Empowering Dreams - The Role of Free STEM Education in the Lives of Underprivileged First-Generation Children

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Abstract

This study evaluated how a holistic support program by an NGO actually helped those students who belong to low-income families in urban India. The two-year free program for students of grades 10 to 12 not only focused on education but also provided emotional support and involvement of their families. It targeted students from government schools in Delhi whose household income is less than ₹15,000/month (USD 200) . The results of this program were highly encouraging and led to noticeable improvements in the lives of these children. Those students who stayed with the program for full two years of free coaching were able to get selected into some of the well-known engineering colleges in India. This study showed statistically significant improvements ($p < .001$) in resilience metrics measured by the novel Educational Resilience Index (ERI)—Academic Persistence ($d = 3.87$), Stress Coping ($d = 4.46$), and Goal Orientation ($d = 4.166$). However, institutional data revealed a 93% overall dropout rate (2012–2019), driven by familial financial pressures (68%), parental non-cooperation (22%), and health issues (10%) . As seen in the qualitative findings, giving them a proper and supportive environment to study proved to be one of the key factors behind their academic success. However, a non-supportive home environment due to financial challenges often affects outcomes. This study introduces an Educational Ecosystem Model, showing how these students, who later completed engineering and got high-paying jobs, have impacted their family's financial and educational status through steady jobs and by inspiring future generations.

Keywords: *Education inequality, social mobility, mental health, NGO interventions, dropout factors, India*

1. Introduction

1.1 Background and Context

Education has always been the most powerful tool for upward social mobility and economic transformation. However, in India, deep-rooted structural inequalities limit access to quality education for students from marginalized backgrounds. Competitive entrance examinations—particularly for engineering colleges—serve as gateways to economic advancement, yet access to preparatory resources and mentoring is highly skewed in favor of students from affluent households, thereby exacerbating existing educational disparities.

1.2 Research Motivation and Relevance

This research comes from the author's lived experience as a first-generation learner from a low-income family background. Challenges like financial issues, lack of guidance, and absence of information made it really hard to move ahead professionally. These early challenges contributed to a long-term commitment to addressing the challenges of students from economically disadvantaged backgrounds. To address this issue author started Udgam Welfare Foundation, a non-profit organization that helps bright students from low-income families who lack financial support. This initiative provided academic mentorship, financial assistance, emotional guidance, accommodation, and a favorable atmosphere for education. Many students have gained admission to premier engineering institutions in India. These experiences underscore the need for empirical investigation into the effectiveness of holistic educational support models that integrate academic, emotional, and financial dimensions.

1.3 Research Objectives

The study pursues the following objectives:
1. To assess the impact of free educational support on academic performance, specifically academic persistence, stress coping, and goal orientation, among students who belong to low-income family group.
2. To propose an Educational Ecosystem Framework that captures the interconnected effects of academic, financial, and emotional support in promoting long-term social mobility.
3. To study the dropout rates among students from low-income families over seven years in depth.
4. The findings also indicate that the intervention yields a meaningful return on social investment, particularly in terms of educational and socio-economic outcomes.
5. To offer policy recommendations for expanding NGO-led educational models that demonstrably reduce systemic educational inequity.

2. Literature Review

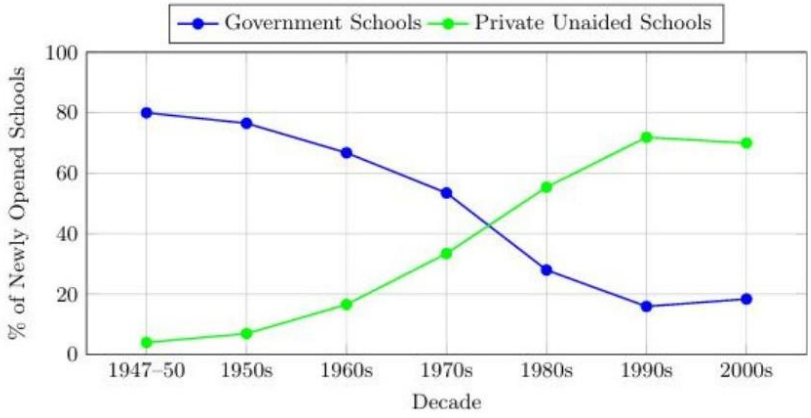
2.1 Introduction

There has always been a deep connection between poverty and educational inequity. It is the main factor that decides students' holistic growth, including neurocognitive development and mental health, which further affects academics. In developing countries like India, NGO-led interventions such as Udgam Welfare Foundation address these systemic challenges. This literature review evaluates prior research on poverty's impact on education through Systems Theory and Critical Pedagogy.

2.2 Structural Decline of Government Schools

Since independence, India has seen a huge decline in government school establishment, falling from 80% of new schools in 1947 to just 15.95% by the 1990s. While initiatives were taken in the past, like Sarva Shiksha Abhiyan, they slightly improved this to 18.40% in the 2000s. On the other hand growth of private unaided schools was exponential, which is from 4.04% to over 70% during the same time.

