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Institutional-Readiness Indicators and Post-School Educational Engagement in Vigyan Jyoti: Evidence from School Stakeholders and JNV Alumni

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Abstract

Perceived benefits are commonly employed to assess school-based initiatives to enhance girls' participation in science, technology, engineering and mathematics (STEM), although implementation conditions and ensuing educational participation are different outcomes. To describe stakeholder-reported implementation-support indicators for Vigyan Jyoti and post-school educational engagement reported by former participants, explicitly stating the inferential limits. This descriptive, multi-source program evaluation included aggregate teacher-domain ratings, professional overall-impact responses from 27 teachers, six coordinators, and six principals, and retrospective questionnaire summaries from 48 JNV alumni in Madhya Pradesh and Chhattisgarh. Proportions and model-based Wilson 95% intervals were recalculated from reported counts; two thresholds were used to examine sensitivity of impact classifications. Means for teacher-domain ranged between 3.8 and 4.0/5. 23/27 teachers (85.2%), 6/6 coordinators and 6/6 principals endorsed at least moderate impact, but high/very-high ratings were lower (13/27, 4/6 and 4/6, respectively). 39/48 (81.3%) of the alumni reported attempting a competitive examination and 15/48 (31.3%) reported clearing at least one. Positive retrospective agreement in the eight domains ranged from 81.3% to 91.7%. Separate professional and alumni strands of evidence report favourable perceptions and examination engagement of respondents, not validated organisational readiness or program-attributable effects. Future evaluations should include fidelity, sampling, and prospective educational pathways documentation.

Keywords: Vigyan Jyoti, Girls in STEM, School Implementation Support, Program Evaluation, JNV Alumni, Gender-Responsive Education, Educational Pathways

1. INTRODUCTION

Participation in science, technology, engineering and mathematics (STEM) is influenced by more than just academic attainment. Students' interests, perceptions of capability, identity, expectations about future opportunities and experiences of inclusion can interact with the educational opportunities available at school [1–3]. So, a gender-responsive program needs to take into account both the experiences of the participants and the organisational arrangements through which opportunities are made available. These dimensions should not be reduced to a single measure of program "success."

Social cognitive career theory relates learning experiences and contextual supports to self-efficacy, outcome expectations and subsequent choices [4, 5]. Situated expectancy-value theory also emphasises the social context of valued activity and perceived costs [6]. Recent studies have emphasised the significance of school STEM opportunities, career awareness, and perceptions of professionals, but do not support a simple equation between positive attitudes and actual STEM pathways [7, 8]. In a UK longitudinal cohort, mathematics interest independently predicted later STEM choice but self-efficacy did not maintain a similar independent effect in adjusted models [9]. A recent synthesis on STEM identity and career intention also found meaningful variation by study context and measurement [10]. The findings underscore the importance of pathway-relevant evidence and caution against attributing later educational decisions to a single program experience.

Vigyan Jyoti was launched in December 2019 by the Department of Science and Technology, Government of India, to support girls studying in Classes IX–XII through science camps, special lectures, role-model interactions, tinkering, counselling and visits to knowledge-partner institutions [11]. The Jawahar Navodaya Vidyalayas (JNVs) are knowledge centers in a wider network of implementation. Its ambition of increasing access and participation in areas of STEM where women are under-represented makes delivery quality, coordination, equitable participation and continuity of guidance legitimate subjects of evaluation [11, 12]. Program activity and program effect are not the same. A school may offer activities but delivery intensity, participation quality and educational outcomes may vary across cohorts.

1.1 Conceptual perspectives and their measurement boundaries

Research on distributed and successful school leadership suggests that coordination, professional practice and resource decisions create the conditions for school improvement to be enacted [13, 14]. More than good will is also needed for gender-responsive STEM practice. Teachers may subscribe to equality but do not sufficiently recognise gendered participation routines, differential expectations or the opportunities they have to intervene [15]. Teacher's organization of participation and feedback may somewhat influence students' perceived capabilities [16]. These studies provide plausible mechanisms, but do not prove that those mechanisms operated in the JNVs studied here.

Implementation fidelity includes dimensions such as adherence, dosage, quality of delivery and participant responsiveness. Favourable impact ratings alone do not imply the degree of fidelity [17]. Organisational readiness is also a separate theoretical construct: Weiner defined readiness for change as collective commitment and collective efficacy [18]. Direct measurement requires appropriate measures of shared readiness and capacity, resources and routines; teacher ratings of perceived student benefit and principals' endorsement of impact are not validated surrogates. Hence, "institutional-readiness indicators" in this article is only used as a qualified umbrella label for perceived pedagogic, relational, coordination and leadership support. No direct estimate is provided of either readiness or implementation fidelity.

