academic program, such as expectancies, values of the task, social influence, and perceived opportunity (Eccles & Wigfield, 2002). Within this context, self-efficacy has an important role in helping women persist, exert effort and have resilience when faced with difficulties while learning challenging new concepts. Self-efficacy is defined as an individual's beliefs about his or her ability to achieve success in an area and will impact his or her ability to set goals, use persistence and adapt to difficulty (Bandura, 1997). Additionally, an interest in STEM careers helps to continue to engage a child in STEM and gives a child a reason to explore STEM outside the classroom setting. It is also becoming increasingly clear that critical thinking and problem-solving skills will help prepare a child for being successful in STEM by teaching them how to evaluate evidence; think logically; and use what they have learned to do something different than they had initially planned. Structured participation in role modeling opportunities (e.g., mentors), experiential and hands-on-type learning experiences, and support from career advisors can enhance a girl's aspirations and feeling of belonging related to pursuing interests in STEM (UNESCO, 2017).

The Vigyan Jyoti Program seeks to influence several intermediate outcomes such as Interest, Self-efficacy, Perceived Competence, and Thinking/Problem solving orientation that are theoretically linked to long-term (sustained) participation in STEM and aspirations for future careers as a result of experiences and exposure in the areas of Structured Enrichment, Mentoring, Exposure (to STEM and STEM Professionals), and Guidance.

1.2.2 Institutional Context: Jawahar Navodaya Vidyalayas

Jawahar Navodaya Vidyalayas represent a distinctive institutional model within Indian school education. Established to nurture talented students, particularly from rural backgrounds, JNVs provide residential schooling supported by a standardized administrative structure under NVS. The residential environment often enables extended academic engagement, structured routines,

peer learning cultures, and participation in enrichment activities beyond conventional classroom time.

From an evaluation perspective, JNVs offer two important advantages. First, standardized governance and broadly comparable academic environments can improve interpretability of program implementation across sites. Second, the residential setting can facilitate consistent exposure to program activities. At the same time, the enriched institutional context may itself influence student outcomes. Therefore, the present impact study treats the JNV context as an enabling environment and relies on comparison logic within similar institutional settings to strengthen inference regarding program-associated effects.

1.2.3 Rationale for the Impact Study

The impact assessment of publicly funded educational programs is vital for program improvement and accountability, as well as for making decisions based on available data and information. Especially when the programs are designed to influence complex aspects such as motivation, self-beliefs, and career pathways, it is vital to ensure that the underlying program processes are activated and the observed impact is in line with the program's goals and objectives (Figure.1.1).

With this in mind, the following are the goals and objectives of the impact study:

1. To assess if Vigyan Jyoti is associated with changes in girls' motivation, self-beliefs, perceived competence, and a pro-active approach to critical thinking and problem-solving;

2. To assess if Vigyan Jyoti is associated with a stronger motivation for STEM subjects and STEM-related careers;

3. To collect stakeholders' perspectives on the program processes, facilitators, and observed impact;

4. To generate useful information for program improvement and strengthening, and potentially scaling up the program.

1.3 Purpose of the Impact Study

The Impact Study will provide information on how girls who participate in the Vigyan Jyoti Program will show differences in cognitive outcomes, motivation towards STEM and the likelihood to pursue STEM education and careers as a result of their participation in the JNV institutional context. To this end, the study will be based on the following five research questions:

1. Are girls who participate in the Vigyan Jyoti Program more interested in STEM than those who do not?

2. Does participation in Vigyan Jyoti improve girls' self-efficacy and competence in STEM?

3. Are there measurable increases in critical thinking skills and problem-solving approaches as a result of participation in Vigyan Jyoti?

4. Do girls who participate in Vigyan Jyoti have a greater likelihood of pursuing STEM education and careers than those who do not?

5. How do stakeholders (students, teachers, coordinators, principals, nodal officers) perceive the implementation process and outcomes of Vigyan Jyoti?

This study will analyze both the individual-level outcomes and the institutional-level stakeholder outcomes associated with program participation to provide a comprehensive understanding of how the program influences participants and the context in which it is implemented.

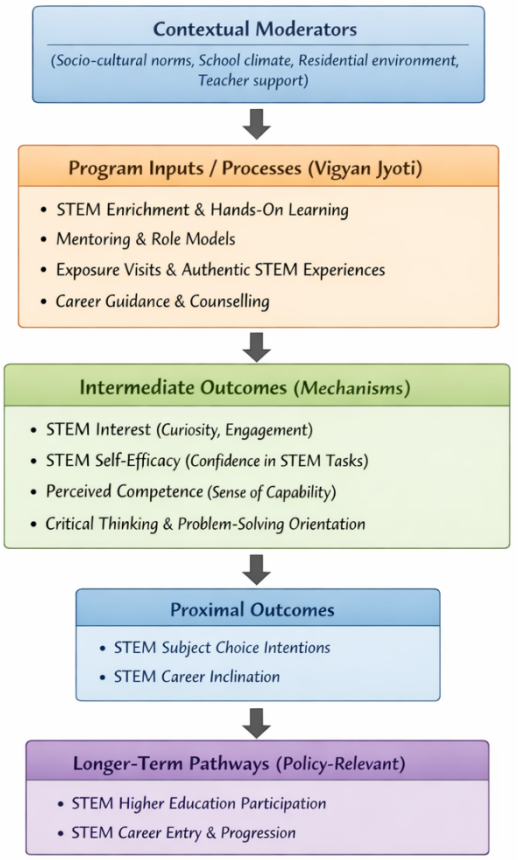


Figure 1.1: Conceptual framework linking Vigyan Jyoti inputs to intermediate outcomes and longer-term STEM pathways.

1.4 Scope of the Impact Study

Clear boundaries enhance analytical precision and prevent unwarranted extrapolation. The scope of the present study is defined across geographical, institutional, participant, temporal, and substantive dimensions.

1.4.1 Geographical Scope

The study covers selected JNVs located in Madhya Pradesh and Chhattisgarh where the Vigyan Jyoti scheme is implemented, along with selected comparison JNVs within comparable administrative and academic contexts.

1.4.2 Institutional Scope

The evaluation focuses on JNVs implementing Vigyan Jyoti and includes a comparison set of JNVs to support estimation of program-associated differences within similar institutional conditions.

1.4.3 Participant Scope

The participant groups include:

- girl students in Classes IX to XII of JNVs;

- alumni who completed Class XII from JNVs (where relevant to pathway evidence);
- STEM teachers associated with the program in JNVs;
- teacher coordinators in JNVs;
- principals of participating JNVs; and
- nodal officers/functionaries involved in program delivery.

1.4.4 Temporal Scope and Cohort Logic

The impact evaluation spans the years 2020-21 through 2024-25 and has been structured as a multidimensional evaluation of impact by cohort throughout the various years and classes of an adolescent. All data are collected for girls in classes IX-XII at the time that the data collection is being undertaken. A major feature of the overall design is that students presently in class XII represent a sustained period of time in terms of their exposure to the program as they participated in the Vigyan Jyoti program when they began in class IX and have continued in successive classes. Therefore, the evaluation shows how the program influenced these students in those various periods and the degree that it influenced these girls with varying amounts of program participation over that time period and with their cohorts (with varying degrees of program participation) throughout those years.

Where retrospective indicators were used (for example, students provided self-ratings to indicate how they viewed themselves today relative to when they were in earlier classes) care was taken to provide a cautious interpretation of this indicator. This was accomplished by using input from other stakeholders who had direct contact with these students and/or who could provide supportive documentation positively supporting the validity of these retrospective self-ratings by triangulating the evidence gathered from multiple sources to reduce the potential for recall bias and thus improve the credibility of the evaluation findings (Table 1.1.).

1.5 Significance of the Impact Study

The implications resulting from this study cut across many domains including policy, program, institution and scholarship:

1. Policy implication: The research informs policymakers where to focus on strengthening, expanding and refining gender responsive STEM interventions using empirical data.
2. Program implication: The findings indicate strengths, conditions for implementation and areas needing improvement which will allow for iterative enhancement of STEM programs.
3. Institutional implication: Participating JNVs will benefit from understanding how structured enrichment/ mentoring in STEM relates to enhancing girls' motivations and capabilities in STEM.
4. Scholarly implication: This research adds to the evidence base in India regarding school level gender responsive STEM intervention research, specifically in the context of standardized settings.

Construct	Conceptual meaning in this study	Operational focus (what is captured)	Primary evidence source
STEM Interest	Enduring curiosity and engagement in STEM learning and activities	Enjoyment, engagement, willingness to explore STEM beyond class	Student rating scale; stakeholder corroboration
STEM Self-efficacy	Belief in one's capability to learn and succeed in STEM tasks	Confidence in handling STEM concepts/tasks; persistence with difficulty	Student rating scale; teacher perceptions
Perceived Competence	Self-perceived academic capability in STEM learning contexts	Sense of capability and readiness for STEM learning demands	Student rating scale
Critical Thinking Orientation	Disposition to evaluate evidence, reason logically, and analyze claims	Analytical approach to information, justification of answers, reasoning habits	Student rating scale; stakeholder examples
Problem-solving Orientation	Disposition and strategy use to solve unfamiliar or complex problems	Strategy selection, stepwise reasoning, confidence in solving new problems	Student rating scale; stakeholder accounts
STEM Inclination	Intention and preference for STEM subjects and STEM career pathways	Subject choice intentions, career aspirations, perceived fit in STEM	Student rating scale; alumni/records (where available)
Stakeholder Perception	Interpretations of program functioning and outcomes in institutional context	Implementation enablers/challenges, observed changes in learners	Interviews/FGDs with teachers, coordinators, principals, nodal officers

***Table 1.1*:** Operational definitions and measurement focus of key constructs used in the impact study.

1.6 Summary

This section lays down the conceptual and contextual basis of the current impact study of the Vigyan Jyoti program. The study will examine gender equity in the areas of Science, Technology, Engineering, and Mathematics (STEM) as a key development issue as well as the importance of the adolescent years in developing STEM identity, motivation, and career aspirations. Accordingly, four intermediate constructs (STEM interest; self-efficacy; perceived competence; and critical thinking/problem-solving) will be defined and identified as a primary mechanism through which the program is expected to affect students' engagement with STEM learning and future pathways. Additionally, the scope of the study is further refined by the temporal design of the study, which consists of multiple cohorts of students (classes IX through XII) being evaluated over the years 2020-2025 and who will demonstrate varying amounts of exposure to the program, beginning with class IX and continuing through their completion of class XII. The student cohort also includes existing class XII who will have had ongoing exposure to the program for a number of years.

The following chapter describes the details of the Vigyan Jyoti program, including its design, objectives, and key implementation components, while also identifying the program theory that will be used to inform the evaluation framework used in this study. In addition, this section elaborates upon the conceptual rationale of the research methodology that will be utilized to carry out the research described in this report.

Chapter 2

PROGRAM DESCRIPTION: VIGYAN JYOTI

2.1 Introduction

The Department of Science and Technology (DST), Government of India has launched an Initiative to strengthen girls' involvement in Science, Technology, Engineering, and Mathematics (STEM) education - Vigyan Jyoti - with the aim of encouraging girls to move on to higher education and careers in STEM. This Initiative was established in response to the continuing gap in girls' participation in all the areas of science, technology, and engineering, even though there has been an increase in girls' participation in general school attendance rates. The importance of Vigyan Jyoti is that it is a gender-responsive Initiative that seeks to eliminate gender inequities related to STEM participation. Gender inequities are not limited to access to schooling; furthermore, students experience differing degrees of STEM-related opportunities for participation and persistence based on the amount of exposure they have had to STEM opportunities, the availability of role models and mentors, their self-confidence in their ability to succeed, their knowledge of post-secondary academic and career pathways in STEM, and the degree to which they have developed an interest in and competence for problem-solving prior to adolescence. Therefore, it is important to recognize that STEM-related participation is a function of a continuous developmental process of exposure to and engagement with STEM and not simply based on an individual academic choice.

In the context of the current impact study, the Vigyan Jyoti program is being implemented in some Jawahar Navodaya Vidyalayas (JNVs), which are under the administration of the Navodaya Vidyalaya Samiti (NVS), under the Ministry of Education. The residential and merit-based nature of JNVs presents an environment that is conducive for the provision of enrichment, mentoring, guidance, and support in the form of exposure. This chapter is designed to provide information about the program in an organized manner by describing the rationale, goals, objectives, target group, institutional context, implementation architecture, key components, and the Theory of Change for the current study.

2.2 Program Rationale

The underlying rationale for Vigyan Jyoti is predicated upon the idea that secondary education play an important role in influencing the academic interests, self-concept, and potential aspirations of students. Adolescence is the period of the life cycle during which individuals develop

relatively stable representations of their capabilities, interests, and potential career paths. This period is especially important for girls since their subject interest, self-confidence in science, technology, engineering, and mathematics (STEM) learning, and aspirations for STEM pathways could be dependent upon social expectations, the relative absence of exposure to genuine STEM learning contexts, and the relative absence of women as role models in science and technology. In the context of STEM education research and policy discussions, the prevailing view is that continued learning in STEM subjects is associated with intermediate determinants of learning in STEM subjects, which include interest in STEM subjects, self-efficacy, competence, critical thinking/problem-solving orientation, and awareness of learning and career pathways. These determinants are further reinforced in the presence of intellectually challenging STEM learning contexts, encouragement, mentoring, guidance from mentors and role models, and exposure to genuine learning contexts in which STEM knowledge is enacted in the 'real world.'

In this context, Vigyan Jyoti is conceived of as a highly structured intervention that seeks to target the determinants of learning in STEM subjects during the critical period of adolescence. The academic enrichment aspect of the intervention seeks to build learning and capability, the mentoring and role model aspect seeks to build confidence and a sense of belonging and aspiration, the exposure aspect seeks to build awareness of STEM learning contexts, and the guidance aspect seeks to build awareness of learning pathways and informed decision-making.

2.3 Goal and Objectives of the Vigyan Jyoti Program

2.3.1 Overall Goal

The goal of the Vigyan Jyoti program is to increase and maintain the engagement of girls in STEM education and professions. It does this by increasing their level of motivation, confidence, perceived capacity, awareness, and aspiration throughout their secondary and senior secondary years of schooling. The above-stated goal is in alignment with the broader developmental objectives, which include:

1. Enhancing gender equality in STEM fields through addressing the existing gaps in participation and advancement;

2. Enhancing the country's STEM talent pool through increasing the number of girls who are ready to take up STEM education and professions at the higher level;

3. Enhancing the country's growth through discovering the scientific talent of students from rural and socially diverse backgrounds.

2.3.2 Specific Objectives

The program's goal is to achieve the following:

1. To enrich girls' academic learning that enhances their understanding of STEM, curiosity, inquiry, critical thinking, problem-solving, etc.

2. To increase the confidence level of girls in their STEM abilities through learning experiences that reinforce their abilities.

3. To increase exposure to the real world of STEM through the connection of girls with the real world.

4. To increase the level of mentor support that enhances the STEM identity, sense of belonging, confidence, etc.

5. To assist girls in making informed academic and career choices through learning experiences that guide girls on academic, career, etc. choices.

2.4 Target Group and Beneficiary Profile

2.4.1 Primary Beneficiaries

The primary beneficiaries of the Vigyan Jyoti program are girl students of Classes IX to XII studying in selected Jawahar Navodaya Vidyalayas. At this stage, their academic interests and courses of future direction begin to take shape. However, the program is particularly important for those who have shown academic promise and could benefit from opportunities to further explore their academic interests in STEM areas and expand their horizons for their academic and career prospects. Most of the students in the JNV schools belong to rural areas with diverse social backgrounds, where they have limited exposure to external STEM institutions, laboratories, and professionals. At such locations, the Vigyan Jyoti program is not only an academic support system but also an academic bridge between the academic world and the outside world.

2.4.2 Secondary Beneficiaries

The program also benefits a few other key stakeholders in the school system. In particular, the program benefits:

1. teachers/school coordinators, who assist in the organization of the STEM activities;

2. the school system, which is strengthened in its capacity to deliver STEM enrichment programs and gender-sensitive education support; and

3. the community, which benefits indirectly as more girls pursue their STEM ambitions.

2.4.3 Cohort Structure and Continuity of Participation

For the purposes of this impact study, covering the period from 2020-21 to 2024-25, the project envisions itself as a multi-year program, with the students entering the program in Class IX and receiving support over the following years. This means that students in Class IX, Class X, Class XI, and Class XII will comprise the program cohorts, each having varying durations of program experience. This is relevant to the interpretation of the findings because the differences observed between the grade levels could also be due to the duration of program experience that the students have had. For instance, the students in Class XII would likely have been the ones with the highest duration of program experience, having been with the program from Class IX and then through Class XII itself. As indicated in Table 2.1, the profile of the beneficiaries of the Vigyan Jyoti project is closely linked to the developmental and institutional context that guides girls' participation in STEM fields.

2.5 Institutional Setting: Jawahar Navodaya Vidyalayas

The Vigyan Jyoti program, as it is implemented within the Jawahar Navodaya Vidyalayas (JNVs), is one of the main pillars of the program itself. The JNVs are special schools designed to foster

Category	Description	Relevance for the present impact study
Primary beneficiaries	Girl students of Classes IX–XII in selected JNVs	Central focus of outcome assessment
Academic stage	Secondary and senior secondary schooling	Critical period for interest formation and pathway decisions
Social context	Predominantly rural and socially diverse backgrounds	Important for interpreting equity and exposure-related effects
Secondary beneficiaries	Teachers, coordinators, schools, and wider community	Relevant for understanding implementation and institutional support
Cohort continuity	Students enter in Class IX and continue through later grades	Supports multi-cohort interpretation of cumulative exposure

***Table 2.1*:** Target group and beneficiary profile of Vigyan Jyoti.

the growth of bright minds, especially from rural areas, through merit-based admission, academic support, and a similar governing framework provided by the Navodaya Vidyalaya Samiti. This framework is advantageous for the program in many ways, especially when considering the overall design and implementation of the program itself.

The first advantage is the availability of time for the students within the campus setting, where they will have more time to interact and benefit from the activities provided within the program. The second is the similar framework provided within the JNVs, allowing for easier comparison between the results of the program in each school. The third is the availability of leadership within the schools, allowing for easier planning and documentation of the activities within the program itself. Lastly, the significance of the JNVs is their ability to reach minds that would otherwise not have access to the program. The school setting is not just a location; it is the main facilitator of the program itself.

2.6 Implementation Architecture and Key Roles

Vigyan Jyoti implementation occurs through a coordinated ladder structure that ranges from the national policy to the classroom. At the highest level, the vision is set, general program support is provided, and the policy is defined by the Department of Science and Technology. Moving down the ladder, the Navodaya Vidyalaya Samiti, along with its regional bodies, extends the program to the schools. At the school level, the administrative support is provided by the Principal, the enabling environment is created, and the program is coordinated. At the local level, the program coordinator, along with the support of STEM teachers and resource persons, coordinates the program. From the above structure, it is evident that the success of the program is ensured through the participation of the students, along with the coordination of the support structure.

