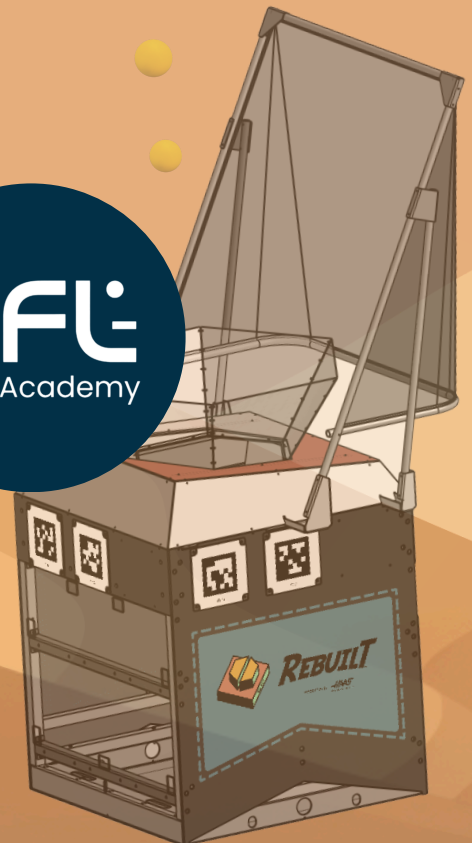


Catalyzing Change

How has Team Sigma scaled and expanded opportunities beyond academics for underserved students and fostered inclusion of neurodivergent team members, influencing their pathways (2023–2026)?

2023



improvise · adapt · overcome

Research Paper

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Abstract

This study examines the impact of Team Sigma’s multi-tiered outreach and inclusion framework (2023–2026) on underserved communities in India. In regions where success is traditionally tethered to rote academic performance, this research investigates how the integration of hands-on STEM learning and the intentional inclusion of neurodivergent perspectives shift career aspirations and institutional mindsets. Utilizing the "Build Your First Robot" (BYFR) program as a catalyst, Team Sigma facilitated the establishment of 24 robotics and AI laboratories in partnership with 25 underserved schools, leveraging corporate social responsibility (CSR) funding. Data collected via school administrator interviews and student evaluations indicate a significant rise in student engagement and a shifting perception among educators regarding technology-based career pathways. Furthermore, the study explores Team Sigma’s internal model of "Inclusion as an Asset," where eight neurodivergent members leveraged diverse cognitive approaches to excel in high-pressure leadership and technical roles. The findings demonstrate that by bridging the resource gap and fostering inclusive environments, student interest can be successfully transitioned from curiosity to competitive engineering and sustainable STEM participation.

Introduction

The **FIRST Robotics Competition (FRC)** is an international platform that transcends traditional engineering by challenging high school students to design, build, and program industrial-sized robots under strict constraints. However, the true "impact" of FRC lies beyond the playing field, rooted in the core values of **Gracious Professionalism®** and **Coopertition®**. For **Team Sigma 9692**, the name "Sigma" (Σ)—the mathematical symbol for summation—represents the synthesis of these values: Discovery, Innovation, Impact, Inclusion, Teamwork, and Fun.

The Opportunity Gap in Underserved Communities

In many of India's underserved communities, the definition of success is narrow, often confined to traditional academic performance and stable, low-risk career paths such as government service or basic administration. While global interest in Science, Technology, Engineering, and Mathematics (STEM) is surging, students in these regions face a "participation barrier." Research indicates that nearly 50% of students from underserved backgrounds desire STEM careers, yet they lack the hands-on resources and mentorship required to bridge the gap between interest and professional viability.