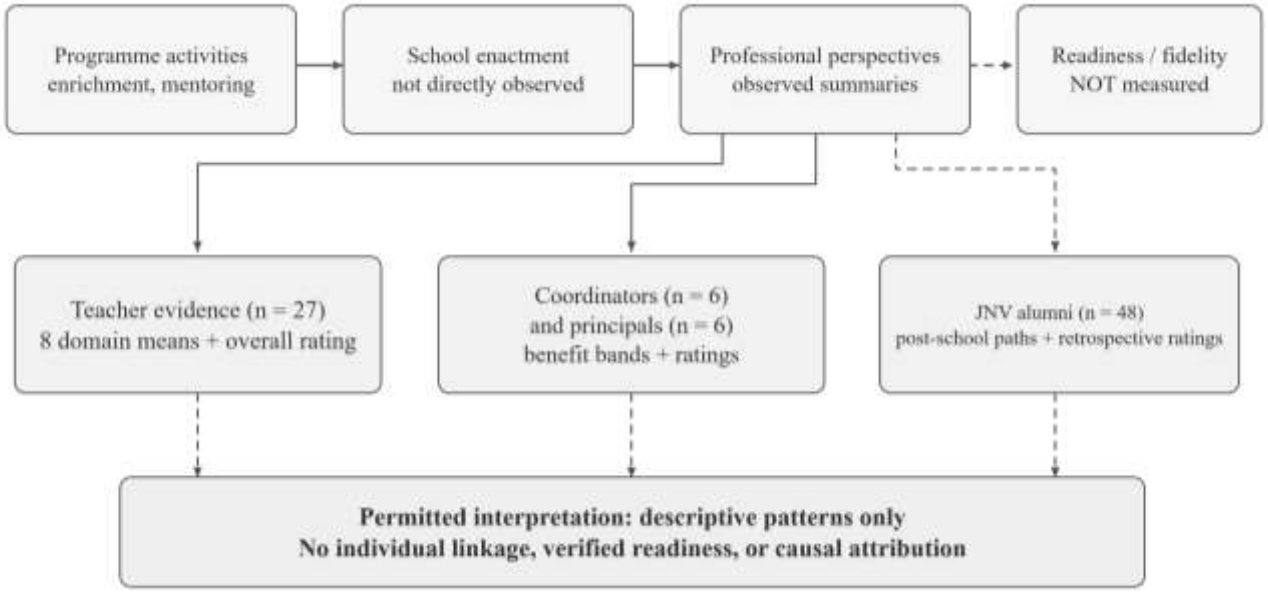
1.2 Research gap and contribution

Enrichment research on girls-in-STEM typically examines confidence, interest or career intention post participation [19–21]. Such evidence is helpful but does not replace data on school implementation, verified educational destinations, or program-attributable outcomes. Research on role models further warns that positive motivational goals can have unintended or context-dependent effects [22]. What is the analytical problem for the present Indian program-evaluation setting to report professional assessments and alumni follow-up together without treating them as a single longitudinal dataset?

Relevant conceptual lenses exist in the published research; this study does not claim to offer a new model of readiness or an original statistical estimator.

The contribution is a bounded integration of four professional and alumni evidence sources. The analysis: (a) maintains differences in respondent role and measurement scale, (b) examines how an impact statement changes when "positive" is more narrowly defined, (c) demonstrates uncertainty when denominators are known, and (d) suggests what additional data are necessary to test organisational and educational mechanisms. This is a purely descriptive-evaluation, not causal impact, contribution. Figure 1 shows the frontier between observed information and plausible but unverified processes.

Figure 1: Evidence Architecture and Boundaries of Permitted Inference



1.3 Research questions

- RQ1. What domains of learner-facing program support are there in teacher-reported aggregate means? RQ2. What grade-wise patterns of perceived benefit do the coordinators mention?
- RQ3. How do the overall impact classifications differ between moderate-or-higher and high/very-high thresholds for professional respondents?
- RQ4. What competitive-examination engagement and educational pathways do alumni respondents report?
- RQ5. Which patterns are repeated in professional and alumni reports and which inferences are unsupported?