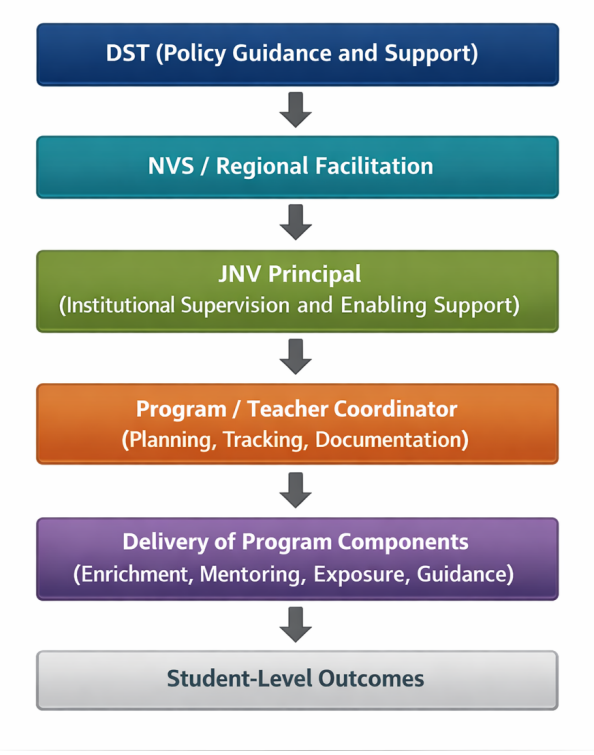


***Figure 2.1*:** Implementation architecture of Vigyan Jyoti in Jawahar Navodaya Vidyalayas.

The role structure summarized in Table 2.2 further clarifies the institutional arrangements that support implementation continuity and program monitoring.

Level	Key function	Indicative roles
National	Policy direction and program support	DST guidance, broad oversight
System / Regional	Facilitation and coordination	NVS and regional administrative support
School leadership	Institutional enabling and supervision	Principal's oversight, scheduling, support
School coordination	Planning, tracking, and documentation	Program/teacher coordinator
Delivery level	Direct engagement with students	STEM teachers, invited mentors, resource persons

***Table 2.2*:** Indicative implementation roles in Vigyan Jyoti.

2.7 Core Components of the Vigyan Jyoti Program

Vigyan Jyoti works as a multiple-component program in which the components of learning, motivational aspects, and exposure-based components come together in an integrated package. Each of the components has its own role to play, and the overall effect is cumulative in nature.

2.7.1 STEM Enrichment and Academic Support

The purpose of this learning component is to enrich students' concept, curiosity, and scientific thinking by providing learning experiences beyond the classroom. This learning component will cover hands-on learning, inquiry-based learning, demonstrations, small-scale learning projects, problem-based learning, and academic support in STEM learning areas. In terms of the present impact study, the general impacts of this learning component are to increase students' interest in STEM, competence, and critical thinking/problem-solving disposition.

2.7.2 Mentoring and Role Model Engagement

This component of the program will help students get in touch with female scientists, engineers, researchers, mathematicians, and other STEM professionals who could potentially become mentors and role models. In this way, the students will get a better and more understandable idea about the different STEM professions, and this will have a significant effect on the students' self-confidence, self-belonging, self-believing, and self-aspiring nature.

2.7.3 Exposure to STEM Ecosystems

The exposure aspect expands students' understanding of the places where STEM knowledge is created, used, and expanded. This could include going to universities, labs, innovation centers, science museums, or activities related to STEM. This challenges students to look beyond the textbook concept of STEM, allowing them to have a more tangible understanding of the concept.

2.7.4 Career Guidance and Pathway Support

This component enables the student to understand their chosen subjects, explore choices for their higher education, prepare for their entrance exams, and learn about scholarships, all while considering their long-term STEM career choices. It's not just about providing information, it's about growth, helping the students map their growing interests and confidence into an educational plan.

2.7.5 Interrelationship Among Components

The components of Vigyan Jyoti are not independent of each other; rather, they complement each other. Academic enrichment can help to improve competence, mentoring can help to foster confidence, drive, and motivation, while exposure can help to foster a sense of relevance and awareness of opportunities, and guidance can help to translate motivation into action. As illustrated in Table 2.3, these fundamental elements are intended to affect not only the immediate factors but also the intermediate factors that affect ongoing participation in STEM.

2.8 Unified Theory of Change for the Impact Study

This impact study is situated around one Theory of Change for Vigyan Jyoti, detailing how the program is supposed to influence student outcomes. The basic assumption is that continuous support, such as academic enrichment, mentoring, exposure, and guidance, during the adolescent years, may enhance motivation and cognitive perspectives to ensure students remain engaged and moving forward in their academic and professional lives.

The foundation of success at the ground level is based on inputs, such as institutional support, program guidelines, program coordinators, teachers, mentors, and available resources. These lead

Program component	Illustrative focus	Intended immediate outcomes	Expected intermediate influence
STEM enrichment and academic support	Inquiry, conceptual learning, problem solving, hands-on engagement	Improved learning participation and academic engagement	Stronger conceptual understanding, perceived competence, and critical thinking/problem solving
Mentoring and role model engagement	Interaction with women in STEM, guidance, encouragement	Increased visibility of attainable STEM pathways	Enhanced self-efficacy, confidence, belongingness, and aspirational orientation
Exposure to STEM ecosystems	Visits to institutions, laboratories, innovation spaces, STEM events	Expanded awareness of STEM opportunities and environments	Broader career perspective and reduced psychological distance from STEM
Career guidance and pathway support	Subject choices, examinations, scholarships, higher education routes	Better informed educational and career decisions	Stronger pathway clarity and STEM inclination

***Table 2.3*:** Core components of Vigyan Jyoti and their intended immediate and intermediate influences.

to the development of a planned program of activities, such as academic enrichment, mentoring, exposure, and guidance, delivered to the students. The result of the activities is the production of outputs, such as student participation, learning, and awareness of STEM options. The program, with continuous activity, is expected to influence intermediate outcomes, such as building student interest, self-efficacy, perceived competence, and cognitive perspectives toward STEM subjects and careers. These intermediate outcomes are anticipated to influence proximal outcomes, such as the intention of pursuing STEM subjects and a stronger inclination toward STEM subjects and careers. Ultimately, all of this is anticipated to influence higher education and future STEM careers. The causal sequence of Figure 2.2 underpins the outcome domains selected for this impact study.

The stage-wise alignment summarized in Table 2.4 clarifies how each level of the program is linked to the expected outcome trajectory.

2.9 Monitoring and Documentation: Evaluation-Relevant Records

In a multi-component program such as Vigyan Jyoti, records are vital to understand how the program is implemented, how consistently the program is exposed to the students, and how the implementation of the program varies for each school and batch of students. The records include session logs, student attendance, exposure visit reports, mentoring session records, and summaries of the coordinators or principals, among other records, which provide context for how consistently and how intensely the program was actually implemented.

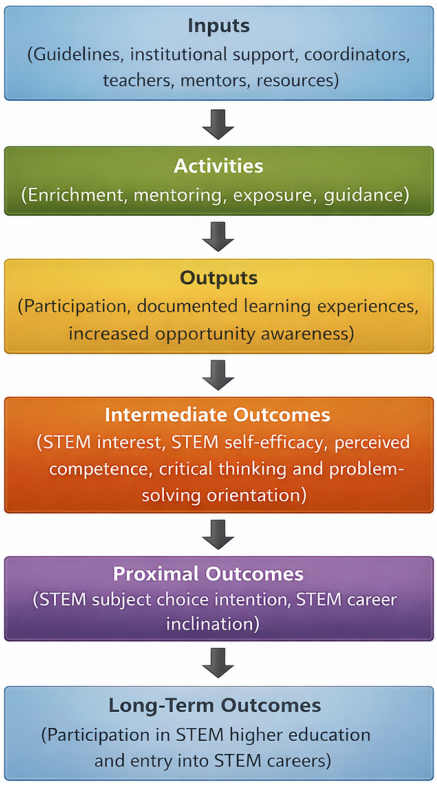


***Figure 2.2*:** Theory of Change for Vigyan Jyoti.

Stage	Description	Underlying assumption
Inputs	Institutional support, guidelines, personnel, mentors, and resources	Adequate support structures enable effective and sustained delivery
Activities	Enrichment, mentoring, exposure, and guidance	Structured engagement can shape beliefs, awareness, and learning orientation
Outputs	Participation and documented program experiences	Active engagement increases opportunity awareness and program reach
Intermediate outcomes	Interest, self-efficacy, perceived competence, critical thinking/problem solving	Motivational and cognitive strengthening supports persistence in STEM
Proximal outcomes	STEM inclination, pathway clarity, subject choice intention	Stronger confidence and clarity increase the likelihood of STEM continuation
Long-term outcomes	STEM higher education participation and careers	Early strengthening of aspiration and capability beliefs contributes to long-term progression

***Table 2.4*:** Theory of Change alignment for Vigyan Jyoti.

There are two major reasons why such records are vital for the program implementation. First, such records provide context for why the results of the program may vary, whether such variations are due to how consistently or intensely the program is implemented. Second, such records increase the credibility of the results of the impact study by linking the results with concrete records of program processes in action, as is the case in this impact study, where such records are considered vital supporting records for understanding both exposure and implementation context, where available.

2.10 Summary

In this chapter, Vigyan Jyoti is presented in an organized fashion: what it is, why it is, what it hopes to achieve, whom it hopes to serve, what institutions it uses, how it is designed, what its parts are, and what Theory of Change underlies it. This chapter will demonstrate that Vigyan Jyoti is not simply a trick, nor is it meant to be a quick fix, but is instead designed as a multi-part program to increase girls' interest in STEM by working on intermediate outcomes such as interest, self-efficacy, competence, and mindset related to critical thinking and problem-solving, as well as proximate outcomes such as girls developing more interest in STEM and thinking about how they might pursue it.

This chapter will also demonstrate the significance of JNV and why it is important that Vigyan Jyoti is designed to be a multi-year program, working with girls from Class IX through Class XII. This chapter is important because it will provide context for the impact study findings from 2020-21 through 2024-25.

Chapter 3

METHODOLOGY

3.1 Introduction

The present impact study was undertaken to examine the extent to which the Vigyan Jyoti Program contributes to the development of certain dispositions pertinent to science, technology, engineering, and mathematics (STEM) among adolescent girls in Jawahar Navodaya Vidyalayas (JNVs). The assessment also sought to examine the degree to which the Vigyan Jyoti Program influences the interest of girls in STEM fields, self-efficacy, problem-solving capacity, and critical thinking, and the degree to which the Vigyan Jyoti Program increases the inclination of girls to pursue STEM courses and STEM-related professions upon the completion of Class XII. Additionally, the assessment sought to elucidate the processes by which such changes are likely to occur.

For the purpose of addressing these issues in a scientific and analytically rigorous fashion, the assessment was undertaken as a logic-driven evaluation, wherein the assessment questions are explicitly linked to the indicators, data sources, and methods of analysis. The Vigyan Jyoti Program had been implemented in the field, and the randomization of schools or students was not possible. For the purpose of the assessment, a quasi-experimental comparison group design was employed. The methodological framework for the assessment was based on the integration of quantitative data from student assessments with descriptive and explanatory data from STEM teachers, teacher coordinators, principals, alumni, and a nodal official. Such a design enabled the study to generate a comprehensive understanding of both measurable outcomes and the contextual processes associated with the implementation and perceived effects of the program.

3.2 Evaluation Approach and Research Paradigm

3.2.1 Evaluation Approach

This impact study utilized an impact-oriented evaluation framework, supported by scientific evidence relating to the outcomes as well as the processes by which these outcomes are perceived to have been achieved. The evaluation had two lines of inquiry, as described below.

One line of inquiry was concerned with the evidence relating to the outcomes, such as the perceived association between the Vigyan Jyoti Program and the enhancement of the core constructs of interest, self-efficacy, problem-solving capacity, and critical thinking capacity, as well as the girls' propensity for STEM courses and careers as opposed to those who did not participate.

The second line of inquiry was concerned with the perceptions and processes, such as the perceptions of the implementers of the Vigyan Jyoti Program and the relevant stakeholders

regarding the perceived benefits for the girls who had participated in the Program, as well as the perceived processes by which these benefits had been achieved.

This dual line of inquiry was integrated in the study to not only examine the differences associated with the Vigyan Jyoti Program but also to examine these differences in association with the exposure to the Program as well as the perceptions of the relevant stakeholders.

3.2.2 Research Paradigm: Pragmatic Mixed-Methods

A pragmatic paradigm was considered particularly pertinent for the current research, as the assessment entailed the measurement of the differences in the program-related outcome patterns as well as the interpretation of the contextual mechanisms underlying these patterns.

As such, the quantitative research paradigm was applied for the measurement of the patterns and disparities in the major STEM constructs across the classes and the program-related groups, whereas the qualitative and descriptive research evidence from various stakeholders was applied for the elucidation of the potential mechanisms, the facilitating factors, the benefits, and the constraints. The application of the mixed research paradigm enabled the integration of the measurement and the interpretation of the research evidence, as well as the enhancement of the credibility of the research interpretations due to the triangulation of the research evidence from the diverse sources.

3.3 Research Design: Quasi-Experimental Mixed-Methods

3.3.1 Rationale for the Design

As the Vigyan Jyoti Program had already been implemented in some schools, the random assignment of schools or students to the treatment and the comparison groups was not possible. Therefore, the current impact study adopts a quasi-experimental design with a comparison group, which is a methodologically appropriate design for such a study. As can be seen from the current design, the treatment and the comparison groups are inherently formed based on the status of the implementation of the Vigyan Jyoti Program. To be more specific, the girls who are enrolled in schools that implement the Vigyan Jyoti Program are the treatment group, whereas the girls who are enrolled in schools without the implementation of the Vigyan Jyoti Program are the comparison group.

Despite the fact that the current design does not use the method of random assignment to the treatment conditions, the current design does use the method of randomisation at the sampling level. To be more specific, the schools from both categories are randomly drawn from the sampling frame of the relevant schools. Such a method increases the representativeness of the sample and reduces the arbitrariness of the selection of the school clusters.

3.3.2 Structure of the Design

- Treatment group (VJ group): girls studying in schools where Vigyan Jyoti interventions were implemented and received by enrolled girls.
- Comparison group (non-VJ group): girls studying in comparable schools where the Vigyan Jyoti program was not implemented.

The student-level outcomes were subject to quantitative analysis to discern the patterns and group differences for the major student-level STEM-related variables and the variables associated with aspirations. At the same time, the perspectives of the teacher, teacher coordinators, principal,

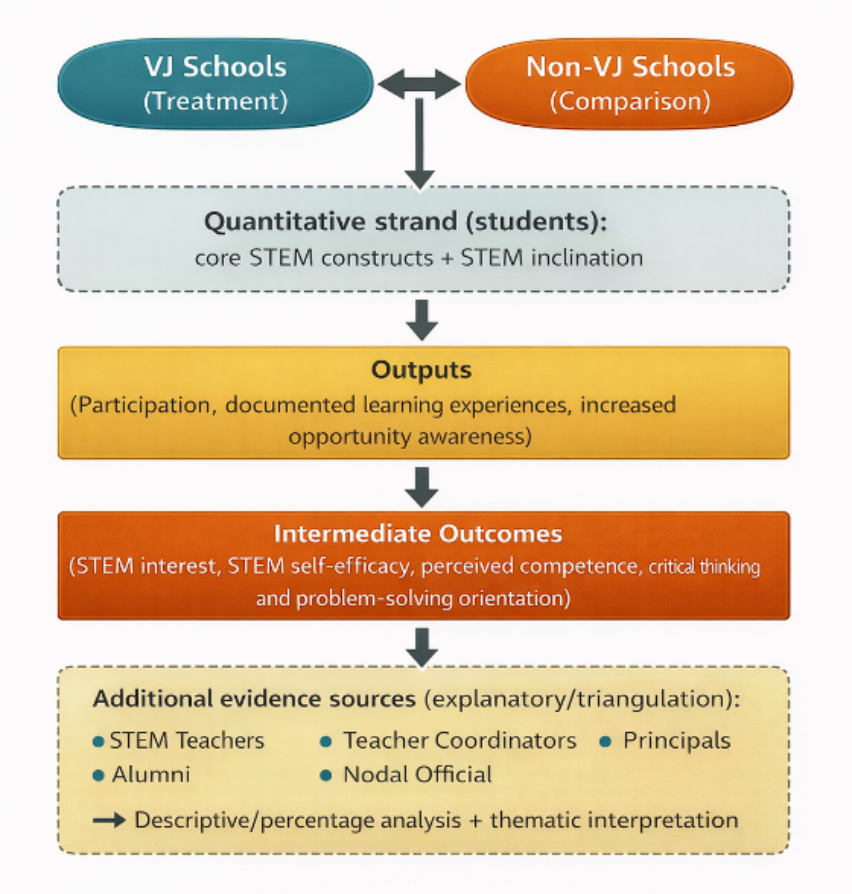


***Figure 3.1*:** Overview of the Evaluation Design (Quasi-Experimental Mixed-Methods).

alumni, and the nodal official were integrated to explicate, validate, and triangulate the emerging patterns from the student data. As depicted in Figure 3.1, the present impact study adopted the quasi-experimental approach to the study, with the quantitative study being the main basis for the impact assessment of the student-level outcomes, with the qualitative and stakeholder-based study providing supporting evidence to the quantitative study. The approach helped to create a better understanding of the outcomes and the underlying process through which the outcomes were being determined.