The Team Sigma Framework: Labs, AI, and Inclusion

To dismantle these barriers, Team Sigma has developed a three-pillar intervention strategy designed to redefine success for students and educators alike:

- **Institutional Infrastructure (BYFR):** Through the **Build Your First Robot (BYFR)** program, Team Sigma introduces students in government schools to the fundamentals of robotics. By leveraging Corporate Social Responsibility (CSR) funding and partnering with the **Chingari Shakti Foundation**, the team has established 24 permanent robotics labs across India. This initiative goes beyond equipment installation, providing five-day teacher training modules and quarterly audits to ensure long-term sustainability.
- **Technological Literacy (AI Fellowship):** Recognizing that Artificial Intelligence is an essential modern skill, the team launched an **AI Fellowship**. This program educates underprivileged students on AI ethics, prompt engineering, and real-world applications, shifting the perception of AI from a "shortcut" to a vital learning companion.
- **Cognitive Diversity (Inclusive Excellence):** Internally, Team Sigma champions the FIRST core value of Inclusion by intentionally integrating neurodivergent members. Over the past three years, the team has welcomed more than eight neurodivergent students, moving beyond "accommodation" to a model where diverse cognitive styles—such as those associated with ADHD and dyspraxia—are utilized as technical and strategic assets.

By combining infrastructure, education, and inclusivity, Team Sigma aims to prove that when resources are democratized, underserved and neurodivergent students do not just participate in the future of technology—they lead it.

Methodology

This study employs a mixed-methods research design to evaluate the efficacy of Team Sigma's outreach and inclusion initiatives. The methodology is divided into three distinct investigative tracks: institutional STEM integration, AI literacy, and qualitative analysis of internal neurodivergent integration.

I. Institutional STEM Integration (BYFR and Lab Initiative)

To assess the impact of the Build Your First Robot (BYFR) program and subsequent lab installations, a qualitative interview-based approach was utilized.

- Participants: Administrative heads and lead educators from 20+ participating government schools across India.
- Procedure: Following the delivery of hands-on sessions utilizing Lego Mindstorms EV3 kits, semi-structured interviews were conducted. These focused on three key indicators: student engagement levels, shifts in academic attendance, and institutional willingness to adopt permanent robotics curricula
- Data Analysis: Responses were subjected to thematic analysis to identify recurring trends in community perception and institutional commitment.

II. AI Literacy and Ethical Adoption (AI Fellowship)

A quantitative assessment was conducted to measure the impact of the AI Fellowship workshops on underprivileged student populations.

- Participants: [Insert Number] students from underserved backgrounds.
- Instrumentation: A post-session evaluation instrument was used to measure:
 - a. Confidence Levels: Self-reported understanding of AI (measured on a Likert-style scale).
 - b. Skill Acquisition: Binary (Yes/No) assessment of prompt-engineering proficiency and pedagogical expectations.
 - c. Ethical Commitment: A formal "Responsible AI Pledge" served as a behavioral indicator of ethical intent and community knowledge-sharing.
- Procedure: Data was compiled from session evaluation sheets and analyzed using descriptive statistics to determine the percentage of students who successfully transitioned to "confident" users of AI.

III. Qualitative Analysis of Neurodivergent Integration

To evaluate the "Inclusion as an Asset" model, the study utilized a case-study approach focusing on the internal team structure of Team Sigma.

- **Participants:** Eight neurodivergent team members (encompassing ADHD and dyspraxia) with tenures spanning 2023-2026.
- **Data Collection:** Semi-structured qualitative interviews were conducted to compare the robotics environment against traditional academic settings. The inquiry focused on:
 - a. **Hyperfocus and Engagement:** The relationship between hands-on engineering and cognitive focus.
 - b. **Strategic Contribution:** How non-linear thinking styles influenced technical problem-solving.
 - c. **Leadership Progression:** The transition of neurodivergent members into high-ranking roles (e.g., Captaincy, Scouting Lead).
- **Analysis:** Interview transcripts were reviewed to identify the specific environmental factors in FRC that allow "divergent" traits to function as professional strengths.

The Sigma 9692 Logic Model Framework

Component	Defination	Your Team's Specifics
Inputs (Resources)	What you "invest" to make the project happen.	CSR Funding, FRC Team 9692 expertise, Lego Mindstorms/AI tools, Chingari Shakti Foundation partnership.
Activities (Actions)	The actual work you perform.	Conducting BYFR workshops, setting up physical labs, 5-day teacher training, AI Fellowship sessions.
Outputs (Numbers)	The direct "products" of your activities.	23 workshops, 24 labs established, 1,200+ students trained in BYFR, 8+ neurodivergent members integrated.
Outcomes (Changes)	The short-to-medium term shifts in people.	60% increase in STEM interest, increased student attendance, neurodivergent members taking leadership roles.
Impact (Long Term)	The broad, lasting "society-level" change	Creating a new "career pathway" beyond traditional academics for underserved communities in India.