2. METHODOLOGY

2.1 Design, setting and scope

The NCERT PAC Research Program 2025–2026 (PAC Code 23.03) used a multi-source observational program-evaluation design to synthesise evidence related to Vigyan Jyoti in selected JNVs of Madhya Pradesh and Chhattisgarh. Professional respondents described perceived benefits to learners and program impact overall. Ex-participants provided retrospective reports of post-school pathways,

examination engagement and perceived salience of the program. These streams of evidence were analysed independently before a qualitative comparison of reported directions was made. The study was not designed to estimate treatment effects or to generalise representatively to all program schools.

The analytic records available are aggregate teacher-domain means, known respondent counts for professional overall-impact items, coordinator benefit-band summaries, and alumni category counts. The analytic dataset supplied did not link the participating schools to the individual alumni outcomes. Manuscript summaries do not provide information on the number of eligible respondents invited, school-level allocation, administration dates, alumni graduation cohorts, and exact follow-up interval. These are not retrospectively reconstructed, but taken as limitations.

2.2 Participants and recruitment

Professional respondents who were involved in program delivery or oversight were purposively selected based on their role. Twenty-seven teachers responded to the overall-impact item, and there were eight teacher-domain aggregate means. Six teacher coordinators and six principals provided complementary coordination and leadership information. The alumni component included 48 respondents who were described in the source study as the former Vigyan Jyoti participants from the sample JNVs across the two states. No comparable sample of non-participant alumni was available. School-specific response rates and alumni representativeness require the use of source recruitment logs or denominator information.

Table 1: Evidence Sources, Units of Analysis and Inferential Boundaries

Evidence source	Available coverage	Analysis unit	Critical boundary
Teachers	27 overall-impact responses; eight domain means	Professional counts; aggregated means	No item-level variation or respondent-linked scores
Coordinators	6 respondents	Ordinal grade-wise benefit bands; overall impact	No exact band-by-domain cell counts in supplied summary
Principals	6 respondents	Overall-impact category	Endorsement only; no observed resource or leadership measure
JNV alumni	48 respondents	Educational labels, exam responses, eight retrospective items	No non-participant group or verified longitudinal linkage

2.3 Variables, questionnaires and construct mapping

Teacher ratings were obtained for perceived interest/curiosity, self-confidence, participation, academic achievement, persistence in problem solving, questioning, guidance seeking and critical thinking in eight cases. Only the means of published domains were available for analysis. The coordinators provided categorical bands of the share perceived to benefit by grades and five domains, and overall impact categories. Principals made an overall judgement about future STEM education and career opportunities. Source summaries do not contain verbatim full item texts, exact anchors for all professional items, psychometric validation data or administration language; these cannot be assumed.

The labels for educational course or preparation, competitive examinations attempted and passed and the eight retrospective statements with five categories of responses were included in the alumni questionnaire. "Positive agreement was defined as “agree” plus “strongly agree”. The counts by examination are not mutually exclusive because an individual respondent can provide more than one type of examination. Some course labels are for subjects or preparation and not for confirmed degree enrolment. Five course entries were missing. A post hoc binary STEM-enrolment rate is not calculated.

Table 2: Observed Measures, Constructs and Missing Evidence

Domain	Available observation	Legitimate inference	Additional measurement needed
Perceived pedagogic support	Teacher means for engagement, achievement, inquiry and thinking	Favourable teacher-reported domains	Classroom observation; validated pedagogy instrument
Perceived relational support	Confidence, questioning, guidance and retrospective alumni items	Perceived support and recollections	Matched longitudinal student records; support networks
Perceived program coordination	Coordinator ordinal benefit bands by grade	Described reach and continuity	Delivery logs; attendance, dosage and adaptation
Perceived institutional endorsement	Principal and professional overall-impact ratings	Reported value or legitimacy	Resources, routines and change commitment measures
Organisational readiness / fidelity	No direct instrument or record	Not estimated	Validated readiness instrument and direct fidelity audit

2.4 Administrative permissions and ethics

Administrative permissions, voluntary participation, confidential processing and reporting of de-identified aggregates under NCERT PAC 23.03. The original ethics committee decision, exemption letter, and the consent forms/scripts for each respondent category are not included. Administrative permission is not independent ethics approval. The author is required to confirm and accurately describe the original consent procedure and whether institutional ethical review or exemption was required and documented, prior to submission. Here, no approval identifier is given or implied.

2.5 Statistical analysis and reproducibility

Descriptive estimates were selected as the best measure available. We reported teacher-domain averages without dispersion estimates because we did not have respondent-level scores. Their unweighted mean (3.91) summarises eight domain means, not a psychometrically valid composite. The numeric mid-points were not given to the coordinator band responses. Overall impact ratings were summarised as counts, percentages and reported ordinal medians. The classification was explored at two thresholds: moderate or higher, and high/very high. These are related descriptions rather than independent hypothesis tests, as they derive from the same rating.