3.4 Study Locale and Regional Coverage

The present impact study was carried out under the Western Region of NCERT, through the Regional Institute of Education (RIE), Bhopal. Geographically, the present impact study covered the two states falling within the jurisdiction of RIE Bhopal, namely, Madhya Pradesh and Chhattisgarh. As may be seen from Figure 3.2, which shows the regional scope of the present impact study carried out within the Western Region of NCERT, namely, the RIE Bhopal region, the Jawahar Navodaya Vidyalayas (JNV) included within the present impact study were spread across the two states of Madhya Pradesh and Chhattisgarh. In the state of Madhya Pradesh, the present impact study included the schools implemented through the Vigyan Jyoti package and located at Indore, Ujjain-I, Rajgarh, and Dewas, and the comparison schools at Raisen, Ratlam-I, Hoshangabad, and Shajapur. In the state of Chhattisgarh, the present impact study included the schools implemented

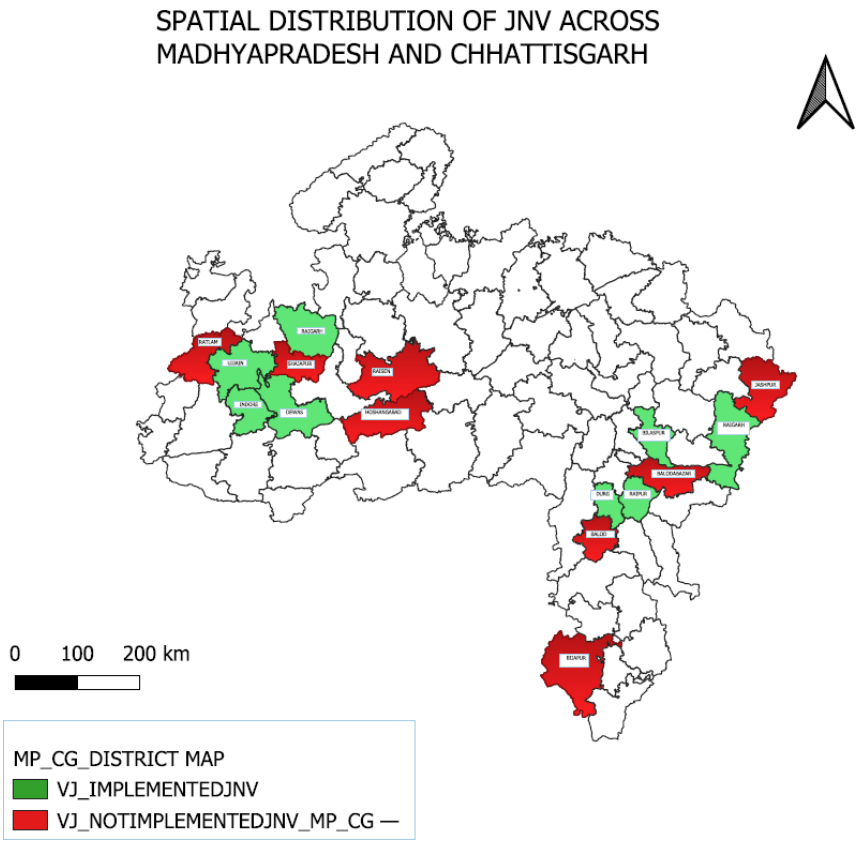


***Figure 3.2*:** Regional Coverage of the Present Impact Study (Western Region of NCERT—Bhopal Region: MP and CG).

through the Vigyan Jyoti package and located at Durg, Bilaspur, Raigarh, and Raipur, and the comparison schools at Balod, Baloda Bazar, and Jashpur. Hence, the regional scope of the present impact study covered the schools included within the present impact study, spread across the two states of Madhya Pradesh and Chhattisgarh, and defined the operational field boundaries for the present impact study. JNV Bijapur was not included within the present impact study since consent for the impact study was not forthcoming from the school.

Thus, the regional scope of the present impact study was fully congruent with the jurisdiction of RIE Bhopal and was institutionally relevant, geographically correct, and contextually appropriate, and was anchored within the actual area of program implementation within the Western Region of NCERT.

3.5 Program Logic Model: Mapping the Pathway to Impact

This impact assessment utilises a logic-based approach that describes the anticipated influence of the Vigyan Jyoti Program on girls in STEM fields. The program logic provides a conceptual base for the evaluation, clearly specifying the links between inputs, goals, processes, outputs, and outcomes over varying time periods. The logic model (see Figure 3.3) was instrumental in the development of the evaluation questions, indicators, data collection tools, as well as the interpretation of the results and the application of a broad program outcomes base.

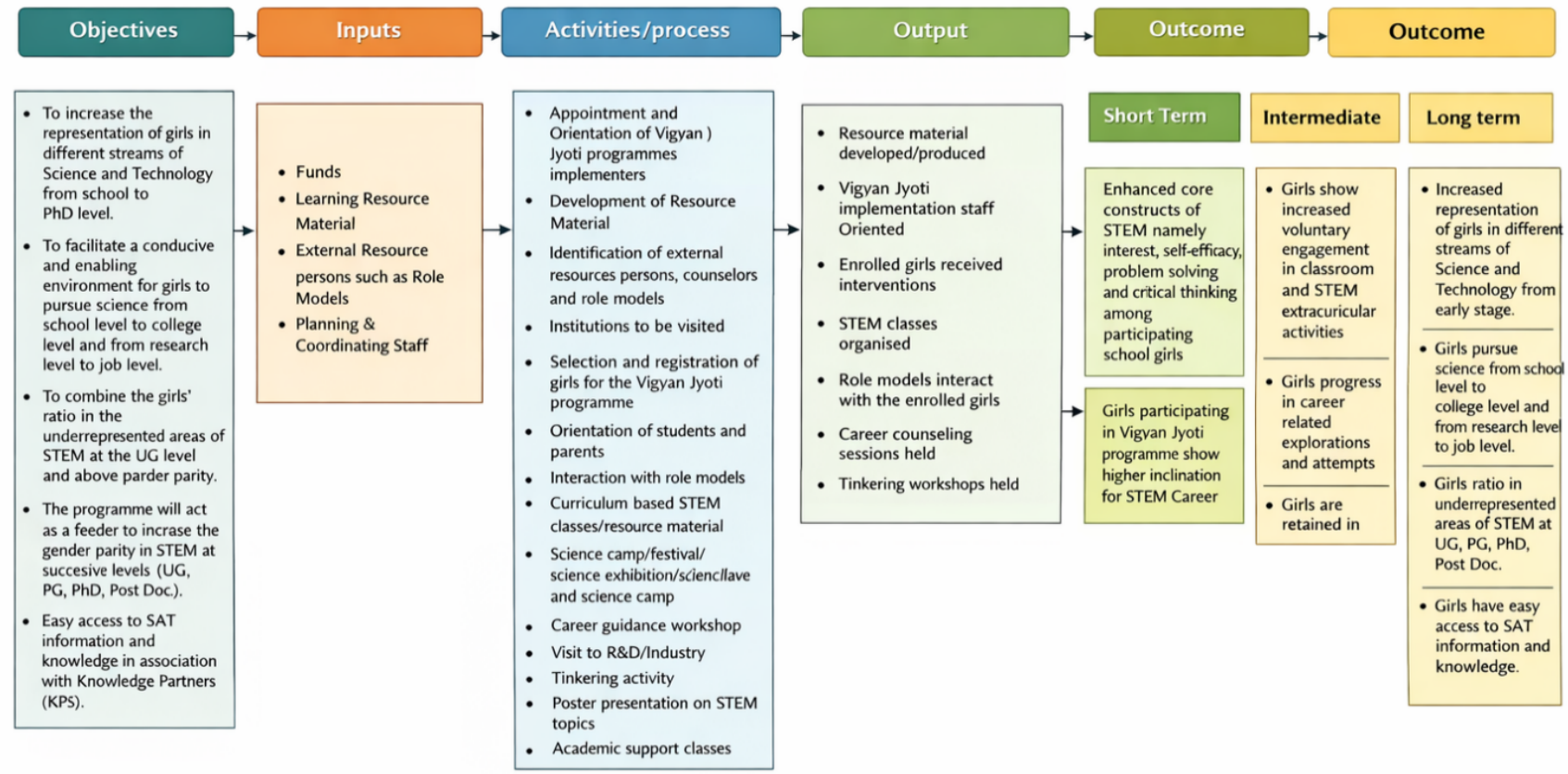


***Figure 3.3*:** Logic Model of Vigyan Jyoti Program.

3.6 Evaluation Questions and Analytical Framework

The questions for evaluation were formulated to explore the impact of the Vigyan Jyoti Program through the following three major domains:

(i) Core STEM constructs,

(ii) perceptions of stakeholders regarding the impact of the program, and

(iii) girls' inclination towards STEM courses and careers.

Each of the questions for evaluation was related to the most appropriate indicators, which helped create an analytical framework for the present impact study. This framework establishes the link between the methodology of the program logic and the evaluation methods, ensuring consistency between the methods and the questions for evaluation. The complete framework for the evaluation is presented in Table 3.1, "Impact Study of Vigyan Jyoti Program: Evaluation Framework."

Evaluation Questions	**Indicators**	**Data sources**	**Methods of Analysis**
To what extent does participation in the Vigyan Jyoti program influence the core constructs of STEM namely interest, self-efficacy, problem solving and critical thinking among participating school girls?	Improvement in mean scores on core constructs of STEM across grade levels (IXth to XIIth) of girls participating in Vigyan Jyoti program.	Student Questionnaire	Descriptive Statistical Analysis using Graphs
	Higher performance scores on core constructs of STEM of girls of XIIth standard who are undergoing Vigyan Jyoti program as compared to those in IXth standard of the program.		t-test for correlated mean scores
	Higher performance on the core constructs of STEM among girls enrolled in Vigyan Jyoti program as compared to the comparison group of girls who are not participating in the program.		Independent samples t-test/ Mann Whitney U test
To what extent do the STEM Teachers, Teacher Coordinators and Principals perceive the impact of the Vigyan Jyoti program on the participating girls	Percentage STEM functionaries perceiving impact	Teacher Questionnaire, Teacher Coordinator Questionnaire, Principal Questionnaire	Percentage Analysis
	Frequency of STEM functionaries perceiving higher impact		Chi-square test

Girls participating in Vigyan Jyoti program show higher inclination to opt for STEM subjects after class XII.	Higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM subjects as compared to those in the program who have received least inputs.	Student Questionnaire, Alumni Questionnaire	Percentage Analysis
	Higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM subjects as compared to the girls in the comparison group who are not enrolled in Vigyan Jyoti program.		
Girls participating in Vigyan Jyoti program show higher inclination to opt for STEM Career.	Higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM career as compared to those in the program who have received least inputs.	Student Questionnaire, Alumni Questionnaire	Percentage Analysis
	Higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM career as compared to the girls in the comparison group who are not enrolled in Vigyan Jyoti program.		

***Table 3.1*:** Impact Study of Vigyan Jyoti Program—Evaluation Framework.

3.7 Sampling Design and Statistical Power

3.7.1 Sampling Strategy

The questions for evaluation were formulated to explore the impact of the Vigyan Jyoti Program through the following three major domains:

(i) Core STEM constructs,

(ii) perceptions of stakeholders regarding the impact of the program, and

(iii) girls' inclination towards STEM courses and careers.

Each of the questions for evaluation was related to the most appropriate indicators, which helped create an analytical framework for the present impact study. This framework establishes the link between the methodology of the program logic and the evaluation methods, ensuring consistency between the methods and the questions for evaluation. The complete framework for the evaluation is presented in Table 3.1, "Impact Study of Vigyan Jyoti Program: Evaluation Framework."

Component	Planned Design
VJ Schools	4 schools from MP + 4 schools from CG = 8 schools, randomly selected from the available Vigyan Jyoti schools
Non-VJ Schools	4 schools from MP + 4 schools from CG = 8 schools, randomly selected from eligible non-VJ schools
VJ Students	400 students (MP) + 400 students (CG) = 800 students
Non-VJ Students	400 students (MP) + 400 students (CG) = 800 students
Alumni	5 per VJ school × 8 schools = 40
Teachers	5 per VJ school × 8 schools = 40
Teacher Coordinators	1 per VJ school × 8 schools = 8
Principals	1 per VJ school × 8 schools = 8
Nodal Official	1
Method of Sampling	Cluster sampling
Unit of Sampling	School
Unit of Measurement	Student, alumni, teacher, teacher coordinator, principal, nodal official

***Table 3.2*:** Planned Sample Design and Units of Sampling/Measurement.

3.7.2 Achieved Response

During the field implementation, responses were not obtained from one of the non-Vigyan Jyoti schools in Chhattisgarh. This non-response has been suitably taken care of while interpreting the results of the state-wise comparisons as well as the group-wise comparisons undertaken in the present impact assessment exercise. At the student level, the final sample for the study consists of 701 Vigyan Jyoti girl students of IX to XII standards, while the sample of non-Vigyan Jyoti girl students of IX to XII standards consists of 583 students. The proposed distribution of the principal respondent categories along with the actual achieved distribution is given in Table 3.3, which is headed by the title 'Sample Distribution by Respondent Group (Planned and Achieved).'

3.7.3 Statistical Power and Interpretation of Effect Sizes

The adequacy of the achieved sample was considered sufficient for conducting the proposed group-wise and grade-wise analyses within the scope of the present impact study. In addition to testing statistical significance, the study also emphasised the interpretation of practical significance through effect-size measures. In educational evaluation, effect-size indices are important because they indicate the substantive magnitude of differences or associations beyond the mere existence of statistical significance.

3.8 Data Collection Instruments

This impact study utilizes structured data collection tools for various categories of respondents in order to ensure triangulation of data. For students, the structured questionnaire had a rating scale of 40 questions. This rating scale is designed for the evaluation of basic concepts in STEM. It had retrospective ratings related to Class VIII and current ratings. It also had questions related to students' preference for STEM subjects and STEM careers. Separate questionnaires were also designed for stakeholders. These questionnaires were designed to collect information about the perception of the benefits of the program, the experience of the program implementation, and the

Respondent Group	Sampling Method	Planned Sample (MP + CG)	Achieved Sample (MP + CG)
VJ Girl Students (Classes IX–XII)	Cluster-based inclusion in selected VJ schools	800	701
Non-VJ Girl Students (Classes IX–XII)	Selection within selected non-VJ schools	800	583
VJ Alumni	School-based respondent identification	40	10
VJ STEM Teachers	Role-based purposive selection	40	—
Teacher Coordinators	Role-based inclusion (1 per VJ school)	8	6
Principals	Role-based inclusion	8	6
Nodal Official	Key informant	1	1

Note: *One non-VJ school in Chhattisgarh did not provide responses.*

***Table 3.3*:** Sample Distribution by Respondent Group (Planned and Achieved).

perception of the changes in the girls who were part of the program. Different questionnaires were used for the following categories of respondents:

1. girl students,
2. alumni,
3. STEM teachers,
4. teacher coordinators,
5. principals,
6. nodal officials.

The validity and reliability of the questionnaires were ensured by subjecting them to expert opinions in a workshop setup. Experts in the field evaluated the questionnaires in terms of relevance, construct, clarity, suitability of the questions, and suitability in terms of coverage of the study objectives. With the help of experts, the questionnaires were improved in terms of conceptual suitability and applicability. Further, the readability of the questionnaires in terms of language suitability was also checked at DMS, Bhopal. This also improved the questionnaires in terms of suitability. Thus, the questionnaires used in the study were highly applicable in terms of conceptual suitability as well as suitability in terms of expertise. Although the questionnaires for students were used for collecting quantitative data, the questionnaires for stakeholders were used for collecting descriptive data.

3.9 Data Collection Procedures and Data Management

Data collection activities were carried out through field visits to the selected schools, using standardized administrative procedures. Questionnaires for the students were conducted in a group setting, with the objective of achieving uniformity in administration and conditions of response, while the questionnaires for the stakeholders were conducted individually, based on the standardized school-visit schedule.

Before the final data collection, the questionnaires were reviewed and refined through a workshop with experts, and the linguistic readability of the questionnaires was evaluated to ensure their suitability for field data collection activities. This helped to improve the clarity, usability, and contextual appropriateness of the questionnaires for the selected schools.

For the systematic management of the data collected, the data were entered into a structured database, with each data point being provided with a unique identifier. To improve the data quality, the quantitative data were subject to range checks, consistency checks, and verification activities to ensure the minimization of data entry errors. Qualitative data, such as open-ended questions and key-informant inputs, were collected for subsequent data analysis activities.

3.10 Data Analysis Plan

3.10.1 Quantitative Analysis

Quantitative analysis was carried out through a structured process, which included screening, descriptive profiling, scale development, reliability analysis, and inferential analysis, which was consistent with the evaluation framework. Quantitative analysis was done through an assessment of missing values and outliers, followed by descriptive analysis and group-wise analysis.

The statistical methods used for the present study included descriptive statistical analysis through graphical methods, paired t-tests for correlated scores, independent t-tests, the Mann-Whitney U test, frequency analysis, and chi-square tests, etc., based on the suitability of the methods for the variables and the level of measurement and the requirements of the evaluation questions.

3.10.2 Qualitative Analysis

The qualitative and descriptive information gathered from the stakeholders was subjected to thematic analysis. The thematic analysis process involved familiarization with the data, development of initial codes, identification of emerging themes, refinement of thematic categories, and interpretation of the results in relation to the evaluation questions.

This analytical approach was particularly relevant in clarifying the patterns that emerged from the quantitative data, identifying perceived mechanisms through which the program was thought to have operated, and recording insights that were relevant. Illustrative information provided by the stakeholders was used judiciously, as necessary, to enhance the interpretative narrative.

3.10.3 Integration of Findings

In the current study, an integrative interpretive approach was used, wherein quantitative as well as qualitative evidence was integrated during the analysis and discussion sections of the study. This has also enabled the contextualization of quantitative evidence, an analysis of convergence across evidence sources, as well as an improvement in the credibility of inferences. In contrast to viewing these two strands as separate components, an interpretation of quantitative evidence was made in relation to stakeholder perceptions, contextual conditions, and implementation experiences, resulting in an overall comprehensive understanding of the impact of the Vigyan Jyoti Program.

3.11 Limitations

The findings of the impact study are interpreted within the framework of several methodological limitations, including the following:

1. The non-random assignment of schools and teachers precludes the possibility of establishing strict causality.
2. A heavy reliance on self-reporting may be subject to several biases and interpretations.
3. Retrospective ratings of Class VIII may be subject to recall bias.
4. A cross-sectional approach, including grade-level measurement, may be subject to developmental biases.

Furthermore, it is pertinent to note that the impact study was limited to the Bhopal regional jurisdiction, including the states of Madhya Pradesh and Chhattisgarh. As such, it may not be automatically generalizable outside of the study setting. In addition, it is pertinent to note that one non-VJ school in the state of Chhattisgarh did not provide responses, which impacted the sample size. Finally, it may be noted that the quality of program implementation may not have been captured fully, particularly without direct observation.

3.12 Ethical Considerations

It was observed that appropriate ethical standards were followed in the present impact study. Voluntary participation of the respondents was ensured, and their responses were kept confidential at all stages of data collection, processing, and reporting. Also, all the responses were anonymized by using codes to ensure the confidentiality of the respondents' identities. Before conducting the study, necessary administrative permissions were obtained, and data collection was arranged in a manner that minimally interfered with the regular functioning of the schools.

3.13 Summary

The impact evaluation methodology of the present study followed a quasi-experimental comparison group approach as part of a broader pragmatic mixed-methods approach to assess the impact of the Vigyan Jyoti Program on girls' STEM-related dispositions and aspirations. The methodology was informed by a program logic model and an evaluation framework that established clear links between evaluation questions, indicators, data sources, and analysis techniques.