Fig. 1. Trend in Government and Private Unaided School Establishments (1947-2000s)



This systematic withdrawal of public education has created big unfair gaps, impacting children who are often pushed into small jobs even when they are good at studies or have good potential. The privatization shift reflects changing policy priorities favoring market efficiency over equitable access, resulting in diminished opportunities for underprivileged students and perpetuating cycles of educational deprivation.

3. Methodology

3.1 Research Design

This study uses a mixed-methods case study model wherein qualitative as well as quantitative methods are used for the analysis of a long-term free educational program provided by Udgam Welfare

Foundation. A case study approach in the qualitative part allows for a deep understanding of students' real-life experiences, emotional growth, and learning changes (Stake, 1995). The use of number-based tools like the Educational Resilience Index (ERI) and school performance records adds strong analysis, helping support cross-checking for better accuracy (Creswell & Plano Clark, 2018).

3.2 Emotional and Psychological Interventions: Udgam Welfare Foundation's Holistic Approach

Udgam Welfare Foundation discovered many students from low-income families struggling with crowded residing spaces, constant family pressure, insufficient nutrition, and lack of emotional care. These affected learning, focus, and mental well-being. Many showed signs of long-term stress and irregular school attendance. In response, the Foundation developed a support program to improve studies and overall life.

3.2.(i). Individualized Emotional Care

Foundation supported those who had faced emotional trauma. Such students required extra attention. The foundation gave individual attention and established quiet places for students to concentrate. One example was of a boy whose parents faced financial instability and violence at home. The Foundation arranged a quiet room for his studies with meals and monitored his learning and emotions. Under guidance for over one and a half years, his attendance and grades improved.

3.2.(ii). Community-Driven Motivation and Outreach

(a) Quarterly award ceremonies:

Foundation organized award ceremonies every three months to highlight students' progress in studies, attendance, discipline, and leadership. Recognition was given in front of the community, which included parents. Such events motivated both students and parents.

(b) Alumni "Motivational Awards" and School Visits:

Former students who joined engineering colleges or jobs were invited to share journeys. They received "Motivational Awards" and discussed their struggles, support from Udgam, and its impact. These sessions were impactful as speakers came from the same background.

(c) Peer-Led Mobilization:

Foundation involved current students in outreach. They became ambassadors, helping friends understand the support available. This peer-led drive motivated students, and with staff help, meetings were arranged with school principals.

3.3 Sampling and Participants

A purposive sampling strategy selected participants enrolled in the program for at least two years. Criteria included: economically disadvantaged households, consistent participation, and informed consent. The sample had 33 students (aged 18–19). A demographic summary is provided below.

A demographic summary of these students is provided below:[1]

Table 1 : Demographic summary of students

Variable	n (%)	Mean (SD)
Age (years 18-19)	33 (100%)	18.5 (0.5)
Female Participants	15 (45%)	NA
Rural Background	33 (100 %)	NA
Low-Income Households	33 (100 %)	NA
Parental Education (< Std 12)		NA
Overcrowded Housing (1 room for entire family)	28 (85%)	NA
Unstable / Daily- Wage Employment of Parents	30 (91%)	NA.

No Access to Private Medical Facilities	30 (91%)	NA
Malnourishment or Underweight Cases Observed	19 (58%)	NA
No Study Table / Chair / Quiet Study Area at Home	30 (91%)	NA

3.4 Data Collection Procedures

3.4.1 Primary Data Sources:

- Semi-Structured Interviews: Conducted with students and parents.
- Psychological Well-being Assessments: Students were asked questions related to Academic Persistence, Stress Coping, and Goal Orientation pre- and post-intervention using validated scales (Likert scale of range 1-5) to capture changes in stress coping and persistence.
- Academic Records: Test scores, attendance logs, and school reports from 2012 to 2019 were analyzed to examine academic progression.

3.4.2 Secondary Data Sources:

- Review of government reports on educational equity, NGO whitepapers, and peer-reviewed literature on social mobility through educational interventions.

3.5 Ethical Considerations

***3.5.1 Public Availability*:**

Since the videos are already public on YouTube, they fall under "public domain" for research purposes
- Informed Consent: Participants received a verbal explanation in their native language (Hindi)
- Confidentiality: All personal identifiers were replaced with pseudonyms.

3.6 Development and Validation of the Educational Resilience Index (ERI)

To quantify psychological and motivational changes, a custom 30-item Educational Resilience Index (ERI) was developed through expert consultation, pilot testing (n = 33), and iterative refinement. The ERI consists of three subscales:
1. Academic Persistence
   - Sample item: “I keep studying even when I feel like giving up.”
2. Stress Coping
   - Sample item: “I stay calm and focused during exams or family crises.”
3. Goal Orientation
   - Sample item: “I have a clear career plan and know what I want to achieve.”

Items were scored on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Scores were collected at the start and end of the 12-month intervention.