For observed counts of binary responses k among n available responses the reported % was 100(k/n). To demonstrate the uncertainty in counts, we recomputed Wilson score intervals at the nominal 95% level with z = 1.95. These intervals are based on independent Bernoulli observations from a binomial model. Interpretations of population coverage may be compromised by school clustering, non-probability recruitment, and respondent selection. Hence, they are offered as model-based descriptors, not design-based confidence statements about all JNVs or all program participants. We do not estimate any p-values, program impact effect sizes, school-level models, or causal estimators.

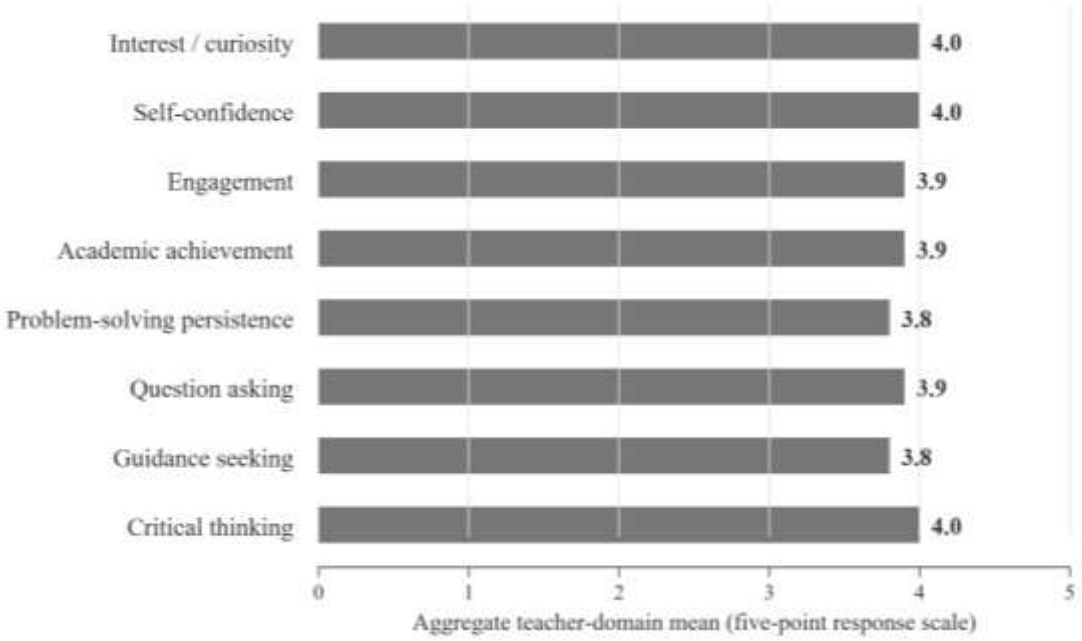
Each percentage and interval is reconstructed in the aggregate-count reproducibility file that accompanies this article. Source-data verification cannot be performed from aggregate summaries alone. To make comparisons of themes we report descriptive agreement only between professional groups and alumni. The convergence at the individual level or temporal mediation analysis is impossible due to different people, instruments, time points and sampling processes.

3. RESULTS

3.1 Teacher-reported domains of perceived support

Teachers' aggregate domain scores were in a narrow range of 3.8-4.0 on the five-point response scale (Figure 2). Interest/curiosity, self-confidence and critical thinking each reported a mean of 4.0; engagement, achievement and question asking were 3.9; problem-solving persistence and seeking guidance for further education or careers were 3.8. The unweighted mean of the 8 reported means was 3.91. Differences of .1-.2 points are not considered statistically significant or educationally decisive because standard deviations, covariances and distributions of individual responses were not available.

Figure 2: Aggregate Teacher Ratings Across Eight Learner-Facing Domains



3.2 Coordinator-reported grade-wise reach

The available coordinator summaries indicated that perceived benefit in Class IX was concentrated in the 25–50% category, with some responses in the 50–75% category. Class X showed a shift toward 50–75%; Classes XI and XII were described as dominated by the 50–75% category across five domains

(Table 3). Since original category-by-domain counts were not supplied, neither a formal trend test nor a numerical estimate of exposure accumulation is possible. The pattern is compatible with several explanations, including continuity, different cohorts and variable delivery intensity.