A cluster sampling approach was followed, with random sampling of schools by lottery, with the school being the sampling unit. The sampling achieved was clearly stated, including non-response at the school level. A validity and reliability study of the data collection instruments was conducted through expert consultation, with experts meeting in workshop settings to evaluate the data collection instruments. Linguistic readability was also conducted at DMS, Bhopal. A standard approach was followed in data collection and management, with practical as well as statistical significance being incorporated into the analysis through effect sizes. A methodologically coherent basis was established for understanding both outcomes and processes associated with the Vigyan Jyoti Program through triangulation of quantitative and qualitative data.

Chapter 4

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents a systematic analysis and interpretation of evidence developed in association with the set of outcome-oriented evaluation questions identified for the purpose of the current impact study of the Vigyan Jyoti Program. The chapter is structured in a manner that is consistent with the identified and approved evaluation framework, and it addresses a set of four broad analytical concerns, viz., (i) the extent to which the Program influences the core construct of STEM for the girls who participate in it, (ii) the extent to which the Program is perceived by STEM teachers, teacher coordinators, and principals as influencing the girls who participate in it, (iii) the extent to which girls who participate in the Program show an inclination towards pursuing STEM subjects after class XII, and (iv) the extent to which girls who participate in the Program show an inclination towards pursuing STEM as a career.

The analysis presented within this chapter is underpinned by evidence derived from a range of instruments and respondent groups, as represented by the Student Questionnaire, Teacher Questionnaire, Teacher Coordinator Questionnaire, Principal Questionnaire, and Alumni Questionnaire. The chapter has been constructed within a report-ready academic format by carefully synthesizing the statistical evidence derived from the main report, as well as the interpretive observations and revision suggestions as represented within the remarks document, and additional evidence derived from the response sheet for the alumni questionnaire. In order to maintain the confidentiality and anonymity of participating institutions, it is important to note that within this chapter, as within the remainder of the report, individual schools are not identified or referred to by name. A methodological caveat is necessary with regard to the evidence derived from responses within the alumni questionnaire. The response sheet for this questionnaire for revision purposes provided responses from a total of ten alumni from Madhya Pradesh only; conversely, there were no corresponding responses from the population within Chhattisgarh. The findings derived from this questionnaire are thus represented as supplementary evidence from a restricted respondent group. Although useful insights are derived from this additional layer of analysis by extending the respondent group beyond the individual school level to post-school educational and career aspirations, it is important to note that this evidence is not interpreted as a basis for state-wise comparison or generalization.

4.2 Evaluation Question 1

To what extent does participation in the Vigyan Jyoti program influence the core constructs of STEM namely interest in STEM subjects, self-efficacy in STEM activities, problem solving

and critical thinking among participating school girls?

To answer this question, student responses, both from those who have undergone the interventions under Vigyan Jyoti program and those who have not undergone them, were collected on a structured questionnaire. The indicators of program influence are:

1. Improvement in mean scores on core constructs of STEM across grade levels (IX to XII) of girls participating in Vigyan Jyoti program.

2. Higher performance scores on core constructs of STEM of girls of class XII who are undergoing Vigyan Jyoti program as compared to those in class IX of the program.

3. Higher performance on the core constructs of STEM among girls enrolled in Vigyan Jyoti program as compared to the comparison group of girls who are not participating in the program.

4.2.1 Indicator 1

Is there an improvement in mean scores on core constructs of STEM across grade levels (IX to XII) of girls participating in Vigyan Jyoti program?

The first indicator was analyzed through the application of descriptive statistics by referring to the visuals presented in Figures 4.1, 4.2, and 4.3. Figure 4.1 is a chart named "Interest in STEM Courses, Self-Efficacy in STEM Skills, Problem Solving Ability and Critical Thinking Ability of Vigyan Jyoti and Non-Vigyan Jyoti Students Across Grades." It provides a general idea of the combined result for both states. Overall, the combined figure does not reveal a clear advantage for the Program students over the non-Program students across all grades. Although the mean difference between the two groups is not large, the significance test does not reveal any statistically significant difference. Hence, the impact of the Program on the four core constructs does not reveal a clear trend at the aggregate level. However, the individual graphs for the individual states present a slightly different picture. Figure 4.2 refers to the case of Madhya Pradesh. It reveals a slightly more favorable trend for the Program students. For the upper grades, the Program girls appear to have a higher mean value on all the constructs compared to the non-Program girls. The initial findings reveal that in the case of Madhya Pradesh, the difference in the mean performance between the Program girls and the non-Program girls in Class XII is statistically significant on the constructs of self-efficacy and critical thinking. It seems to suggest a possible effect of the sustained exposure to the Program over the years.

However, Figure 4.3, pertaining to the Chhattisgarh state, does not reflect the same level of Program impact. From the descriptive analysis, it is inferred that in Class XII, the non-Program group is showing slightly higher means on some constructs, but these are not significant. Therefore, although the descriptive analysis for the Chhattisgarh state is less favorable, it cannot be inferred that the Program has a negative impact, but rather that its impact is perhaps not equally reflected in all contexts.

From the graphical analysis, it is inferred that the impact of the Vigyan Jyoti Program on the core STEM constructs is context-dependent rather than uniform. Further, it is inferred from the descriptive analysis that the Program has a greater impact in the Madhya Pradesh context compared to the Chhattisgarh context. Additionally, it is inferred that the Program has a greater impact in higher classes rather than in lower classes.

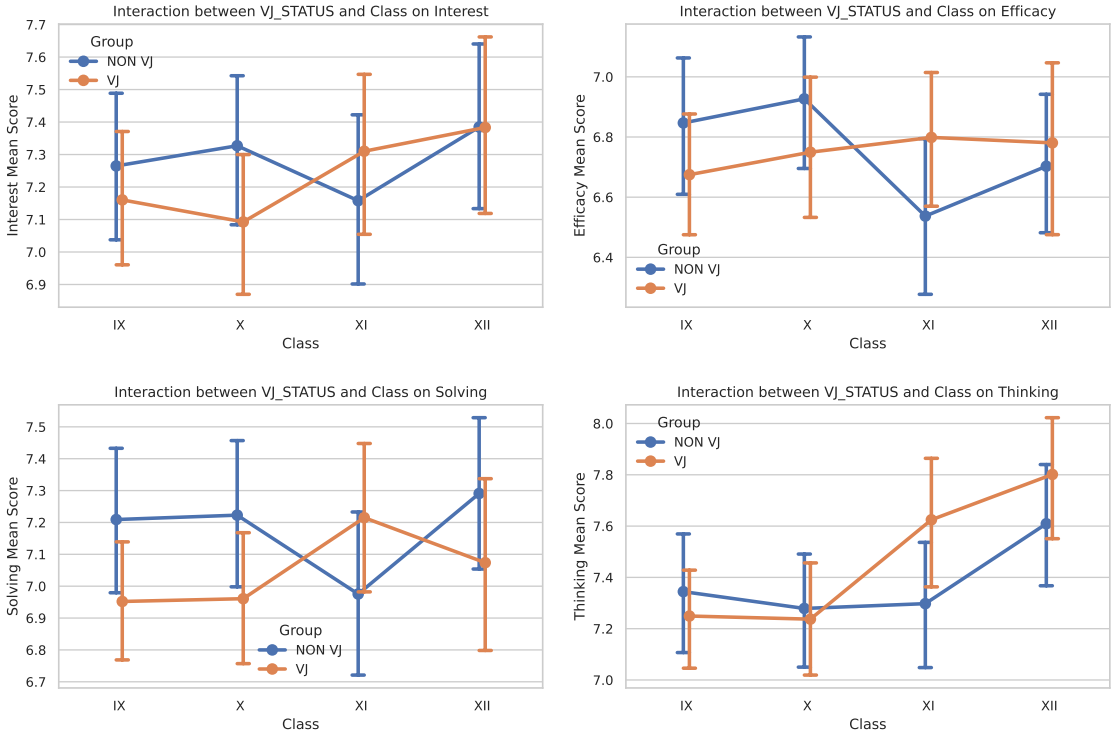


Figure 4.1: *Interest in STEM Courses, Self Efficacy in STEM Skills, Problem Solving Ability and Critical Thinking Ability* of VJ and Non-VJ Students Across Grades.

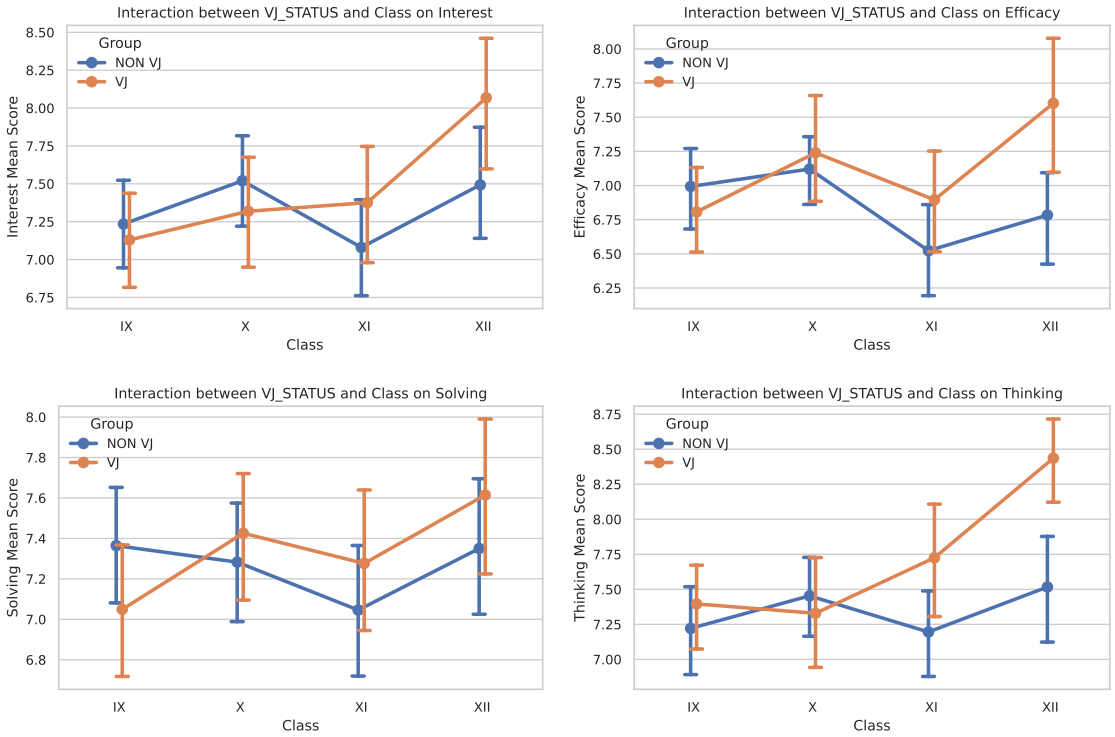


Figure 4.2: *Interest in STEM Courses, Self Efficacy in STEM Skills, Problem Solving Ability and Critical Thinking Ability* of VJ and Non-VJ Students of MP Across Grades.

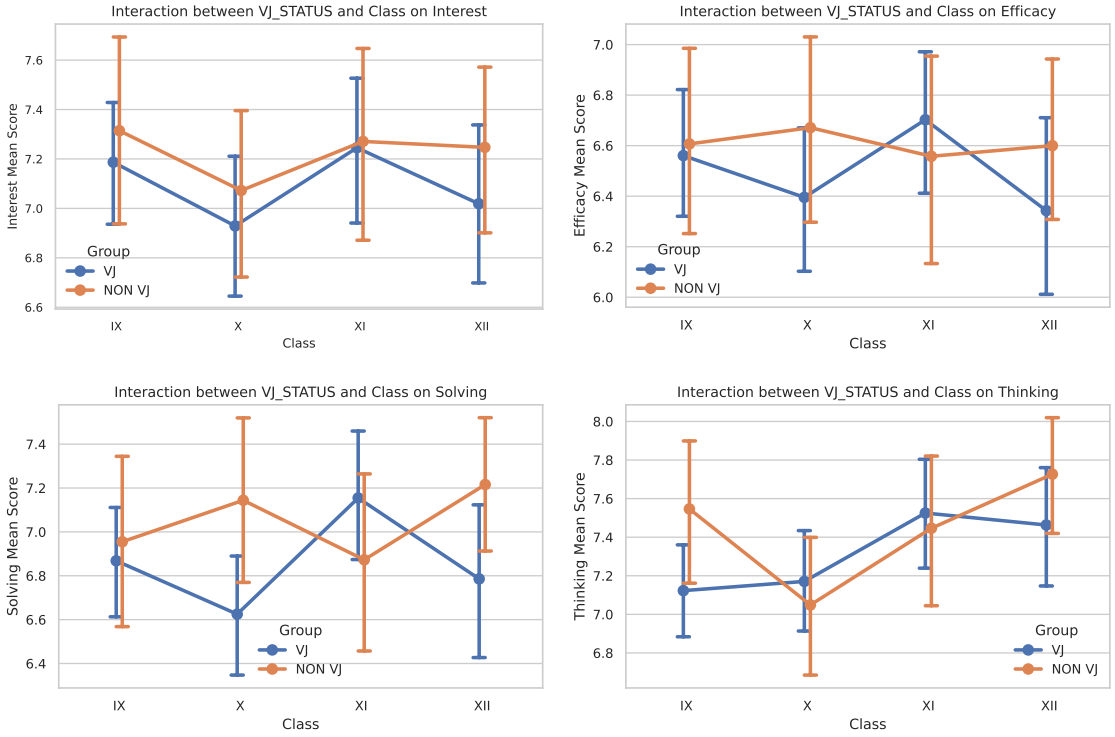


Figure 4.3: *Interest in STEM Courses, Self Efficacy in STEM Skills, Problem Solving Ability and Critical Thinking Ability* of VJ and Non-VJ Students of CG Across Grades

4.2.2 Indicator 2

Is there a higher performance on core constructs of STEM of girls of XIIth standard who are undergoing Vigyan Jyoti program as compared to those in IXth standard of the program?

Performance on core constructs of STEM of class XII students who have received all inputs of Vigyan Jyoti program as compared to that of class IX who have very little exposure to the interventions was represented through mean scores obtained by students in core constructs. Data was analysed for significance using t-test. Results are presented in the following table.

Core Construct	Class	*N*	Mean	SD	*t*-value	*p*
Interest towards STEM courses	IX	114	7.130	1.780	3.498	<.001
	XII	41	8.068	1.345		
Self-Efficacy	IX	114	6.807	1.682	2.811	<.001
	XII	41	7.602	1.506		
Problem Solving	IX	114	7.049	1.730	2.198	<.05
	XII	41	7.615	1.280		
Critical Thinking	IX	114	7.396	1.712	4.682	<.001
	XII	41	8.436	0.986		

Table 4.1: Comparison of standard IX and XII on Core Constructs for students undergoing Vigyan Jyoti program in Madhya Pradesh.

It may be seen that the t-value of 3.498 is significant at .001 level for interest towards STEM courses. This would mean that the class XII students undergoing the Vigyan Jyoti program have shown an improvement in interest towards STEM courses as compared to their counterparts in class IX. Further, it may be seen that the t-values are significant at .001 level for self-efficacy and critical thinking and at .05 level for problem solving ability. This would mean that the class XII students undergoing the Vigyan Jyoti program have shown an improvement in the above mentioned three core constructs as compared to their counterparts in class IX. Overall, it may be said that the program has resulted in improved performance on the core constructs of STEM by class XII.

Core Construct	Class	*N*	Mean	SD	*t*-value	*p*
Interest towards STEM courses	IX	132	7.19	1.50	-0.78	.438
	XII	77	7.02	1.51		
Self-Efficacy	IX	132	6.56	1.51	-0.98	.328
	XII	77	6.34	1.57		
Problem Solving	IX	132	6.87	1.47	-0.38	.706
	XII	77	6.79	1.55		
Critical Thinking	IX	132	7.12	1.39	1.70	.091
	XII	77	7.46	1.40		

***Table 4.2*:** Comparison of standard IX and XII on Core Constructs for students undergoing Vigyan Jyoti program in Chhattisgarh.

The present evaluation also looked in to the possibility of students perceiving a difference in themselves in core constructs of STEM. They were asked to rate themselves on the core constructs as they were in class VIII and as they perceive themselves in XII standard. A repeated measures t-test was used to study the significance of difference in the comparative self-perception of girls. The hypothesis tested are:

H_0: $\mu_{\text{class XII}} - \mu_{\text{class VIII}} = 0$

H_a: $\mu_{\text{class XII}} - \mu_{\text{class VIII}} \neq 0$

Results for Madhya Pradesh and Chhattisgarh are as follows:

Core Construct of STEM	*N*	Mean	SD	df	*t*-value	*p*
Interest in STEM Courses in class VIII	41	6.82	1.33	40	5.16	<.001
Interest in STEM Courses in class XII	41	8.07	1.35			
Self-Efficacy in STEM in class VIII	41	5.62	1.33	40	7.38	<.001
Self-Efficacy in STEM in class XII	41	7.60	1.51			
Problem Solving Ability in class VIII	41	5.69	1.28	40	7.42	<.001
Problem Solving Ability in class XII	41	7.61	1.28			
Critical Thinking Ability in class VIII	41	5.92	1.61	40	9.06	<.001
Critical Thinking Ability in class XII	41	8.44	0.99			

***Table 4.3*:** Comparative Self-Perception of class XII Girls from MP on Core Constructs of STEM.

Core Construct of STEM	*N*	Mean	SD	df	*t*-value	*p*
Interest in STEM Courses in class VIII	77	6.18	1.57	76	5.16	<.001
Interest in STEM Courses in class XII	77	7.02	1.51			
Self-Efficacy in STEM in class VIII	77	5.42	1.74	76	5.03	<.001
Self-Efficacy in STEM in class XII	77	6.34	1.57			
Problem Solving Ability in class VIII	77	5.70	1.70	76	5.66	<.001
Problem Solving Ability in class XII	77	6.79	1.55			
Critical Thinking Ability in class VIII	77	6.12	1.61	76	7.77	<.001
Critical Thinking Ability in class XII	77	7.46	1.40			

***Table 4.4*:** Comparative Self-Perception of class XII Girls from CG on Core Constructs of STEM.

Results of the repeated measures t-test shows that in both Madhya Pradesh and Chhattisgarh, the class XII girls who have received the Vigyan Jyoti interventions perceive a significant improvement in the core constructs namely Interest in STEM subjects, Self-Efficacy in STEM skills, Problem Solving ability and Critical Thinking ability. In other words, the beneficiary girl students of Madhya Pradesh and Chhattisgarh perceive that there is an impact of the program on the core constructs. It may however be mentioned that such a perceived benefit of the program may be encouraging to the program implementers, it is possible that there could be extraneous factors other than the program interventions which may have influenced the perception of students.

4.2.3 Indicator 3

Is there a higher performance on the core constructs of STEM among girls enrolled in Vigyan Jyoti program as compared to the comparison group of girls who are not participating in the program?