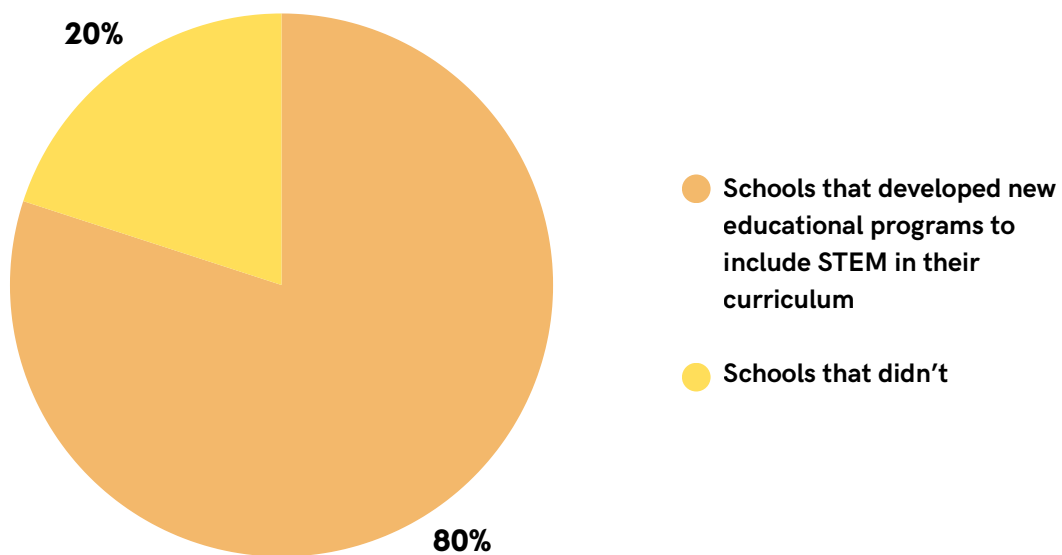
Results

I. Institutional STEM Integration and Laboratory Impact

The BYFR outreach initiative and subsequent lab installations yielded significant measurable changes in institutional behavior and student engagement.

- **Scale of Outreach:** Team Sigma conducted **23 BYFR programs** across 20 institutions, directly impacting **1,100+ underserved students**.

Institutional Adoption: Following the initial workshops, **80% of participating schools** formally integrated STEM modules into their standard curricula. Furthermore, Team Sigma successfully established **24 permanent AI and Robotics laboratories**, reaching an estimated **7,000 students** through long-term infrastructure.