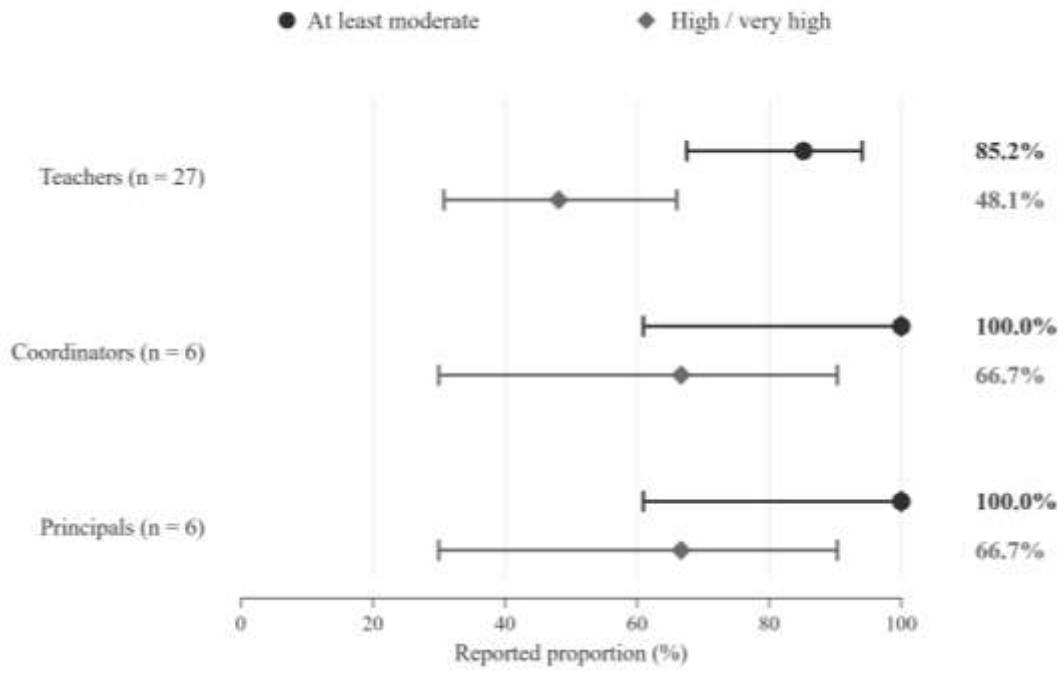
Table 3: Coordinator-Reported Grade-Wise Benefit Bands

Grade	Available dominant band	Interpretation constrained by available summaries
Class IX	Mostly 25–50%; some 50–75%	Lower perceived reach among this class; counts unavailable
Class X	Shift toward 50–75%	Described wider reach; no respondent-linked change
Class XI	50–75% dominant across five domains	Perceived continuity, not measured cumulative dosage
Class XII	50–75% dominant across five domains	Perceived continuity, not verified individual trajectory

3.3 Overall-impact ratings: effect of decision threshold

Under the inclusive threshold of at least moderate perceived impact, 23/27 teachers endorsed a positive category (85.2%; Wilson 95% interval 67.5–94.1). All six coordinators and all six principals endorsed at least moderate impact (100% each; 61.0–100.0). The stronger high/very-high threshold reduced the corresponding results to 13/27 teachers (48.1%; 30.7–66.0), 4/6 coordinators (66.7%; 30.0–90.3) and 4/6 principals (66.7%; 30.0–90.3). Teachers' reported median category was moderate, whereas both other professional groups had a median of high. Figure 3 makes the threshold dependence and particularly wide intervals for the n = 6 groups visible.