While answering evaluation question 2 a descriptive analysis was presented to know whether there is a higher performance of class XII girls who have received Vigyan Jyoti interventions as compared to those who have not received it. In continuation, 2-Way ANOVA were conducted to answer the question 'Is there a higher performance on the core constructs of STEM among girls enrolled in Vigyan Jyoti program as compared to the comparison group of girls who are not participating in the program?' Results are presented below.

Overall comparison of VJ and non-VJ students of different classes on core construct of STEM: To examine whether girls enrolled in the Vigyan Jyoti (VJ) program perform better on the core constructs of STEM compared to girls who are not part of the program (Non-VJ), a two–way ANOVA was conducted. The independent variables considered were *program Status* (VJ and Non-VJ) and *Class* (IX, X, XI and XII). The dependent variables analysed were the four core constructs of STEM, namely Interest in STEM Courses, Self-Efficacy in STEM Skills, Problem Solving Ability and Critical Thinking Ability.

The results of the two–way ANOVA reveal that the main effect of program status is not statistically significant for Interest in STEM courses ($F(1, 1276) = 0.29$, $p = .588$), Self-Efficacy ($F(1, 1276) \approx 0.00$, $p = .977$), and Problem Solving Ability ($F(1, 1276) = 2.10$, $p = .148$). Similarly, the interaction effect between program status and class level is also not statistically significant for these constructs. This indicates that, when students across all classes and both states are considered together, participation in the Vigyan Jyoti program does not produce a statistically significant difference in the levels of Interest, Self-Efficacy, or Problem Solving Ability compared to the comparison group.

	Sum of Squares	df	Mean Square	F	p
VJ STATUS	0.68	1	0.68	0.29	.588
CLASS	5.76	3	1.92	0.83	.478
VJ STATUS × CLASS	6.25	3	2.08	0.90	.441
Residuals	2956.75	1276	2.32		

***Table 4.5*:** Summary of 2-Way ANOVA for Interest in STEM Courses.

	Sum of Squares	df	Mean Square	F	p
VJ STATUS	0.00	1	0.00	8.15e-4	.977
CLASS	4.60	3	1.53	0.65	.585
VJ STATUS × CLASS	10.60	3	3.53	1.49	.215
Residuals	3021.08	1276	2.37		

***Table 4.6*:** Summary of 2-Way ANOVA for Self-Efficacy.

	Sum of Squares	df	Mean Square	F	p
VJ STATUS	4.74	1	4.74	2.10	.148
CLASS	1.84	3	0.61	0.27	.846
VJ STATUS × CLASS	13.41	3	4.47	1.98	.116
Residuals	2886.07	1276	2.26		

***Table 4.7*:** Summary of 2-Way ANOVA for Problem Solving Ability.

	Sum of Squares	df	Mean Square	F	p
VJ STATUS	2.76	1	2.76	1.20	.274
CLASS	35.60	3	11.87	5.14	.002
VJ STATUS × CLASS	9.41	3	3.14	1.36	.254
Residuals	2943.78	1276	2.31		

(a) ANOVA - Thinking

Comparison							
CLASS		CLASS	Mean Difference	SE	df	t	p_{tukey}
X	-	XI	-0.20	0.12	1276.00	-1.67	.339
X	-	XII	-0.45	0.13	1276.00	-3.56	.002
X	-	IX	-0.04	0.11	1276.00	-0.35	.985
XI	-	XII	-0.24	0.13	1276.00	-1.88	.236
XI	-	IX	0.16	0.12	1276.00	1.36	.522
XII	-	IX	0.41	0.12	1276.00	3.29	.006

(b) Post Hoc Comparisons - CLASS

***Table 4.8*:** Summary of 2-Way ANOVA for Critical Thinking Ability.

For Critical Thinking Ability, however, the analysis shows a statistically significant main effect of class ($F(3, 1276) = 5.14$, $p = .002$). Post-hoc comparisons using Tukey's test indicate that students in class XII perform significantly better than those in class IX and class X. This suggests that critical thinking ability tends to improve as students progress to higher classes, particularly by the time they reach class XII.

The result is significant for the main effect 'class' in "Critical Thinking Ability". A post-hoc test using Tukey's test was conducted for further analysis for this category.

It can be seen that there exists an improved performance of the Vigyan Jyoti students on critical thinking at class XII compared to class IX and X. The impact of the program can be found in class XII students.

Descriptive statistics for the states of Madhya Pradesh and Chhattisgarh also provide additional insights. In Madhya Pradesh, students enrolled in the Vigyan Jyoti program in class XII show higher mean scores across all four core constructs compared to their Non-VJ counterparts, especially in Interest, Self-Efficacy and Critical Thinking. In contrast, the differences between VJ and Non-VJ students in Chhattisgarh are comparatively small and inconsistent across classes.

			Interest		**Efficacy**		**Solving**		**Thinking**	
CLASS	VJ STATUS	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD
IX	NON VJ	90	7.23	1.40	6.99	1.43	7.36	1.41	7.22	1.54
	VJ	114	7.13	1.78	6.81	1.68	7.05	1.73	7.40	1.71
X	NON VJ	87	7.52	1.44	7.12	1.24	7.28	1.31	7.45	1.38
	VJ	78	7.32	1.60	7.24	1.77	7.43	1.48	7.33	1.85
XI	NON VJ	83	7.08	1.45	6.52	1.49	7.05	1.52	7.20	1.58
	VJ	76	7.38	1.68	6.90	1.65	7.28	1.57	7.73	1.83
XII	NON VJ	80	7.49	1.65	6.78	1.53	7.35	1.55	7.52	1.70
	VJ	41	8.07	1.35	7.60	1.51	7.61	1.28	8.44	0.99

***Table 4.9*:** Descriptives for state Madhya Pradesh.

			Interest		**Efficacy**		**Solving**		**Thinking**	
CLASS	VJ STATUS	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD
IX	NON VJ	55	7.31	1.41	6.61	1.45	6.96	1.46	7.55	1.42
	VJ	132	7.19	1.50	6.56	1.51	6.87	1.47	7.12	1.39
X	NON VJ	66	7.07	1.43	6.67	1.51	7.14	1.63	7.05	1.49
	VJ	108	6.93	1.44	6.40	1.53	6.63	1.42	7.17	1.40
XI	NON VJ	57	7.27	1.50	6.56	1.63	6.87	1.57	7.45	1.45
	VJ	77	7.25	1.40	6.70	1.31	7.15	1.37	7.53	1.30
XII	NON VJ	63	7.25	1.43	6.60	1.35	7.22	1.36	7.73	1.23
	VJ	77	7.02	1.51	6.34	1.57	6.79	1.55	7.46	1.40

***Table 4.10*:** Descriptives for state Chhattisgarh.

Welch's t-tests conducted for overall comparisons across all classes and states show that the differences between VJ and Non-VJ students are not statistically significant for any of the four constructs (Interest: $p = .393$, Self-Efficacy: $p = .828$, Problem Solving: $p = .086$, Critical Thinking: $p = .651$). When analysed separately for Madhya Pradesh, statistically significant differences in favour of VJ students are observed in class XII for Interest ($p = .043$), Self-Efficacy ($p = .006$) and

Critical Thinking ($p < .001$), whereas no such significant differences are observed for students from Chhattisgarh.

	t	df	p
Interest	0.85	1261.75	.393
Efficacy	0.22	1270.44	.828
Solving	1.72	1252.01	.086
Thinking	-0.45	1253.23	.651

Note. $H_a \mu_{NONVJ} \neq \mu_{VJ}$

***Table 4.11*:** Welch's t of Non VJ versus VJ across all classes and states.

	IX			X		
	t	df	p	t	df	p
Interest	0.47	202.00	.638	0.85	155.78	.399
Efficacy	0.86	200.89	.394	-0.49	136.20	.622
Solving	1.43	201.76	.153	-0.65	154.73	.514
Thinking	-0.77	198.50	.445	0.49	141.22	.628

	XI			XII		
	t	df	p	t	df	p
Interest	-1.18	148.94	.239	-2.06	96.47	.043
Efficacy	-1.49	151.51	.138	-2.81	82.08	.006
Solving	-0.94	154.76	.349	-1.00	95.32	.319
Thinking	-1.95	149.00	.054	-3.77	117.04	< .001

Note. $H_a \mu_{NONVJ} \neq \mu_{VJ}$

***Table 4.12*:** Welch's t of Non VJ versus VJ for state Madhya Pradesh.

Overall, the results indicate that while the Vigyan Jyoti program does not show a statistically significant overall difference between VJ and Non-VJ students across all classes and states combined, some positive effects are observable at higher grade levels, particularly among class XII students in Madhya Pradesh, where VJ students demonstrate higher performance on certain core constructs of STEM.

4.3 Evaluation Question 2

To what extent do the STEM Teachers, Teacher Coordinators and Principals perceive the impact of the Vigyan Jyoti program on the participating girls?

This evaluation question examines stakeholder perceptions of the Vigyan Jyoti Program from the standpoint of school-level STEM functionaries. In accordance with the evaluation framework, the analysis includes teachers, teacher coordinators, and principals. The present draft integrates all three sets of responses so that the stakeholder evidence is analytically complete.

4.3.1 Indicator 1

Percentage STEM functionaries perceiving impact.

	IX			X		
	t	df	p	t	df	p
Interest	0.55	106.72	.582	0.64	138.00	.523
Efficacy	0.20	105.06	.845	1.16	138.99	.246
Solving	0.37	101.91	.712	2.14	123.25	.034
Thinking	1.91	99.20	.059	-0.54	131.28	.593

	XI			XII		
	t	df	p	t	df	p
Interest	0.10	115.91	.920	0.91	135.03	.362
Efficacy	-0.55	104.59	.582	1.04	137.66	.299
Solving	-1.08	110.93	.283	1.74	137.31	.083
Thinking	-0.33	113.48	.746	1.18	137.22	.239

Note. $H_a \mu_{NONVJ} \neq \mu_{VJ}$

***Table 4.13*:** Welch's t of Non VJ versus VJ for state Chhattisgarh.

In order to understand the perception of STEM functionaries regarding the impact of the Vigyan Jyoti program, teachers, teacher coordinators and principals were asked to rate a set of statements related to changes observed among participating girls. The responses were measured on a five–point Likert scale where 5 indicates "Strongly Agree" and 1 indicates "Strongly Disagree". The mean scores obtained for the statements are presented in Table 4.14.

The results indicate that STEM functionaries generally perceive a positive impact of the Vigyan Jyoti program on participating girls. The mean scores for all the statements range between 3.8 and 4.0, which indicates that respondents tend to agree that the program has contributed positively to the development of the students.

The highest mean score of 4.0 is observed for the statements that participation in Vigyan Jyoti has increased girls' interest and curiosity in science and mathematics, improved their self-confidence in learning and performing tasks in science and mathematics, and strengthened their critical thinking skills. This suggests that the program is perceived to have a strong influence on developing students' motivation and higher-order thinking abilities in STEM learning.

Similarly, relatively high mean scores (3.9) are obtained for statements related to improved classroom engagement, better academic achievement in science and mathematics, and increased willingness among girls to ask questions and clarify doubts. These results indicate that STEM functionaries observe greater participation and active involvement of girls in STEM-related learning activities after joining the program.

The statement regarding girls' interest and persistence in solving problems in science and mathematics and their inclination to seek guidance about higher studies and career opportunities in STEM received mean scores of 3.8. Although slightly lower than the other items, these scores still indicate a positive perception of program impact in encouraging students to think about future academic and career pathways in STEM.

Overall, the responses of STEM functionaries suggest that the Vigyan Jyoti program is perceived to have a favourable impact on girls' interest, confidence, engagement and critical thinking abilities in STEM learning.

Statement	Mean score
Participation in Vigyan Jyoti has increased girls' interest and curiosity in science and mathematics.	4.0
Participation in Vigyan Jyoti has improved girls' self-confidence in learning and performing tasks in science and mathematics.	4.0
Girls exhibit more active engagement and participation in science and mathematics activities after joining Vigyan Jyoti.	3.9
Girls show improvement in their academic achievement levels in science and mathematics after joining Vigyan Jyoti.	3.9
Participation in Vigyan Jyoti has enhanced girls' interest and persistence in solving problems in science and mathematics.	3.8
Girls are more eager to ask questions and clarify doubts in science and mathematics classrooms after joining Vigyan Jyoti.	3.9
Girls are more inclined to ask questions and seek guidance about higher study and career opportunities in science and mathematics.	3.8
Participation in Vigyan Jyoti has strengthened girls' critical thinking skills (e.g., identifying inconsistencies, logical reasoning, evidence-based conclusions).	4.0

Table 4.14 **:** Mean scores of teacher's observations in 5-point scale (5 strongly agree and 1 strongly disagree).

4.3.2 Indicator 2

Frequency of STEM functionaries perceiving higher impact.

In order to obtain a clearer understanding of the perceived impact of the Vigyan Jyoti program, teacher coordinators and teachers were asked to estimate the proportion of girls who have benefited from the program in various areas such as interest in science and mathematics, confidence in learning STEM subjects, problem solving ability, critical thinking ability and determination to pursue STEM after class XII. Their responses were recorded in terms of percentage ranges of students perceived to have benefited.

Teacher coordinator Questionnaire:

Given below are the areas of impact of Vigyan Jyoti program. Based on teacher coordinator's observations indicating the estimated percentage of girls enrolled in the Vigyan Jyoti program (whom they have taught) and have benefited in the following areas.

The responses of teacher coordinators presented in Table 4.15 indicate that, across different classes, most coordinators reported that between 50% and 75% of the participating girls benefited in the various areas considered. In classes XI and XII, the majority of responses fall in the 50–75% category for all five areas of impact. This suggests that teacher coordinators perceive a moderate to substantial level of program impact on students' interest in STEM, confidence in learning

science and mathematics, problem solving abilities, critical thinking abilities and determination to pursue STEM studies after class XII.

Sl.	Area	IX				X			
		<25%	25-50%	50-75%	>75%	<25%	25-50%	50-75%	>75%
i	Interest towards learning science and mathematics	0	2	0	0	0	1	1	0
ii	Confidence shown in learning science and mathematics	0	2	0	0	0	1	2	0
iii	Problem solving abilities	0	1	1	0	0	1	3	0
iv	Critical thinking abilities	0	2	1	0	0	1	3	0
v	Determination to pursue STEM after XIIth.	0	2	1	0	0	1	2	0

Sl.	Area	XI				XII			
		<25%	25-50%	50-75%	>75%	<25%	25-50%	50-75%	>75%
i	Interest towards learning science and mathematics	0	0	2	0	0	0	2	0
ii	Confidence shown in learning science and mathematics	0	0	3	0	0	0	2	0
iii	Problem solving abilities	0	0	3	0	0	0	3	0
iv	Critical thinking abilities	0	0	3	0	0	0	3	0
v	Determination to pursue STEM after XIIth.	0	0	3	0	0	0	2	0

***Table 4.15*:** Frequency table for teacher coordinators observations.

Teacher coordinators were also asked to provide their overall assessment of the extent to which the Vigyan Jyoti program has impacted the future prospects of girls in STEM education and careers. As shown in Table 4.16, most of the coordinators rated the program impact as either "High" or "Moderate", with a smaller proportion rating it as "Very High". None of the coordinators reported the impact as "Low" or "Very Low". This indicates that teacher coordinators generally perceive the program to have a positive influence on the future STEM aspirations of participating girls.

Based on teacher coordinator's overall experience the extent Vigyan Jyoti program has impacted the future prospects of girl students' STEM education and STEM career:

Very low impact	Low impact	Moderate Impact	High Impact	Very High impact
0	0	2	3	1

***Table 4.16*:** Frequency table for teacher coordinators assessment of the impact of the program.

Teacher Questionnaire:

Given below are the areas of impact of Vigyan Jyoti program. Based on teacher's observations indicating the estimated percentage of girls enrolled in the Vigyan Jyoti program (whom they have taught) and have benefited in the following areas.

The responses obtained from teachers, presented in Table 4.17, also reflect a similar trend. A substantial number of teachers reported that between 50% and 75% of the girls have benefited from the program in the areas of interest towards science and mathematics, confidence in learning STEM subjects, problem solving ability and critical thinking ability across classes IX to XII. In several instances, particularly in classes X, XI and XII, teachers also reported that more than 75% of students benefited in some of these areas. This suggests that teachers perceive a noticeable improvement in students' engagement with STEM subjects and their cognitive skills after participating in the program.

Sl.	Area	IX				X			
		<25%	25-50%	50-75%	>75%	<25%	25-50%	50-75%	>75%
i	Interest towards learning science and mathematics	2	4	5	4	2	4	9	7
ii	Confidence shown in learning science and mathematics	3	4	5	3	2	5	9	6
iii	Problem solving abilities	3	5	5	2	2	6	8	6
iv	Critical thinking abilities	3	5	4	3	2	5	8	7
v	Determination to pursue STEM after XIIth.	3	2	7	3	2	4	10	6

Sl.	Area	XI				XII			
		<25%	25-50%	50-75%	>75%	<25%	25-50%	50-75%	>75%
i	Interest towards learning science and mathematics	1	5	11	6	1	4	6	8
ii	Confidence shown in learning science and mathematics	2	4	10	6	1	4	7	7
iii	Problem solving abilities	2	5	10	6	1	5	6	7
iv	Critical thinking abilities	2	5	10	6	1	5	6	7
v	Determination to pursue STEM after XIIth.	2	3	12	6	1	4	5	8

***Table 4.17*:** Frequency table for teachers observations.

Teachers were also asked to provide an overall assessment of the program's impact on the future prospects of girls in STEM education and careers. As shown in Table 4.18, the largest number of responses fall under the categories of "Moderate" and "High" impact, followed by "Very High" impact. Only a small number of teachers perceived the impact to be "Low" or "Very Low".

Based on teacher's overall experience the extent Vigyan Jyoti program has impacted the future prospects of girl students' STEM education and STEM career:

Very low impact	Low impact	Moderate Impact	High Impact	Very High impact
1	3	10	8	5

***Table 4.18*:** Frequency table for teachers assessment of the impact of the program.

Overall, the responses from both teacher coordinators and teachers indicate that STEM functionaries perceive a moderate to high level of impact of the Vigyan Jyoti program on girls' interest in STEM learning, their confidence and higher order thinking skills, as well as their inclination to pursue STEM education and careers in the future.

In order to complete the stakeholder analysis presented in the evaluation framework, we also considered the responses of the principals. There were six principals who provided feedback. The feedback provided by the principals provides an institutional perspective on the impact of the program. This complements the feedback provided by the teachers and teacher coordinators on the classroom observations that they provided.

The feedback provided by the principals is within the positive range. One-third of the feedback (33.3%) provided by the principals on the impact of the program on the future education and career opportunities of girls in the field of STEM was classified as Very High. Another one-third of the feedback was classified as High, while the remaining one-third was classified as Moderate. There was no feedback that fell in the range of Low or Very Low. This indicates that the institutional perspective on the Vigyan Jyoti Program was positive.