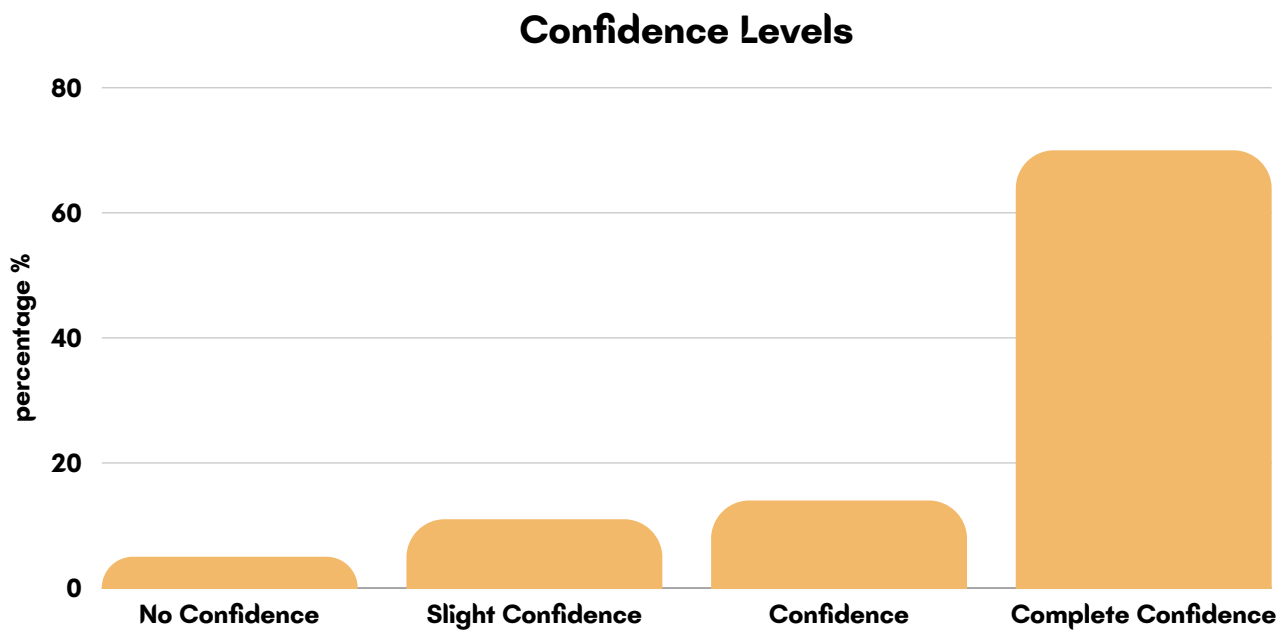


- **Engagement Metrics:** Administrative feedback indicated a **100% success rate** in increasing student enthusiasm. Administrators estimated a **60% rise in STEM interest**, correlated with improved general school attendance and class participation.
- **Competitive Success:** The efficacy of the lab model was validated by students from the **Salaam Bombay Foundation**. Utilizing Team Sigma's lab resources, nine students qualified for **Codeavour 6.0**, ultimately securing **2nd and 3rd place** in the national Junior Category.

II. AI Fellowship and Ethical Literacy

Quantitative data from the AI Fellowship sessions across [Number] schools indicates a successful transition from technological curiosity to functional AI literacy.

Confidence and Competency: Post-session evaluations showed that **__% of students** reached "complete confidence" in understanding AI concepts. Notably, **__% of participants** reported proficiency in prompt engineering, demonstrating an ability to generate accurate and useful technical outputs.



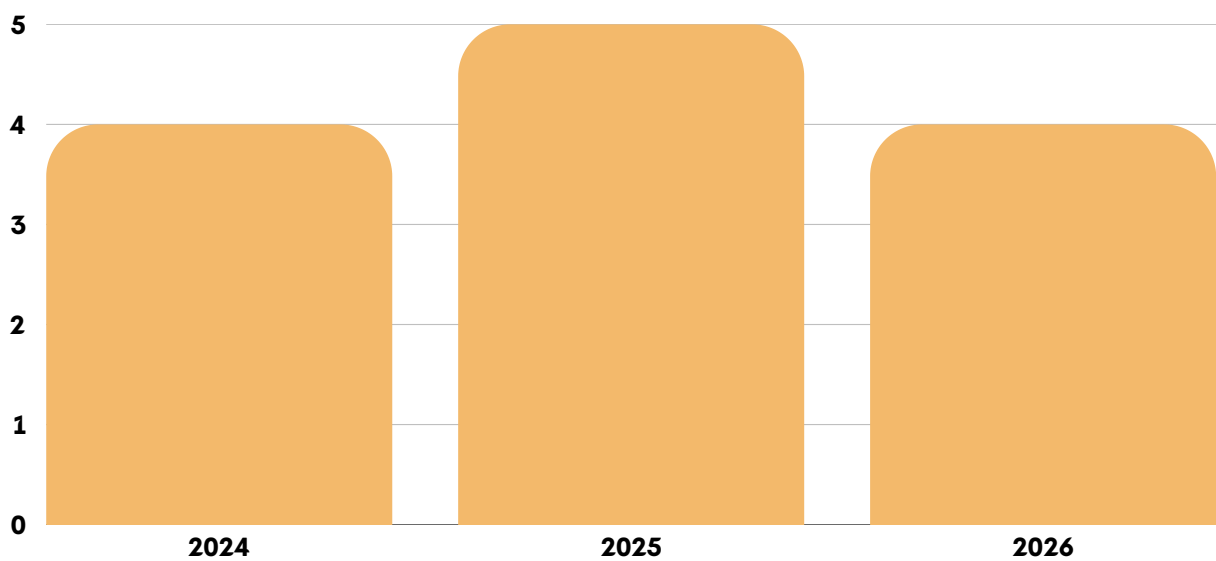
- **Pedagogical Shift:** **__% of students** expressed intent to utilize AI as a "learning companion" for academic self-improvement. A qualitative highlight included a student at **Swami Vivekanand High School** who utilized workshop techniques to optimize autonomous language learning (English and Japanese), demonstrating the program's ability to spark independent inquiry.
- **Ethical Commitment:** The "Responsible AI Pledge" saw a **__% signature rate**, indicating a high community commitment to ethical usage and the "ripple effect" of peer-to-peer teaching.