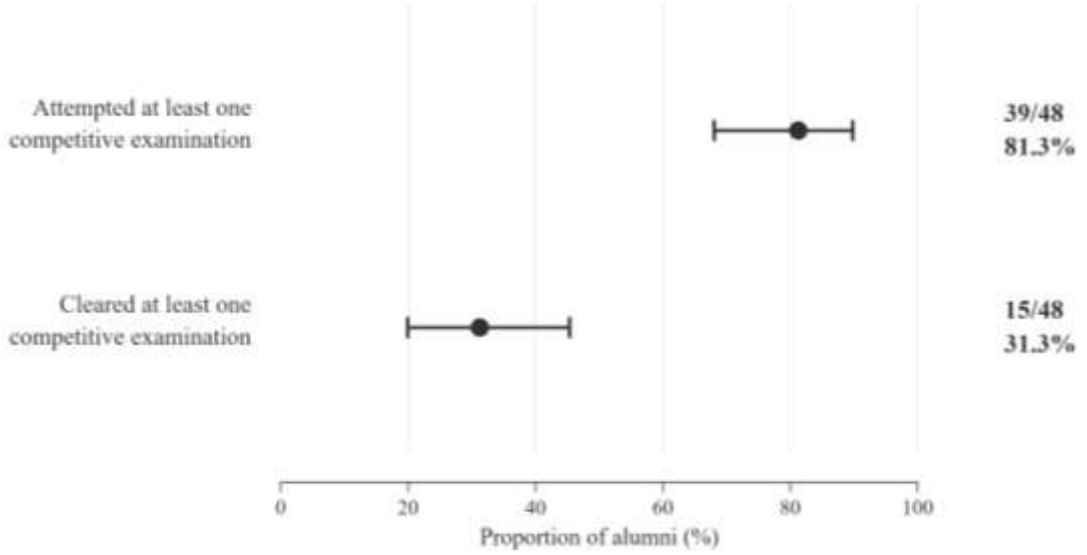
Figure 3: Professional Perceived-Impact Ratings Under Two Classification Thresholds



3.4 Post-school educational pathways among responding alumni

Of 48 alumni respondents, 39 (81.3%; Wilson 95% interval 68.1–89.8) reported attempting at least one competitive examination after Class XII, whereas 15 reported clearing at least one (31.3% of all 48; 19.9–45.3). Note: The basis for the clearance proportion is the total number of respondents, 48. It is not a pass rate among examinees. 45.8% (22/48) attempted NEET and 20.8% (10/48) attempted JEE Main Examination categories may overlap, so summing examination counts may overstate the number of unique examinees. Clearances reported were CUET (6), JEE Main (5), NEET (3) and MP PNST (1). In the external exam records this could not be verified individually.

Figure 4: Competitive-Examination Engagement Reported by 48 Alumni



Course or preparation fields were heterogeneous with the most frequently reported entries being B.Sc. (13/48, 27.1%) and B.Tech. (9/48, 18.8%). Other labels were B.A., B.Pharm., BCA, Biology, Mathematics, Science, Diploma and NEET preparation. Five respondents did not have a course entry. A verified STEM-continuation rate is not calculated due to the need for degree verification, coherent field coding, and complete entries. Self-reported examination engagement is an indicator of educational activity, not an indicator of demonstrated program impact.

Table 4: Selected Alumni Educational and Examination Indicators

Measure	Count / denominator	Percent	Wilson 95% interval (%)
Any examination attempted	39/48	81.3	68.1–89.8
NEET attempted	22/48	45.8	32.6–59.7
JEE Main attempted	10/48	20.8	11.7–34.3
Any examination cleared	15/48	31.3	19.9–45.3
B.Sc. label reported	13/48	27.1	16.6–41.0
B.Tech. label reported	9/48	18.8	10.2–31.9

3.5 Alumni retrospective perceptions

Positive retrospective agreement across the eight items ranged from 39/48 (81.3%) for awareness of further study to 44/48 (91.7%) for critical thinking. Self-confidence: 43/48 (89.6%). Question asking: 41/48 (85.4%). Four other domains had 42/48 positive responses each (87.5%). The median percentage of positive agreement was 87.5% across items. Figure 5 shows model-based intervals. Table 5 preserves full source category counts. None of the eight items had a "strongly disagree" response in the available data.