The perspective of the principal is important because it covers more than just the classroom. It covers the school environment, the opportunities within academics, the process of building aspirations, and the educational direction of the school. The feedback provided by the principals was consistent and positive. This provides further support to the positive feedback provided by the teachers and teacher coordinators.

4.3.3 Integrated Interpretation

When the responses of teachers, teacher coordinators, and principals are considered together, a coherent pattern emerges. At the instructional level, the Program is perceived to have strengthened girls' interest, confidence, participation, and critical-thinking ability. At the institutional level, it is also seen as beneficial for girls' future STEM education and career prospects. The convergence of responses across all three stakeholder categories lends credibility to the perception-based evidence and suggests that the Program is viewed positively at multiple levels of school functioning.

Thus, the evidence under Evaluation Question 2 indicates that the perceived impact of the Vigyan Jyoti Program is not limited to isolated classroom impressions but is shared across different categories of STEM functionaries. This strengthens the interpretive value of the stakeholder evidence within the overall evaluation.

4.4 Evaluation Question 3

To what extent do girls participating in Vigyan Jyoti program show higher inclination to opt for STEM subjects after class XII ?

This evaluation question examines whether participation in the Vigyan Jyoti Program is associated with stronger inclination among girls to opt for STEM subjects after school. In

accordance with the evaluation framework, the discussion draws upon student responses and supplementary alumni evidence. The alumni analysis in this chapter is based on ten alumni responses available from Madhya Pradesh and is presented only as supplementary evidence.

4.4.1 Indicator 1

Do higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM subjects as compared to those in the program who have received least inputs?

STATE	CLASS	Opting STEM	Not opting STEM	Total	% Opting STEM	N	χ^2	df	p
MP	IX	98	16	114	86.0 %	309	19.22	3	< .001
	X	54	24	78	69.2 %				
	XI	62	14	76	81.6 %				
	XII	41	0	41	100.0 %				
CG	IX	120	12	132	90.9 %	394	7.16	3	.067
	X	93	15	108	86.1 %				
	XI	73	4	77	94.8 %				
	XII	74	3	77	96.1 %				
Total	IX	218	28	246	88.6 %	703	23.22	3	< .001
	X	147	39	186	79.0 %				
	XI	135	18	153	88.2 %				
	XII	115	3	118	97.5 %				

***Table 4.19*:** Percentage of class VJ girls showing inclination to opt for STEM subjects at different levels of their training.

To examine whether greater exposure to the Vigyan Jyoti program is associated with a higher inclination to opt for STEM subjects after class XII, the responses of students from classes IX to XII who are enrolled in the program were analysed. Students of class IX represent those who have received relatively fewer inputs from the program, whereas students of class XII represent those who have received the program interventions for a longer duration. The percentage of students expressing their intention to opt for STEM subjects was calculated for each class level and the significance of the association was tested using the Chi-square test. The results are presented in Table 4.19.

The results for Madhya Pradesh show that 86.0% of girls in class IX expressed an inclination to opt for STEM subjects. This percentage decreases slightly in class X (69.2%), but increases again in class XI (81.6%) and reaches 100.0% in class XII. The Chi-square test indicates that the differences across classes are statistically significant ($\chi^2 = 19.22$, $df = 3$, $p < .001$). This suggests that the inclination to opt for STEM subjects tends to increase as students progress through higher classes and receive greater exposure to the Vigyan Jyoti program.

In the case of Chhattisgarh, the percentage of girls expressing an inclination to opt for STEM subjects is already high in class IX (90.9%) and remains consistently high across subsequent classes, reaching 96.1% in class XII. However, the Chi-square test does not show a statistically significant difference across classes ($\chi^2 = 7.16$, $df = 3$, $p = .067$). This indicates that although a large proportion of girls express interest in STEM subjects, the increase across classes is not statistically significant.

When the data from both states are combined, the percentage of girls opting for STEM subjects increases from 88.6% in class IX to 97.5% in class XII. The Chi-square test shows that the association between class level and inclination to opt for STEM subjects is statistically significant ($\chi^2 = 23.22$, $df = 3$, $p < .001$). This suggests that students who have received greater exposure to the Vigyan Jyoti program are more likely to express an inclination to pursue STEM subjects after class XII.

Overall, the results indicate that participation in the Vigyan Jyoti program is associated with a higher inclination among girls to opt for STEM subjects as they progress through higher classes, particularly when the data from both states are considered together.

4.4.2 Indicator 2

Do higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM subjects as compared to the girls in the comparison group who are not enrolled in Vigyan Jyoti program?

STATE	VJ STATUS	Opting STEM	Not opting STEM	Total	% Opting STEM	N	χ^2	df	p
MP	VJ	41	0	41	100.0 %	121	2.67	1	.102
MP	NON VJ	75	5	80	93.8 %				
CG	VJ	74	3	77	96.1 %	140	0.67	1	.415
CG	NON VJ	62	1	63	98.4 %				
Total	VJ	115	3	118	97.5 %	261	0.53	1	.466
Total	NON VJ	137	6	143	95.8 %				

***Table 4.20*:** Percentage of class XII girls showing inclination to opt for STEM subjects.

In order to examine whether participation in the Vigyan Jyoti program is associated with a higher inclination to opt for STEM subjects, the responses of class XII girls enrolled in the program (VJ) were compared with those of girls who were not enrolled in the program (Non-VJ). Class XII students were considered for this comparison because they would have completed their schooling and would be in a position to make decisions regarding their choice of subjects for higher studies. The results of this comparison are presented in Table 4.20.

The results for Madhya Pradesh indicate that all the girls enrolled in the Vigyan Jyoti program (100.0%) reported their inclination to opt for STEM subjects, whereas 93.8% of the girls in the comparison group reported the same. Although the percentage of girls opting for STEM subjects is slightly higher among the VJ students, the Chi-square test shows that the difference between the two groups is not statistically significant ($\chi^2 = 2.67$, $df = 1$, $p = .102$).

In Chhattisgarh, 96.1% of the girls enrolled in the Vigyan Jyoti program expressed their inclination to opt for STEM subjects, while 98.4% of the girls in the comparison group reported the same. The Chi-square test again indicates that the difference between the two groups is not statistically significant ($\chi^2 = 0.67$, $df = 1$, $p = .415$).

When the data from both states are combined, 97.5% of the girls enrolled in the Vigyan Jyoti program expressed their intention to opt for STEM subjects compared to 95.8% of girls in the comparison group. However, the Chi-square test reveals that this difference is not statistically significant ($\chi^2 = 0.53$, $df = 1$, $p = .466$).

Overall, the results indicate that a very high proportion of girls, irrespective of whether they are enrolled in the Vigyan Jyoti program or not, show an inclination to opt for STEM subjects after class XII. Although the percentage is marginally higher among the VJ students, the difference

between the two groups is not statistically significant. This suggests that while the program may contribute to sustaining students' interest in STEM, the inclination to pursue STEM subjects is already high among girls in both groups.

12.2% of VJ students and 3.6% of NON VJ students of class XII says that one of the the reason for their preference for STEM subjects is *various activities organised in their school.*

Summary of Findings for Evaluation Question 3:

The analysis examined whether girls participating in the Vigyan Jyoti program show a higher inclination to opt for STEM subjects after class XII. The results indicate that a very high proportion of girls enrolled in the program express an intention to pursue STEM subjects. When students from different classes within the program are compared, the percentage of girls expressing inclination towards STEM subjects tends to increase as they progress through higher classes. This trend is statistically significant when the data from both states are considered together, suggesting that increased exposure to the program may be associated with stronger inclination towards STEM subjects.

However, when girls enrolled in the Vigyan Jyoti program are compared with those who are not enrolled in the program, the difference in the proportion opting for STEM subjects is not statistically significant. In both groups, the percentage of girls expressing interest in pursuing STEM subjects after class XII is very high. This suggests that while participation in the program may help sustain students' interest in STEM, the inclination to opt for STEM subjects is already strong among girls in the participating schools.

Overall, the findings indicate that girls participating in the Vigyan Jyoti program demonstrate a high level of inclination to pursue STEM subjects after completing school. The increase in inclination with higher levels of program exposure suggests a potential positive influence of the program, although the comparison with the non-participating group indicates that interest in STEM subjects is generally high among girls in both groups.

The alumni response data from Madhya Pradesh indicate that all ten respondents included in the study were pursuing higher education in STEM-related disciplines, with none enrolled in non-STEM courses. This pattern is significant as it demonstrates a clear continuity between the STEM orientation expressed by these students during their school years and their subsequent academic choices at the higher education level. The finding suggests that the inclination towards STEM among the surveyed alumni was not merely a temporary preference during schooling, but was translated into actual participation in STEM pathways after school education. At the same time, this result should be interpreted with caution, as the number of respondents is limited and the evidence pertains only to a specific state. Therefore, while the trend is educationally meaningful, it cannot be generalised without further evidence from a broader sample. From a research perspective, the finding does not imply that the Vigyan Jyoti Program alone determined the students' higher education choices; rather, it may be viewed as one important enabling factor within a wider network of influences such as aspiration, family support, institutional context, and available opportunities. Nevertheless, the observed alignment between school-level STEM preference and higher education enrollment in STEM disciplines provides an important indication of the Program's potential role in fostering sustained engagement with STEM education among girls.

4.4.3 Interpretation

The results from Evaluation Question 3 indicate that girls who participate in the Vigyan Jyoti Program show a preference for STEM subjects after completing their Class XII studies. Moreover, this preference is more pronounced if their interaction with the program has been longer. However,

it is important to note that a strong inclination toward STEM is already observed among girls in both groups. Hence, it is not a statistically significant difference between the two groups.

If we consider the responses from the alumni as well, it is observed that all of them are pursuing higher studies related to STEM subjects. This shows that it is not merely a "wishful thinking" phenomenon; it is being acted upon at the higher education level as well. The most important observation is that it is a nurturing phenomenon rather than a huge jump into a field where girls are already showing a high inclination toward STEM subjects.

4.5 Evaluation Question 4

To what extent do girls participating in Vigyan Jyoti program show higher inclination to opt for STEM Career?

This evaluation question examines the extent to which participation in the Vigyan Jyoti Program is associated with girls' inclination to pursue STEM careers. Compared to the previous question on STEM subject choice, this outcome area presents stronger evidence of program-related differentiation.

4.5.1 Indicator 1

Do higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM career as compared to those in the program who have received least inputs?

STATE	CLASS	Opting STEM	Not opting STEM	Total	% Opting STEM	N	χ^2	df	p
MP	IX	50	64	114	43.9 %	309	34.05	3	< .001
	X	35	43	78	44.9 %				
	XI	51	25	76	67.1 %				
	XII	37	4	41	90.2 %				
CG	IX	74	58	132	56.1 %	394	13.32	3	.004
	X	71	37	108	65.7 %				
	XI	53	24	77	68.8 %				
	XII	62	15	77	80.5 %				
Total	IX	124	122	246	50.4 %	703	42.13	3	< .001
	X	106	80	186	57.0 %				
	XI	104	49	153	68.0 %				
	XII	99	19	118	83.9 %				

***Table 4.21*:** Percentage of class VJ girls showing inclination to opt for STEM careers at different levels of their training.

To examine whether greater exposure to the Vigyan Jyoti program is associated with a higher inclination to pursue STEM careers, the responses of girls enrolled in the program from classes IX to XII were analysed. Students in class IX represent those who have received relatively fewer inputs from the program, whereas students in class XII represent those who have been exposed to the program interventions for a longer duration. The percentage of students expressing their intention to pursue STEM careers was calculated for each class, and the significance of the association was examined using the Chi-square test. The results are presented in Table 4.21.

In Madhya Pradesh, 43.9% of girls in class IX reported an inclination to pursue STEM careers. This percentage remains similar in class X (44.9%) but increases substantially in class XI (67.1%) and further rises to 90.2% in class XII. The Chi-square test indicates that the variation across classes is statistically significant ($\chi^2 = 34.05$, $df = 3$, $p < .001$). This suggests that as students progress through higher classes and receive greater exposure to the Vigyan Jyoti program, their inclination to pursue STEM careers increases significantly.

A similar pattern is observed in Chhattisgarh. The percentage of girls expressing interest in STEM careers increases from 56.1% in class IX to 65.7% in class X, 68.8% in class XI and 80.5% in class XII. The Chi-square test also indicates a statistically significant association between class level and inclination to pursue STEM careers ($\chi^2 = 13.32$, $df = 3$, $p = .004$). This again suggests that increased exposure to the program is associated with greater interest in STEM careers.

When the data from both states are combined, the percentage of girls expressing inclination towards STEM careers increases steadily from 50.4% in class IX to 57.0% in class X, 68.0% in class XI and 83.9% in class XII. The Chi-square test confirms that the difference across classes is statistically significant ($\chi^2 = 42.13$, $df = 3$, $p < .001$).

Overall, the findings indicate that girls who have received greater exposure to the Vigyan Jyoti program show a substantially higher inclination to pursue STEM careers compared to those who have received fewer program inputs. This suggests that the program may play an important role in encouraging girls to consider STEM-related career pathways as they progress through higher classes.

4.5.2 Indicator 2

Do higher percentage of girls who have received all inputs of Vigyan Jyoti program show inclination to opt for STEM career as compared to the girls in the comparison group who are not enrolled in Vigyan Jyoti program?

STATE	VJ STATUS	Opting STEM	Not opting STEM	Total	% Opting STEM	N	χ^2	df	p
MP	VJ	37	4	41	90.2 %	121	8.88	1	.003
MP	NON VJ	52	28	80	65.0 %				
CG	VJ	62	15	77	80.5 %	140	0.31	1	.579
CG	NON VJ	53	10	63	84.1 %				
Total	VJ	99	19	118	83.9 %	261	4.15	1	.042
Total	NON VJ	105	38	143	73.4 %				

***Table 4.22*:** Percentage of class XII girls showing inclination to opt for STEM careers.

To further examine whether participation in the Vigyan Jyoti program influences the inclination of girls to pursue STEM careers, the responses of class XII girls enrolled in the program (VJ) were compared with those of girls who were not enrolled in the program (Non-VJ). Class XII students were considered for this comparison as they are at a stage where they are making decisions regarding their future career paths. The results are presented in Table 4.22.

In Madhya Pradesh, 90.2% of the girls enrolled in the Vigyan Jyoti program reported their inclination to pursue STEM careers, whereas only 65.0% of girls in the comparison group expressed the same inclination. The Chi-square test shows that this difference is statistically significant ($\chi^2 = 8.88$, $df = 1$, $p = .003$). This indicates that girls who participated in the Vigyan Jyoti program in Madhya Pradesh are significantly more likely to express interest in pursuing STEM careers compared to those who did not participate in the program.

In Chhattisgarh, 80.5% of girls enrolled in the Vigyan Jyoti program expressed an inclination towards STEM careers, while 84.1% of girls in the comparison group reported the same. The Chi-square test indicates that the difference between the two groups is not statistically significant ($\chi^2 = 0.31$, $df = 1$, $p = .579$). This suggests that in Chhattisgarh the inclination towards STEM careers is relatively high among girls irrespective of their participation in the program.

When the data from both states are combined, 83.9% of girls enrolled in the Vigyan Jyoti program expressed an inclination to pursue STEM careers compared to 73.4% of girls in the comparison group. The Chi-square test indicates that this difference is statistically significant ($\chi^2 = 4.15$, $df = 1$, $p = .042$).

Overall, the findings suggest that girls who have participated in the Vigyan Jyoti program show a higher inclination to pursue STEM careers compared to girls who have not participated in the program, particularly when the data from both states are considered together. This indicates that the program may contribute positively towards motivating girls to consider STEM-related career pathways.

9.1% of VJ students and 15.2% of NON VJ students of class XII says that one of the the reason for their preference for STEM careers is the *awareness they developed in school.*

Summary of Findings for Evaluation Question 4:

The analysis of students' responses indicates that the inclination to pursue STEM careers increases as girls progress through higher classes within the Vigyan Jyoti program. A significantly higher proportion of girls in class XII expressed interest in STEM careers compared to those in the lower classes, suggesting that prolonged exposure to the program interventions may contribute to strengthening students' aspirations towards STEM-related career pathways.

Further comparison between girls enrolled in the Vigyan Jyoti program and those in the comparison group shows that a higher percentage of program participants express an inclination to pursue STEM careers. This difference is statistically significant when the data from both states are considered together, and particularly pronounced in Madhya Pradesh. These findings suggest that the Vigyan Jyoti program may play a positive role in motivating girls to consider STEM careers after completing school.

The alumni data provides some insight into how far these STEM-oriented paths extend beyond the classroom. All ten of the alumni respondents in the survey were currently pursuing STEM-related programs in higher education, and these current paths therefore represent a continuation of their interest in STEM. However, the respondents' stated future aspirations reveal that the transition from a STEM-related path in college to a future career aspiration does not represent a linear progression toward a single career. Some of the respondents' stated future aspirations were clearly related to STEM-heavy careers: doctor, scientist, engineer, software professional, researcher, or paramedical professional. Other respondents discussed related professional paths, public service careers, teaching careers, management careers, or employment opportunities in general.

The alumni responses indicate that future career choices were shaped by multiple factors rather than by any single consideration. Among the ten respondents, personal ambition emerged as the most influential factor, reported by 80 per cent, followed by workplace safety and security, cited by 40 per cent. Family aspirations and salary-related considerations were each reported by 30 per cent of the respondents, while social status was mentioned by 20 per cent. A smaller proportion of respondents also referred to interest in the nature of work, awareness developed through school, and the influence of role models. These findings suggest that the future career aspirations of the surveyed alumni are guided primarily by self-driven ambition, while also being shaped by practical, familial, and social considerations. At the same time, the diversity of responses indicates that engagement with STEM education does not confine students to a single

occupational pathway; rather, it appears to strengthen their academic confidence and widen their horizon of professional possibilities, many of which remain connected to STEM-related trajectories.

4.5.3 Interpretation

The results for Evaluation Question 4 are perhaps the strongest results presented in the chapter. There is a clear and significant increase in girls' interest in STEM careers as they are exposed to the program, and a significant difference is seen for the Program group in both Madhya Pradesh and when combining all data.

The additional information provided by the alumni results further supports the results for Evaluation Question 4, albeit with some caveats. The fact that all ten girls who completed the survey are pursuing a STEM-related higher education path is a good indicator that girls are oriented toward a STEM future, even after leaving the program. However, the differing future goals and aspirations point toward the fact that many factors influence girls' career development, and it is perhaps a balanced view that the program does strengthen girls' orientation toward a STEM future, while many other factors are at play in determining girls' future career aspirations.

4.6 Summary of Findings

The chapter discussed four issues regarding whether the Vigyan Jyoti Program impacts girls' fundamental STEM development, whether it impacts stakeholders' perceptions of girls' STEM development, and whether it impacts girls' interest in STEM subjects and STEM careers. Overall, when the entire dataset is considered, no clear statistical difference appears between the Program and non-Program groups. However, as the analysis drills down further—by state, class, and amount of program exposure—significant trends emerge.