III. Qualitative Outcomes of Neurodivergent Integration

Analysis of Team Sigma’s internal structure confirms that inclusive environments transform neurodivergent traits into organizational assets.

- **Leadership and Retention:** Over a three-year period, Team Sigma maintained a 100% retention rate for its eight neurodivergent members, with 25% ascending to high-level leadership positions.

Number of Neurodivergent Members



- **Case Study: Kabir Doshi (Co-Captain, 2025):** Diagnosed with **motor dyspraxia**, Doshi transitioned from a technical contributor to a "versatile all-rounder." His persistence resulted in unique mechanical problem-solving methods and a mentorship style that significantly bolstered the confidence of younger FTC teams.
- **Case Study: Vihaan Bhuva (Scouting Captain, 2025):** Diagnosed with **ADHD**, Bhuva leveraged high-stimulation environments to excel in the high-pressure role of Scouting Captain, demonstrating that neurodivergent individuals are uniquely suited for the fast-paced data analysis required in FRC competitions.

Discussion

I. Infrastructure as a Catalyst for STEM Engagement

The success of the BYFR workshops suggests that the primary barrier to STEM in underserved communities is not a lack of interest, but a lack of **tactile engagement**. Traditional Indian classrooms often prioritize theoretical memorization; however, our findings demonstrate that hands-on robotics acts as a "hook" that converts curiosity into sustained academic involvement.

The transition from a one-day workshop to a permanent laboratory is critical. We refer to this as **Institutional Scaffolding**: the initial workshop creates the spark, but the laboratory provides the oxygen for that interest to grow into technical expertise. The 80% adoption rate of STEM modules by participating schools proves that when a "proof of concept" is provided through FRC outreach, educational leaders are willing to pivot away from traditional rote-learning models.

II. AI Literacy: From Consumers to Creators

The AI Fellowship results highlight a significant shift in student psychology. In underserved populations, technology is often viewed as a "black box"—something to be consumed but not understood. By introducing **Prompt Engineering**, Team Sigma demystified the technology, transforming students from passive users into active creators.

The "Responsible AI Pledge" was strategically designed to address the "digital divide" in ethics. As AI becomes ubiquitous, underserved students are at risk of being left behind not just in skill, but in the ethical nuances of the tool. Our data suggests that by framing AI as a **"Learning Companion"** rather than a shortcut, we can improve academic performance in other subjects (e.g., language learning) while simultaneously building a "ripple effect" of digital literacy throughout the community.

III. The Neurodivergent Competitive Advantage

Perhaps the most significant finding of this study is the redefinition of neurodivergence from a disability to a strategic asset. In standard academic settings, traits like ADHD or dyspraxia are often framed as obstacles to be managed. However, the high-stimulation, multi-variable environment of an FRC Pit creates a setting where these cognitive styles can thrive.

- **Hyperfocus:** Members with ADHD utilized "hyperfocus" to manage complex scouting data and real-time strategy.
- **Resilience:** Members with dyspraxia, like Kabir Doshi, developed non-linear problem-solving techniques that offered the team alternative mechanical solutions.

This suggests that inclusive STEM environments do not just benefit the neurodivergent individual; they improve the collective intelligence of the team. By valuing "diverse ways of thinking," Team Sigma created a more robust engineering process that is capable of tackling unconventional challenges.