Figure 5: Positive Retrospective Agreement Across Eight Alumni Domains

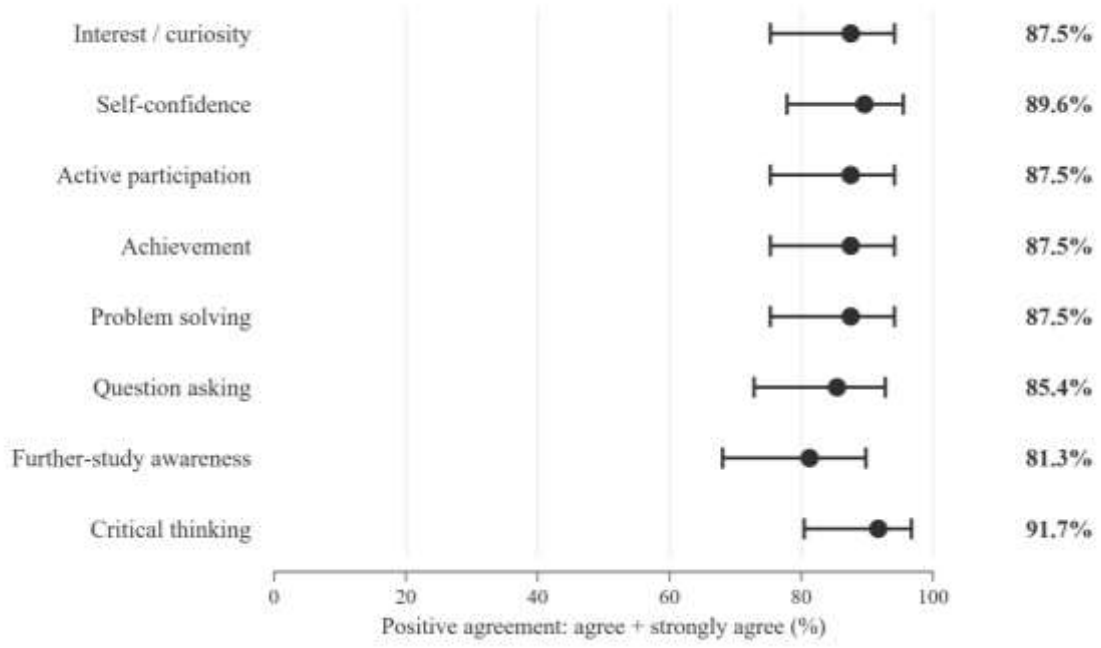


Table 5: Complete Alumni Retrospective Response Distributions (n = 48 Per Item)

Domain	Strongly agree	Agree	Undecided	Disagree	Positive (%)
Interest / curiosity	17	25	6	0	87.5
Self-confidence	16	27	5	0	89.6
Active participation	20	22	5	1	87.5
Achievement	18	24	6	0	87.5
Problem solving	12	30	5	1	87.5
Question asking	10	31	6	1	85.4

Domain	Strongly agree	Agree	Undecided	Disagree	Positive (%)
Further-study awareness	17	22	7	2	81.3
Critical thinking	17	27	4	0	91.7

3.6 Cross-source synthesis and non-linkage

A limited same-direction descriptive pattern emerged: teachers rated confidence and critical thinking as among the highest domains, and alumni retrospectively endorsed self-confidence (89.6%) and critical thinking (91.7%). Teachers' guidance-seeking mean (3.8) was one of the lowest; alumni further-study awareness (81.3%) was the least endorsed of their eight items. These similarities are useful for generating monitoring questions, but the respondents were different, the scales and recall frames were different and the datasets were not linked at school or individual level. Therefore, no statistical agreement and mediation from implementation support to alumni outcomes can be asserted.

Table 6: Cross-Source Pattern Comparison and Permitted Claims

Topic	Professional observation	Alumni observation	Permitted conclusion
Confidence and critical thinking	Teacher means 4.0/5 for each	89.6% and 91.7% positive retrospective agreement	Same-direction reported perceptions; not corroborated change
Guidance and future orientation	Guidance mean 3.8/5	Further-study awareness positive in 81.3%	Possible monitoring priority; no matched estimate
Program continuity	Coordinators describe 50–75% bands in XI–XII	81.3% attempted an exam	Separate descriptions; no dosage-outcome association
Leadership endorsement	6/6 principals at least moderate impact	No linked leadership question	Reported approval; not organisational readiness
Validated readiness / fidelity	No direct measurement	No direct measurement	Not estimated or demonstrated

4. DISCUSSION

4.1 Interpreting favourable perceptions without causal overreach

The main finding is a positive descriptive picture of program relevant educational experiences among professionals and responding alumni but with important measurement uncertainty. The teacher means show that several perceived benefits were endorsed at similar levels; they cannot show actual gains in problem solving or critical thinking. The sensitivity exercise shows that thresholds of reporting are as important as blanket expressions of support. The majority of teachers did not give high/very-high ratings, but moderate or higher ratings were common. This distinction is especially useful in monitoring

contexts, where the interpretation of positively responding categories can affect resource and program decisions.

The alumni results must be interpreted in light of how the sample was drawn. The 81.3% examination-attempt rate suggests that a large number of the respondents were involved in post-school selection processes, but it does not suggest the rate of all eligible program alumni who attempted such examinations. The reported 31.3% clearance proportion also conflates the effects of selection into the alumni sample, examination type, preparation and other factors. This should not be considered as Vigyan Jyoti success rate." A positive retrospective evaluation may also be consistent with significant real-world obstacles to higher education.