With regard to the fundamental STEM development constructs, the analysis of all classes in both states does not reveal a statistically significant difference between Program and non-Program groups. Nevertheless, positive trends are noted among Class XII girls in Madhya Pradesh, especially in self-efficacy and critical thinking. Analysis of the Program itself—distinguishing between Class IX and Class XII girls—may suggest a positive correlation between exposure time and performance in the fundamental constructs. Finally, self-perceptions over time suggest girls report significant development in STEM-related self-efficacy.

With regard to the stakeholder perceptions of girls' STEM development, the results clearly point to a positive reception of the program. Teachers, teacher coordinators, and principals all report a positive impact of the program on girls' interest in STEM subjects, girls' self-efficacy in STEM subjects, girls' interest in STEM careers, girls' self-efficacy in STEM careers, girls' critical thinking skills in STEM subjects, and girls' future orientation in STEM subjects. Adding the principal perceptions provides a richer understanding of the results and aligns with the findings in the classroom.

The data on STEM interest reveals that, in general, the girls in the program tend to have a greater interest in STEM subjects after completing Class XII, particularly if they have been more exposed to the program. However, the data also reveals that the girls in the comparison group have a similarly high interest in STEM subjects. Therefore, while the data on STEM interest does not show a statistically significant difference between the two groups, the evidence from the alumni survey, in which ten respondents provided input, reveals that these interests have indeed led to a greater continuation in STEM-related higher education for the alumni.

Regarding the interest in STEM careers, the data reveals a clear difference between the two groups. Girls who have been more exposed to the program tend to have a much higher interest in STEM careers, and the data also reveals a greater orientation toward STEM careers for the participants in the program compared to the girls in the comparison group in Madhya Pradesh and the data combined. Alumni evidence also supports these findings, suggesting a greater continuation in STEM-related education and a future outlook that is largely, but not completely, STEM-oriented.

The data from the evaluation suggests that the Vigyan Jyoti Program is not a universally effective program, but its impact is greater in certain contexts, particularly where exposure is high and processes are well implemented. In these contexts, the data suggests that the program has a significant impact on girls' confidence in STEM, their critical thinking abilities, and, most particularly, on their orientation toward STEM education and careers.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The impact study was conducted in order to understand the extent of the contribution of the Vigyan Jyoti Program in the enhancement of girls' engagement in STEM activities—specifically in Jawahar Navodaya Vidyalayas in the Western Region. While the previous chapters provided background material on the concept and policy background of the program, the rationale and development of the program, the methods of investigation, and the findings based on various respondents' perceptions and opinions, the present chapter attempts to integrate all these in arriving at clear conclusions and recommendations.

The conclusions are based on the perceptions and opinions of various respondents—students, teachers, teacher coordinators, principals, and alumni. These have been interpreted in light of the conceptual framework and methodological approach of the impact investigation. These have been attempted in a scientifically unbiased manner. Since the investigation employed a quasi-experimental method of investigation, the conclusions are based on the impact of the program rather than causality. The opinions of the alumni have been considered ancillary since these have come from a smaller sample of respondents. Despite these limitations, the conclusions form a good foundation in understanding the educational impact of the Vigyan Jyoti Program.

5.2 Synthesis of Major Findings

The study reveals that the Vigyan Jyoti Program is linked to a number of significant advancements in the development of girls' STEM skills. However, the strength and consistency of the relationship vary depending on the skills being assessed and the grade levels being evaluated. The study revealed that the Vigyan Jyoti Program has a moderately strong relationship with the development of the core STEM skills of interest, self-efficacy, problem-solving skills, and critical thinking skills. However, when the bigger picture is taken into account, the gap between the program participants and the control group may not be significant on all the constructs. However, when the study is analyzed on a more micro-scale by class and by state, the study reveals that the girls who have had the longest exposure to the program, particularly those in Class XII, are more likely to have a favorable outcome compared to those who have not had the same exposure. This relationship is more pronounced in the Madhya Pradesh sample compared to the Chhattisgarh sample, particularly with regard to self-efficacy and critical thinking skills. A second key finding

of the study is the overwhelmingly positive perceptions of the Vigyan Jyoti Program by teachers, teacher coordinators, and principals. These stakeholders are largely in agreement that the Vigyan Jyoti Program increases the girls' interest in science and math subjects, increases their self-confidence in learning STEM subjects, increases their participation levels in class, and provides a future orientation for STEM education. These findings are significant because they are shared by all the stakeholders in the education system.

A third perspective examines the interest of girls in STEM subjects after completing Class XII. The study reveals that girls who participated in the Program showed an inclination towards STEM subjects. Moreover, girls who were exposed to the Program for a longer period showed an increased inclination towards STEM subjects. However, if we compare the girls who participated in the Program with those who did not participate, the girls who participated showed an inclination towards STEM subjects that was already quite high. Hence, the Vigyan Jyoti Program helps maintain the interest of girls in STEM subjects rather than creating new interest in the subject in areas where the girls already showed an inclination towards the subject from the beginning.

A fourth perspective examines the interest of girls in STEM subjects as a career. Unlike interest in subjects, interest in subjects as a career shows a more linear pattern and an even higher differential between girls who participated in the Program and those who did not. Girls who were exposed to the Program showed higher interest in pursuing STEM subjects as a career. Moreover, the girls who were exposed to the Program for a longer period showed higher interest in pursuing STEM subjects as a career. The differential between the girls who participated in the Program and those who did not was statistically significant in the case of the combined dataset and the dataset of Madhya Pradesh. Hence, the Vigyan Jyoti Program is likely to be effective in shaping the interest of girls in their future as a career in the field of STEM subjects.

The last perspective examines the interest of girls who were part of the alumni of the program. The girls who were part of the alumni were pursuing higher education in the field of STEM subjects. Hence, the interest of girls in the field of STEM subjects was translated into action. Though the number of girls who were part of the alumni was small in number, the fact that they were pursuing higher education in the field of STEM subjects suggests that the Vigyan Jyoti Program is likely to be effective in maintaining the interest of girls in the field of STEM subjects.

5.3 Major Conclusions of the Study

5.3.1 The Vigyan Jyoti Program is educationally relevant and developmentally appropriate

The overall findings support the educational relevance of the Vigyan Jyoti Program. The Program addresses a critical stage in girls' educational development, when academic self-concept, subject preference, and career orientation begin to take more stable form. By combining enrichment, mentoring, exposure, and guidance, the Program responds to some of the major barriers that affect girls' continued participation in STEM. The findings suggest that such an intervention is conceptually well-aligned with the developmental needs of adolescent girls and with broader efforts toward gender equity in STEM education.

5.3.2 Sustained exposure is central to Program effectiveness

The most important lesson that could be derived from the research is that the impact of the program becomes more understandable if the girls' involvement is sustained in the long term. The more significant impact of the program on the older girls, particularly those in Class XII,

suggests that the program's impact is cumulative. Thus, it could be concluded that the Vigyan Jyoti program is most effective if it is sustained in the long term.

5.3.3 The Program is especially effective in strengthening motivational and aspirational dimensions

The results suggest a clear strength of the Program—although not in all areas of cognitive ability, most notably in motivation, self-belief, and what the future may hold. More concretely, the results regarding self-efficacy, how stakeholders perceive the program, and girls' career aspirations suggest that Vigyan Jyoti plays a role in supporting girls' self-belief and self-perception in STEM. This is important because psychological and aspirational barriers are common inhibitors of girls' STEM engagement, even in cases where academic potential exists.

5.3.4 Program outcomes are shaped by contextual and implementation factors

The varying results from different states and settings point to the fact that the Program does not have a universal effect. Instead, it depends on how the Program is implemented, the level of institutional support, the quality of mentoring, and the level of exposure and seriousness with which the activities are integrated into the schools' routines. Therefore, the real question is not whether the Program works, but rather which conditions are associated with better results.

5.3.5 Stakeholder support is a significant enabling condition

The positive feedback from teachers, coordinators, and principals suggests that support at the school level is one of the biggest strengths that can be drawn from the Program. Considering that school-based interventions are so heavily dependent on cooperation at the institutional level, it is expected that the positive attitude from those in charge will have a positive impact on how well the program is implemented. In summary, it can be said that the commitment from stakeholders is not something that can be taken lightly, but is in fact an essential driver in achieving success.

5.3.6 The Program functions as a reinforcing influence within a wider ecology of aspiration

The data does not indicate that the Vigyan Jyoti program itself determines the choice of stem paths for girls. Rather, a range of factors influences girls' decisions, including interest, grades, school environment, family support, and opportunities available outside school. In this broader context, the Vigyan Jyoti program is seen as a facilitating force that helps girls convert interest into confidence, confidence into aspiration, and aspiration into persistence in education.

5.4 Lessons Learned from the Study

Several lessons emerge from the present evaluation.

Firstly, consistency trumps isolated outbursts of effort. The sustained trend observed in the girls with prolonged exposure is a testament to the importance of consistency in the development process.

Secondly, the development of aspirations is not limited to academic assistance. The obvious impact on career outlook means that the development of career aspirations is a key component of the program.

Thirdly, the success of a program is a function of how well it is executed. While the structure may be the same, the success may not be the same without serious implementation.

Lastly, the development of girls' enjoyment of subjects and career aspirations are separate issues. While a girl may enjoy her subjects, her career aspirations may not necessarily correlate. The program needs to develop both areas separately.

Additionally, the evaluation of the program needs to be integrated into the way the program is executed. Documentation and evaluation of the program would significantly enhance the evaluation of the program.

5.5 Recommendations for Future Implementation

In light of the findings and conclusions of the study, the following recommendations are proposed for strengthening the Vigyan Jyoti Program:

5.5.1 Strengthen the Program as a multi-year continuum

The program should have a clear progression from Class IX to Class XII, with activities that increase in steps each year. In the early years, the focus is on awareness and building confidence, and in the later years, on decision-making in subjects and careers.

5.5.2 Standardise a minimum core package of Program activities

It is recommended that each participating institution has a minimum, essential set of components. This would, in most cases, comprise mentoring sessions, exposure visits, STEM enrichment, women role models, and career guidance. This would help in standardization, thus increasing consistency, while at the same time allowing for flexibility.

5.5.3 Give greater emphasis to confidence, critical thinking, and pathway awareness

Since the program is designed to impact self-efficacy and future orientation, activities should be designed to enhance the girls' confidence in learning STEM, promote critical thinking, and increase awareness about higher education and career opportunities in STEM.

5.5.4 Institutionalise mentoring and role-model engagement

Mentoring should be a central part of the Program. Structured interactions with women professionals in science, engineering, technology, medicine, and related fields should be arranged on a regular basis so that girls get inspiration and information about these fields.

5.5.5 Intensify career guidance in senior classes

The impact is more visible when the girls are in Classes XI and XII. Hence, the program should provide support during the second phase of secondary. This includes providing guidance on entrance exams, scholarships, higher education opportunities, and new career opportunities in STEM fields. This will empower the girls to convert their dreams into choices.

5.5.6 Improve integration with classroom teaching-learning processes

The inconsistent results in cognitive areas suggest a need to build a bridge between what the Program does and how it all happens in the classroom. Using inquiry-based activities, problem-solving activities, project work, and STEM activities based on the curriculum might help the Program have a greater impact in the classroom.

5.5.7 Build capacity of teachers and coordinators

The teachers and the coordinators also need to be oriented on the objectives of the Vigyan Jyoti, gender-sensitive methods for teaching STEM, mentoring techniques, and documentation. Strengthening the capacity of the implementers is also likely to improve the quality and standardization of the implementation.

5.5.8 Develop robust monitoring and alumni-tracking systems

Future research should aim at documenting activities, student participation, mentoring, exposure visits, and outputs. There is also a need to create an alumni tracking system that measures if school-level aspirations translate into participation in higher education and beyond.

5.5.9 Incorporate periodic formative review

The program would need regular reviews both at the school and coordinating levels, with a view to assessing how well the program is being implemented, identifying any challenges, and making appropriate adjustments as needed. This would ensure that the seriousness of the program is sustained.

5.5.10 Ensure equity-sensitive participation

Not all girls in these participating institutions will benefit equally from the program. Therefore, the program should especially target those girls who are underconfident, underunsure, or underexposed so that support can be directed towards those who need it most.

5.6 Recommendations for Future Research and Evaluation

The study suggests that there are several avenues that could be explored in the future. One of them is to continue the same subjects over time. Another important aspect that needs to be explored is the extent of the program's implementation. This will allow us to better understand the differences in the outcomes. Expanding the alumni database will also allow us to assess whether the goals and aspirations of the school translate into long-term higher education and workforce participation. Further research could also be done to explore which parts of the program the beneficiaries of the program find most important.

5.7 Limitations Relevant to Interpretation

It is important to note that conclusions drawn from this research should be viewed within the context of its limitations. Although it is true that a quasi-experimental comparison group design is appropriate for this type of research within an educational field setting, it is important to note that it is impossible to attain absolute causal certainty. In addition, it is possible that variations

in program implementation could have impacted findings. Finally, it is important to note that some responses from students, especially those that are dependent upon memory as a function of retrospective self-evaluation, may be impacted by accuracy of recall. Although this research is valuable, it is important to note that it is limited.

5.8 Concluding Remarks

The impact study of the project reveals that Vigyan Jyoti is a promising gender-responsive educational project that aims to promote girls' participation, confidence, and advancement in STEM subjects. The most significant takeaway from the study is that it contributes to the development of girls' self-confidence, a critical frame of mind, and their aspirations for future STEM studies and careers. Although the results are not significant for all contexts and indicators, the overall trend of the study is that it is an educationally significant, conceptually sound, and worthwhile project that deserves improvement through systematic refinements.

The study, however, makes it very clear that for the project's success, it is not just necessary that it continues, but it is necessary that it is implemented with quality, regularity, coherence, and assessability. Some of the factors that will be significant for the project's success and will help it reach its full potential are sustained engagement, mentoring, pathway guidance, curriculum integration, capacity building, monitoring, and alumni engagement.

Vigyan Jyoti, therefore, may be considered a very important institutional device that guides girls towards STEM pathways. It is not a solitary, discrete educational choice factor; it is a significant, possibly transformative device in the larger landscape of educational aspiration, opportunity, and gender responsiveness in STEM subjects.

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Annexure –I: State-wise List of Sample Jawahar Navodaya Vidyalayas Included in the Present Impact Study

S. No.	State	Vigyan Jyoti (VJ) JNVs	Non-Vigyan Jyoti (Non-VJ) / Comparison JNVs
1	Madhya Pradesh	JNV Indore; JNV Ujjain-I; JNV Rajgarh; JNV Dewas	JNV Raisen; JNV Ratlam-I; JNV Hoshangabad; JNV Shajapur
2	Chhattisgarh	JNV Durg; JNV Bilaspur; JNV Raigarh; JNV Raipur	JNV Balod; JNV Baloda Bazar; JNV Jashpur

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Annexure II: Student Questionnaire

Instructions for Completing the Survey

CODE:

Dear Student, Welcome!

Thank you for taking time to participate in this important survey. This survey is part of a research study to improve STEM skills among girl students. Your honest and thoughtful responses are extremely valuable to us. There are no right or wrong answers, and your participation is completely voluntary. All your responses will be kept strictly confidential and will not affect your grades or academic standing in any way.

This questionnaire has three parts PART-A, PART-B and PART-C. PART-A seeks information about you and your school. PART-B is a rating scale consisting of forty items to be rated by you on a 10-point scale. Detailed instruction regarding the scale and how to respond to it is given in PART-B. PART-C is a questionnaire consisting of four questions on your future study and career choice.

Please attempt all three parts of the questionnaire frankly without any hesitation. Do not leave any question unanswered. You will be given sufficient time to complete the questionnaire.

सर्वेक्षण पूरा करने के निर्देश

प्रिय छात्र, आपका स्वागत है!

इस महत्वपूर्ण सर्वेक्षण में भाग लेने के लिए समय निकालने के लिए धन्यवाद। यह सर्वेक्षण छात्राओं में STEM कौशल को बेहतर बनाने के लिए एक शोध अध्ययन का हिस्सा है। आपकी ईमानदार और विचारशील प्रतिक्रियाएँ हमारे लिए अत्यंत मूल्यवान हैं। कोई सही या गलत उत्तर नहीं है, और आपकी भागीदारी पूरी तरह से स्वैच्छिक है। आपके सभी उत्तर पूर्णतः गोपनीय रखे जाएंगे और किसी भी तरह से आपके ग्रेड या शैक्षणिक स्थिति को प्रभावित नहीं करेंगे।

इस प्रश्नावली के तीन भाग हैं: भाग-A, भाग-B और भाग-C, भाग-A में आपके और आपके विद्यालय के बारे में जानकारी मांगी गई है। भाग-B एक रेटिंग पैमाना है जिसमें चालीस आइटम शामिल हैं जिनका मूल्यांकन आपको 10-बिंदु पैमाने पर करना है। पैमाने और उस पर प्रतिक्रिया देने के तरीके के बारे में विस्तृत निर्देश भाग-B में दिए गए हैं। भाग-C एक प्रश्नावली है जिसमें आपके भविष्य के अध्ययन और करियर विकल्प से संबंधित चार प्रश्न हैं।

कृपया बिना किसी झिझक के प्रश्नावली के तीनों भागों को स्पष्ट रूप से हल करें। किसी भी प्रश्न का उत्तर न छोड़ें। आपको प्रश्नावली को पूरा करने के लिए पर्याप्त समय दिया जाएगा।

PART A

About You and Your School / आपके और आपके स्कूल के बारे में

1. Your Name: _____
2. Name of Your School: _____
3. Your School's Location: District: _____ State: _____
4. Class in which you are studying: □ Class IX □ Class X □ Class XI □ Class XII

PART B

This rating scale consists of forty statements about you. Please read these statements carefully. You will find a 10-point scale on the left side as well as the right side of the statements. For responding on the left side scale, you have to imagine how you were in VIIIth class and to what extent each statement is applicable to you as a VIIIth class student. Accordingly put a tick (√) mark for each statement. Please respond to the same statement as applicable to you as on today by putting a tick (√) mark on the right-side scale of the statement.

Please remember that you will respond on the left side scale as a VIIIth standard student and on the right-side scale as the statements are applicable to you today. Please respond to all statements.