Conclusion

Team Sigma's initiatives from 2023 to 2026 demonstrate a sustainable model for bridging the gap between corporations and underserved communities. By executing 23 **Build Your First Robot (BYFR)** workshops across 20+ institutions, the team successfully introduced over 1,200 students to the basic concepts of engineering. The establishment of **24 permanent AI and Robotics laboratories** across India has converted these initial points of contact into long-lasting innovation hubs, giving more than **7,000 underprivileged students** the resources they needed to pursue STEM careers that were previously thought to be unattainable.

Additionally, the **AI Fellowship** outreach programs have addressed the gap in the understanding of artificial intelligence amongst underserved communities. By prioritizing ethical frameworks and prompt engineering, the program has equipped underprivileged students with the tools to become active participants in the technology-driven future.

Furthermore, Team Sigma's internal commitment to **Inclusive Excellence** has proven that neurodivergent traits—such as the hyperfocus associated with ADHD or the unique problem-solving approaches of motor dyspraxia—are not merely to be accommodated, but are vital assets in technical leadership and engineering cycles.

Ultimately, the work of Team Sigma proves that when hands-on resources are combined with an inclusive culture, the "digital divide" can be bridged. This research serves as a blueprint for how FRC teams can leverage their expertise to shift societal perceptions of success, proving that the **summation** () of diverse perspectives and equitable access is the most effective driver for technological and social advancement.

Appendix A: Administrative Qualitative Interview Protocol

Conducted with school leadership to evaluate institutional impact.

1. **Baseline Assessment:** Describe the state of STEM/Robotics education within the institution prior to the establishment of the Sigma Lab.
2. **Behavioral Metrics:** Have there been observable shifts in student attendance, engagement, or classroom participation since the program's inception?
3. **Community Perception:** How has the broader community (parents and local stakeholders) responded to the introduction of high-level robotics?
4. **Individual Impact:** Can you identify a specific student whose academic or personal trajectory has significantly altered due to this initiative?
5. **Growth Estimation:** What is the estimated percentage increase in student interest regarding STEM-based career pathways?

Appendix B: AI Fellowship Evaluation & Ethical Instrument

Survey and commitment framework distributed to all participants.

1. **Self-Efficacy:** On a scale of 1-5, how confident do you feel regarding your understanding of AI and its responsible applications?
2. **Pedagogical Utility:** Do you intend to utilize generative AI as a primary learning companion to enhance your academic efficiency?
3. **Expectation Audit:** Did the workshop successfully meet your initial learning objectives regarding AI technology?
4. **Technical Literacy:** Did the session provide a functional understanding of prompt engineering and its optimization?

The Responsible AI Pledge

"I, _____, pledge to utilize artificial intelligence responsibly and ethically. I will use AI as a tool to support my learning, understanding, and personal growth. I commit to maintaining academic integrity and will not use AI to misrepresent my own abilities. Furthermore, I pledge to share this knowledge with at least five other individuals to promote ethical AI usage within my community."

Appendix C: Neurodivergent Member Qualitative Inquiry

Interviews focusing on cognitive diversity and the FRC environment.

1. **Environmental Comparison:** Compare your cognitive engagement in a standard classroom setting versus the high-pressure environment of the FRC Pit.
2. **Crisis Management:** Describe a scenario where you exercised leadership or technical problem-solving during a critical team challenge.
3. **Identity & Inclusion:** In traditional education, you are often labeled "Divergent." Within the framework of Team Sigma, how do you define your role and value?
4. **Vocational Readiness:** In what ways has the Sigma environment prepared you for a professional career in technology or leadership?
5. **Cognitive Advantage:** Why do you believe your unique way of thinking provides a competitive edge in engineering and strategic planning?

Appendix D: Longitudinal Outreach Impact Data (2023–2026)

Program / Initiative	Institutions Impacted	Student Reach (Estimated)
Build Your First Robot (BYFR)	20+ Schools	1200+
AI Fellowship Program	4+ Schools	250+
Permanent Lab Infrastructure	24 Labs	7000+

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Written by