4.2 What existing theories explain—and do not explain

Future expectations and aspirations may be influenced by learning opportunities and support according to Social Cognitive Career Theory [5]. Attention to career information and students' beliefs is supported by research on opportunity structures and perceptions of STEM professionals [7, 8]. But longitudinal evidence warns against replacing self-efficacy with the more complex set of predictors of later choice [9], and meta-analytic evidence shows that identity–intention associations are context dependent [10]. The present study does not include direct pre-program measures or matched post-school outcomes and is therefore unable to test any of these pathways. They are interpretive in nature. They find constructs that should be measured separately in a future evaluation.

School leadership and organisational-readiness theories also imply possible delivery conditions [13, 14, 18]. But a principal's positive overall-impact response does not directly capture protected mentoring time, resource allocation or collective change efficacy. Similarly, the way coordinators perceive benefit bands cannot dictate adherence, dosage or equitable distribution of activities. The results are consistent with interest in implementation support but agnostic about actual fidelity. This is a major conceptual boundary, not a technical flaw that could be overcome by a more vigorous discussion.

4.3 Competing explanations and measurement threats

There are several alternative explanations that merit equal consideration. Participants who are professionals recruited through their program roles may be more exposed to positive activities and have more institutional commitment than non-respondents. Alumni who remained in contact with the school, or who were continuing their education, may also have been more likely to respond. The perceived benefit may be a function of social desirability, recall or attribution to a salient program, rather than a documented difference in educational trajectories. Cross-source similarity itself does not remove these common sources of bias. The nominal Wilson intervals may be further constrained by context and clustering within schools in the interpretation.

The present study therefore does not demonstrate that more exposure across grades resulted in better outcomes, that teacher-reported improvement corresponded with later choices of the same students or that measured organisational readiness predicted success. These are hypotheses for future prospective studies. The best added value that selective journals can do is to demonstrate exactly how descriptive evidence can be reported without turning implementation proxies into effects.

4.4 A prospective evaluation and monitoring agenda

(1) delivered opportunities - session dates, hours, attendance, mentoring participation and adaptations; (2) school enabling conditions - resourcing, role clarity, leadership practices, climate and a validated readiness measure; and (3) student trajectories - repeated interest and confidence measures, subject choices, objectively verified enrolments and exam participation. A future monitoring design could

capture three levels of evidence: Data should include privacy-preserving identifiers for the school and the respondent, clear procedures for consent, and a defined follow-up frame. The proposed design is not tested on the current dataset.

For educational managers, the explicit assignment of coordinator responsibilities, availability of career guidance and documentation of equitable student participation may be more valuable than overall satisfaction ratings. Teacher professional development should focus on gendered participation and feedback practices as observable classroom actions [15, 16]. Monitoring frameworks should differentiate between number of activities delivered and real reach, fidelity and resulting opportunities. A general framework for integrated STEM learning provides a potential lens for designing such experiences [23]. Evidence for students' STEM self-efficacy and career interest indicate that these experiences need to be coupled with credible guidance [24]. A comparison group, repeated measures and predetermined pathway coding would permit stronger inference than this retrospective cross-sectional analysis, where ethical and operational constraints permit.

4.5 Strengths, limitations and interpretive scope

The analysis retains four unique sources of evidence, preserves ordinal and aggregate levels of measurement, audits threshold-dependent response summaries, and does not calculate an unsupported index of program effectiveness. Recalculation ensures that the reported percentages can be traced back to public numerator denominator pairs. While such procedural strengths enhance transparency, they do not address design limitations. Key limitations include purposive sampling, lack of recruitment denominators and respondent-level distributions, small subgroups of professionals, unmeasured school clustering, recall bias, heterogeneous educational labels, lack of verified examination results and lack of a non-participant alumni comparison. "Direct observation of organisational readiness and implementation fidelity was not performed. The work is not intended to be a measure of national program effectiveness but rather a bounded descriptive assessment of participating respondents.

5. CONCLUSION

Available Vigyan Jyoti data indicate favourable teacher-rated learner-facing domains (3.8–4.0/5), predominantly moderate-or-higher professional impact judgements, and substantial reported post-school examination engagement among 48 responding alumni. But the same professional data lead to considerably fewer high/very-high ratings, emphasising the significance of decision thresholds and uncertainty. Alumni reports are meaningful observations of respondents' experiences, not program-attributable effects.

The scientific contribution is a transparent descriptive synthesis of multiple sources, maintaining the distinctions between perceived support, implementation measures and educational outcomes. Directly recorded activity fidelity and organisational capacity, recruitment denominators, validated instruments, and prospectively linked educational follow-up are needed to better evaluate girls' STEM pathways, ideally with defensible comparison evidence.

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