इस रेटिंग स्केल में आपके बारे में चालीस कथन हैं। कृपया इन कथनों को ध्यानपूर्वक पढ़ें। आपको कथनों के बाईं और दाईं ओर **10-**बिंदु वाला स्केल मिलेगा। बाईं ओर के स्केल पर उत्तर देने के लिए, आपको यह कल्पना करनी होगी कि आप आठवीं कक्षा में कैसे थे और आठवीं कक्षा के छात्र के रूप में प्रत्येक कथन आप पर किस हद तक लागू होता है। तदनुसार प्रत्येक कथन के लिए सही का निशान (√) लगाएँ। कृपया कथन के दाईं ओर के स्केल पर सही का निशान (√) लगाकर उसी कथन का उत्तर दें जो आज आप पर लागू है।

कृपया याद रखें कि आठवीं कक्षा के छात्र के रूप में आप बाईं ओर के स्केल पर उत्तर देंगे और आज आप पर लागू होने वाले कथनों के अनुसार दाईं ओर के स्केल पर उत्तर देंगे। कृपया सभी कथनों का उत्तर दें।

Indicate your rating on a scale of 10										ITEM	Indicate your rating on a scale of 10									
10	9	8	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8	9	10
										I am able to identify inconsistencies in an academic argument/explanation. मैं किसी शैक्षिक तर्क/स्पष्टीकरण में विसंगतियों की पहचान करने में सक्षम हूँ										
										I am able to connect ideas and concepts logically. मैं विचारों और अवधारणाओं को तार्किक रूप से जोड़ने में सक्षम हूँ										
										I am confident in solving complex mathematical problems. मैं जटिल गणितीय समस्याओं को सुलझाने में आत्मविश्वासी रखता हूँ।										
										I can easily connect concepts of mathematics with real life situations. मैं गणित की अवधारणाओं को वास्तविक जीवन की परिस्थितियों से आसानी से जोड़ सकता हूं।										
										To me science means boring. मेरे लिए विज्ञान का मतलब है उबाऊ।										
										I am able to evaluate the relevance of data/information/material in a situation. मैं किसी स्थिति में डेटा/सूचना/सामग्री की प्रासंगिकता का मूल्यांकन करने में सक्षम हूं।										
										I am more clear about the job opportunities in science/mathematics/technology and engineering than other areas. मैं अन्य क्षेत्रों की तुलना में विज्ञान/गणित/प्रौद्योगिकी और इंजीनियरिंग में नौकरी के अवसरों के बारे में अधिक स्पष्ट हूं।										
										I am good in performing science experiments and projects. मैं विज्ञान प्रयोग और परियोजनाएं करने में अच्छा हूं।										
										I can live comfortably without knowing about technology. मैं टेक्नोलॉजी के बारे में जाने बिना भी आराम से रह सकता हूं।										
										Irrespective of my personal interest, I will go by the choice of my parents in deciding my career. अपनी व्यक्तिगत रुचि की परवाह किए बिना, मैं अपने करियर के बारे में निर्णय लेने में अपने माता-पिता की पसंद का पालन करूंगा।										
										I am able to use mathematics while studying other subjects like science.										

Indicate your rating on a scale of 10										ITEM	Indicate your rating on a scale of 10									
10	9	8	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8	9	10
										मैं विज्ञान जैसे अन्य विषयों का अध्ययन करते समय गणित का उपयोग करने में सक्षम हूं।										
										I am good in developing programs/apps. मैं प्रोग्राम/ऐप विकसित करने में अच्छा हूँ।										
										I have started collecting information about higher studies in the area of science/mathematics/engineering/technology. मैंने विज्ञान/गणित/इंजीनियरिंग/प्रौद्योगिकी के क्षेत्र में उच्च अध्ययन के बारे में जानकारी एकत्र करना शुरू कर दिया है।										
										To me mathematics is not an attractive subject. मेरे लिए गणित कोई आकर्षक विषय नहीं है।										
										I am able to deal with complicated situations. मैं जटिल परिस्थितियों से निपटने में सक्षम हूं।										
										I use technology extensively in my day-to-day learning. मैं अपने दैनिक अध्ययन में प्रौद्योगिकी का व्यापक उपयोग करता हूँ।										
										I am good at understanding concepts and principles of science. मैं विज्ञान की अवधारणाओं और सिद्धांतों को समझने में अच्छा हूँ।										
										I always try to find a use for waste or throw away material. मैं हमेशा बेकार या फेंक दी गई सामग्री का उपयोग खोजने की कोशिश करता हूं।										
										To me mathematics is an exciting subject. मेरे लिए गणित एक रोमांचक विषय है।										
										I like participating actively in science exhibition. मुझे विज्ञान प्रदर्शनी में सक्रिय रूप से भाग लेना पसंद है।										
										I am able to draw conclusion based on evidences/data. मैं साक्ष्य/डेटा के आधार पर निष्कर्ष निकालने में सक्षम हूँ										
										I am unable to aggregate large amount of data/information while solving a problem. मैं किसी समस्या को हल करते समय बड़ी मात्रा में डेटा/सूचना एकत्रित करने में असमर्थ हूँ।										

Indicate your rating on a scale of 10										ITEM	Indicate your rating on a scale of 10									
10	9	8	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8	9	10
										I am sure about selecting either science/mathematics/ engineering/ technology as subject of study after 12th. मैं 12वीं के बाद अध्ययन विषय के रूप में विज्ञान/गणित/इंजीनियरिंग/प्रौद्योगिकी में से किसी एक को चुनने के बारे में निश्चित हूं।										
										I know the difference between technology and engineering. मैं प्रौद्योगिकी और इंजीनियरिंग के बीच अंतर जानता हूं।										
										I like spending time in working with machines. मुझे मशीनों के साथ काम करने में समय बिताना पसंद है।										
										I like spending time in solving mathematical problems. मुझे गणितीय समस्याओं को सुलझाने में समय बिताना पसंद है।										
										I have a role model to inspire me in determining my career goals in science/mathematics/technology/engineering than in other subject areas. मेरे पास अन्य विषय क्षेत्रों की अपेक्षा विज्ञान/गणित/प्रौद्योगिकी/इंजीनियरिंग में अपने कैरियर के लक्ष्यों को निर्धारित करने में मुझे प्रेरित करने वाला एक आदर्श है।										
										I can easily explain difficult scientific concepts in simple language. मैं कठिन वैज्ञानिक अवधारणाओं को सरल भाषा में आसानी से समझा सकता हूँ।										
										I know the difference between science and technology. मैं विज्ञान और प्रौद्योगिकी के बीच अंतर जानता हूं।										
										I am able to analyse data/information systematically in a given situation. मैं किसी भी परिस्थिति में डेटा/सूचना का व्यवस्थित विश्लेषण करने में सक्षम हूं।										
										I like participating in technology related activities such as robotics. मुझे रोबोटिक्स जैसी प्रौद्योगिकी से संबंधित गतिविधियों में भाग लेना पसंद है।										
										I am curious to solve new problems. मैं नई समस्याओं को सुलझाने के लिए उत्सुक हूं।										
										I can design things/equipment to solve a real-life problem. मैं वास्तविक जीवन की समस्या को हल करने के लिए चीजें/उपकरण डिजाइन कर सकता हूं।										

Indicate your rating on a scale of 10										ITEM	Indicate your rating on a scale of 10									
10	9	8	7	6	5	4	3	2	1		1	2	3	4	5	6	7	8	9	10
										If some design or experiment fails, I am confident of finding an alternative to it. यदि कोई डिजाइन या प्रयोग असफल हो जाता है, तो मुझे विश्वास है कि मैं उसका विकल्प ढूंढ लूंगा।										
										I prefer a career in the area of science/mathematics/engineering/technology. मैं विज्ञान/गणित/इंजीनियरिंग/प्रौद्योगिकी के क्षेत्र में करियर पसंद करता हूं।										
										I admire people working in the areas of science/mathematics/engineering/technology more than others. मैं विज्ञान/गणित/इंजीनियरिंग/प्रौद्योगिकी के क्षेत्र में काम करने वाले लोगों की दूसरों से अधिक प्रशंसा करता हूँ।										
										To me science is a fascinating subject. मेरे लिए विज्ञान एक आकर्षक विषय है।										
										I am good in using electronic devices and gadgets. मैं इलेक्ट्रॉनिक उपकरणों और यंत्रों का उपयोग करने में अच्छा हूँ।										
										Irrespective of my personal interest, I will go by the choice of my friends while deciding subjects of study. अपनी व्यक्तिगत रुचि की परवाह किए बिना, मैं अध्ययन के विषय का निर्णय करते समय अपने मित्रों की पसंद के अनुसार ही चलूंगा।										
										While solving a problem I am able to identify relevant and irrelevant information. किसी समस्या को हल करते समय मैं प्रासंगिक और अप्रासंगिक जानकारी की पहचान करने में सक्षम हूं।										

PART-C

Career Aspiration Questionnaire

1. Normally students peruse programme like B.A., B. Com, B.Sc., B.E., B. Tech., MBBS, etc. after class 12. Write three programmes in order of preference you would like to study after 12th आमतौर पर छात्र 12वीं कक्षा के बाद बी.ए., बी.कॉम, बी.एससी., बी.ई., बी.टेक., एमबीबीएस आदि जैसे प्रोग्राम करते हैं। 12वीं के बाद आप कौन से तीन प्रोग्राम पढ़ना चाहेंगे, अपनी पसंद के अनुसार लिखें।

   1st preference……

   2nd preference …….

   3rd preference…….

2. Which of the following is/are the reason/s for your preference for these programmes? (you may tick whichever applicable) / निम्नलिखित में से कौन सा/से कारण इन कार्यक्रमों के प्रति आपकी प्राथमिकता का/के हैं? (जो भी लागू हो, उस पर टिक करें)

   i) Because of my interest – **मेरी रुचि के कारण**

   ii) Because of my parents' wish – **मेरे माता-पिता की इच्छा के कारण**

   iii) Because my friends opt for them – **क्योंकि मेरे मित्र उन्हें चुनते हैं**

   iv) Because of the guidance received from teachers – **शिक्षकों से प्राप्त मार्गदर्शन के कारण**

   v) Because of various activities organised in my school – **मेरे विद्यालय में आयोजित विभिन्न गतिविधियों के कारण**

   vi) Because of a role model – **किसी आदर्श/प्रेरणास्रोत के कारण**

   vii) Any other? (please specify) **कोई अन्य? (कृपया उल्लेख करें)**

   ……

3. Write three jobs/career you would like to pursue after your studies in order of preference. / अपनी पढ़ाई के बाद आप कौन सी तीन नौकरियां/करियर करना चाहेंगे, उन्हें वरीयता क्रम में लिखें।

   1st preference……

   2nd preference …….

   3rd preference…….

4. Which of the following is/are the reason/s for your career choice? (you may tick whichever applicable) / निम्नलिखित में से कौन सा/से आपके करियर चयन का/के कारण है/हैं? (जो भी लागू हो, उस पर टिक करें)

   i) Because of my interest – मेरी रुचि के कारण

   ii) Because of my parents' wish – **मेरे माता-पिता की इच्छा के कारण**

   iii) Because my friends opt for them – **क्योंकि मेरे मित्र उन्हें चुनते हैं**

   iv) Because of the guidance received from teachers – **शिक्षकों से प्राप्त मार्गदर्शन के कारण**

   v) Because of various activities organised in my school – **मेरे विद्यालय में आयोजित विभिन्न गतिविधियों के कारण**

   vi) Because of a role model – **किसी आदर्श/प्रेरणास्रोत के कारण**

   vii) Any other? (please specify)– **कोई अन्य? (कृपया उल्लेख करें)**

   ……

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Annexure III: Alumni Questionnaire

1. Name: _____
2. Name of School you completed 12th Standard:

   _____
3. Name of Course pursued after 12th Standard: _____
4. Competitive exams attempted after 12th Standard (List the exams):

   _____

   _____
5. Competitive exams cleared (List the exams):

   _____

   _____

Given below are a few statements on the impact of Vigyan Jyoti programme on the participating girl students. Based on your experiences in Vigyan Jyoti programme, please rate the extent to which the programme has impacted you on a 5-point scale by tick-marking in the appropriate box:

Sl. No.	Statement	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
6	There was a noticeable impact on the interest in science and mathematics shown by me					
7	There was a noticeable impact on the self confidence in science and mathematics shown by me					
8	There was a noticeable impact on the active participation in science and mathematics shown by me					
9	There was a noticeable impact on my achievement level in science and mathematics after joining Vigyan Jyoti programme					
10	There was a noticeable impact on the interest in problem solving activities in science and mathematics shown by me					

Sl. No.	Statement	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
11	There was a noticeable impact on the keenness in asking questions in science and mathematics shown by me					
12	There was a noticeable impact on the keenness to know about further study opportunities in science and mathematics					
13	There was a noticeable impact on my critical thinking ability in science and mathematics such as finding inconsistencies in others argument, logically connecting ideas/concepts, evidence based conclusion etc.					

5. Write three jobs/career you would like to pursue after your studies in order of preference

   1st preference……
   2nd preference …….
   3rd preference…….

6. Which of the following is/are the reason/s for your career choice? (you may tick whichever applicable)

   i) My ambition
   ii) Ambition of my parents/family
   iii) Status in the society
   iv) The salary and other benefits
   v) My interest in the nature of work
   vi) Safety and security available in the workplace
   vii) Awareness I have developed from the school
   viii) Influence of my role model
   ix) Any other? (Please specify) …….

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Annexure IV: Teacher Questionnaire

Identification Data

1. Name: _____
2. Name of Your School: _____
3. Subject(s) Taught (Please tick all that apply): □ Physics □ Chemistry □ Biology □ Mathematics □ Computer Science / IT □ Others (Please specify):
   _____
4. Which classes/grades do you teach STEM subjects? (Please tick all that apply):

   □ Class IX □ Class X □ Class XI □ Class XII
5. Total years of teaching experience: □ Less than 5 years □ 5-10 years □ 11-20 years □ More than 20 years
6. Gender: □ Male □ Female

Given below are a few statements on the impact of Vigyan Jyoti programme on the participating girl students. Based on your observations, please rate the extent to which you agree with the statements on a 5-point scale

Sl. No.	Statement	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
7	There is a noticeable impact on the interest in science and mathematics shown by the girls after joining Vigyan Jyoti programme					
8	There is a noticeable impact on the self confidence in science and mathematics shown by the girls after joining Vigyan Jyoti programme					
9	There is a noticeable impact on the active participation in science and mathematics shown by the girls after joining Vigyan Jyoti programme					
10	There is a noticeable impact on the achievement level in science and mathematics shown by the girls after joining Vigyan Jyoti programme					
11	There is a noticeable impact on the interest in problem solving activities in science and mathematics shown by the girls after joining Vigyan Jyoti programme					

Sl. No.	Statement	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
12	There is a noticeable impact on the keenness in asking questions in science and mathematics shown by the girls after joining Vigyan Jyoti programme					
13	There is a noticeable impact on the keenness in asking questions about further study opportunities in science and mathematics shown by the girls after joining Vigyan Jyoti programme					
14	There is a noticeable impact on the critical thinking ability in science and mathematics such as finding inconsistencies in others argument, logically connecting ideas/concepts, evidence based conclusion etc. shown by the girls after joining Vigyan Jyoti programme					

Given below are the areas of impact of Vigyan Jyoti programme. Based on your observations, please indicate what percentage of girls enrolled in Vigyan Jyoti programme have benefited in these areas. (Please tick mark for only the classes taught by you)

Sl. No.	Area	IX				X				XI				XII			
		>25%	25-50%	50-75%	<75%	>25%	25-50%	50-75%	<75%	>25%	25-50%	50-75%	<75%	>25%	25-50%	50-75%	<75%
15	Interest towards learning science and mathematics																
16	Confidence shown in learning science and mathematics																
17	Problem solving abilities																
18	Critical thinking abilities																
19	Determination to pursue Science/Maths/Engineering/Technology after 12th class.																

20. Based on your overall experience in Vigyan Jyoti programme please indicate the extent to which the programme has impacted the future prospects in STEM education and STEM career of girl students. (Tick in appropriate cell)

Very low impact	Low impact	Moderate Impact	High Impact	Very High impact

21. Your suggestions for further improvement on impact of the Vigyan Jyoti programme, if any

……
……
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Annexure V: Questionnaire for Teacher Coordinator

1. Name: _____
2. School: _____
3. Subjects Taught: _____
4. What are the activities included under the Vigyan Jyoti programme in your school for classes IX and X?

   a) _____
   b) _____
   c) _____
   d) _____
   e) _____
   f) _____
   g) _____
   h) _____

   (Please provide a Year wise list of activities performed under Vigyan Jyoti).

5. What activities are included under the Vigyan Jyoti programme in your school for classes XI and XII?

   i) _____
   j) _____
   k) _____
   l) _____
   m) _____
   n) _____
   o) _____
   p) _____

   (Please provide a Year wise list of activities performed under Vigyan Jyoti).

6. Given below are the areas of impact of Vigyan Jyoti programme. Based on your observations, please indicate what percentage of girls enrolled in Vigyam Jyoti taught by you have benefited in these areas

Sl. No.	Area	IX				X				XI				XII			
		>25 %	25-50%	50-75%	<75%	>25 %	25-50%	50-75%	<75 %	>25%	25-50%	50-75%	<75 %	>25 %	25-50%	50-75%	<75 %
i	Interest towards learning science and mathematics																
ii	Confidence shown in learning science and mathematics																
iii	Problem solving abilities																
iv	Critical thinking abilities																
v	Determination to pursue science/maths/Engineering/ Technology after 12th.																

7. Based on your overall experience up to what extent Vigyan Jyoti programme has impacted the future prospects of girl students' STEM education and STEM career. (Tick in appropriate cell)

Very low impact	Low impact	Moderate Impact	High Impact	Very High impact

8. Please state the reason for the above response:

_____
_____
_____
_____ .

9. Your suggestion for further improvement of the Vigyan Jyoti programme, if any

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REGIONAL INSTITUTE OF EDUCATION, BHOPAL

(A CONSTITUENT UNIT OF NCERT, NEW DELHI)

Annexure VI: Questionnaire for the School Principal

1. Name: _____
2. School: _____
3. Qualification: _____
4. Year of implementation of Vigyan Jyoti in your school: _____
5. Year wise number of students enrolled under Vigyan Jyoti: (Please provide name list)

YEAR	IX	X	XI	XII	From Outside JNV
2020-21					
2021-22					
2022-23					
2023-24					
2024-25					

6. What are the activities included under the Vigyan Jyoti programme in your school for classes IX and X?
   q) _____
   r) _____
   s) _____
   t) _____
   u) _____
   v) _____
   w) _____
   x) _____

7. What are the activities included under the Vigyan Jyoti programme in your school for classes XI and XII?
   y) _____
   z) _____
   aa) _____
   bb) _____

cc) _____

dd) _____

ee) _____

ff) _____

8. Based on your overall experience up to what extent Vigyan Jyoti programme has impacted the future prospects of girl students' STEM education and STEM career. (Tick in appropriate cell)

Very low impact	Low impact	Moderate Impact	High Impact	Very High impact

9. Please state the reason for the above response:

_____

_____

_____

_____ .

10. Your suggestion for further improvement of the programme, if any

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