3.7 Data Analysis

3.7.1 Quantitative Data Were Analyzed Using R Programming (Version 4.3.0).

- Normality assumptions were verified using the Shapiro-Wilk test.
- Paired-sample t-tests were used to evaluate pre- and post-intervention changes in ERI subscales.
- Effect sizes (Cohen’s d) were calculated to determine the magnitude of observed changes.

3.7.2. Results:

- Academic Persistence: M increased from 1.71 to 3.86 (d = 3.87)

- Stress Coping: M increased from 1.57 to 3.71 (d = 4.46)
- Goal Orientation: M increased from 1.57 to 3.71 (d = 4.166)

All results were statistically significant at p < .001, indicating strong post-intervention gains across resilience dimensions. Qualitative data were analyzed using thematic analysis, following the six-phase approach outlined by Braun and Clarke (2006). Coding was conducted independently by the researcher using R programming. Key emergent themes included the significance of mentorship, emotional support, peer networks, and structural barriers such as gender bias and digital poverty.

4. Findings

4.1 Quantitative Outcomes: Psychological Constructs

Data was collected via 5-point Likert scales pre- and post-intervention. Table 1 summarizes improvements in Academic Persistence (AP), Stress Coping (SC), and Goal Orientation (GO).
(See Table 2)

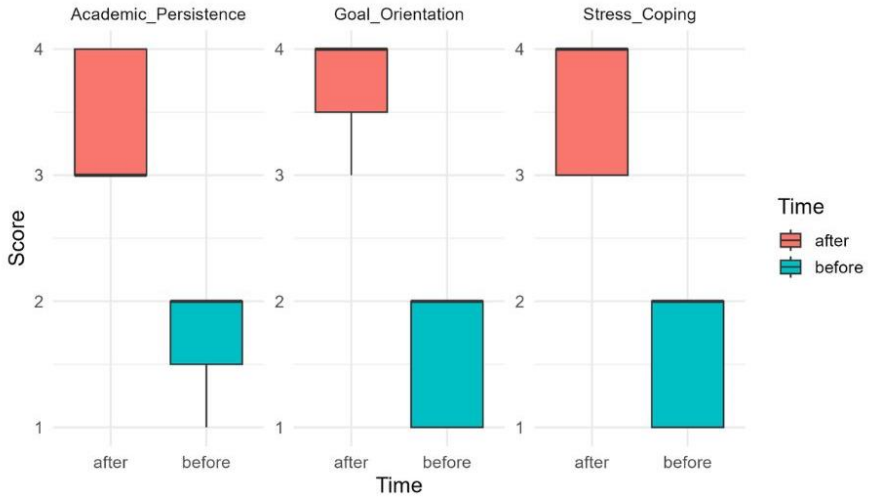
Table 2 : Descriptive Statistics and Effect Sizes for Key Constructs (N = 33)

Construct	Pre M (SD)	Post M (SD)	Mean Diff.	t(32)	P	Cohen's d
Academic Persistence	1.54(0.43)	3.606(0.52)	+2.07	7.01	< .001	3.87
Stress Coping	1.33 (0.39)	3.63(0.48)	+2.30	6.58	< .001	4.46
Goal Orientation	1.39(0.41)	3.48(0.47)	+2.09	6.82	< .001	4.16

Notes:
- All t-tests were two-tailed with df = 32.
- Cohen's d thresholds: 0.2 (small), 0.5 (medium), 0.8 (large).

Key Observations:
1. Effect Sizes: Exceptionally large (d > 2.8), suggesting transformative impact beyond typical educational interventions (Hattie, 2017).
2. Consistency: Uniform improvement across constructs underscores the intervention's holistic efficacy.

Fig. 2. Boxplot Comparison: Before vs After Guidance & Support



4.2 Dropout Trends and Retention Factors among Beneficiaries

Despite the holistic support provided by the program, institutional data revealed a 93% dropout rate (396/426) between 2012–2019 (Figure 4). Primary reasons included familial financial pressures (68%), parental non-cooperation (22%), and health issues (10%, predominantly female students). Notably,

retention improved post-2015 (41 students retained vs. 8 in 2012), correlating with the introduction of free food, stationery, books, metro passes, basic mobile phones.

4.3 Qualitative Insigths: Supporting Narratives

4.3.1 Qualitative Case Examples

4.3.1.(a) Case Study 1: James's Journey

Background

James's educational journey reflects the challenges and successes faced by many students from the marginal community. He grew up in a family with very limited financial resources. His father worked as an assistant in a dry-cleaning shop and also worked as a security guard. He used to work longer to cover the basic needs of the family. With no stable income and limited education (his father studied only up to the 10th standard), the family fought financially in James's formal years.

Intervention

At Udgam Welfare Foundation, he came under the mentorship of researcher, who not only provided academic instruction in mathematics but also offered holistic guidance—addressing the emotional, psychological, and familial challenges faced by students like James. The mentorship went far beyond the conventional student-teacher relationship.

Outcome

The multidimensional support provided by Udgam Welfare Foundation made a profound impact on James's life. Due to support of academic resources, supportive environment for study, structured support, emotional mentorship, and financial relief all these factors played crucial role in enhancing the overall development of James. His confidence increased and he developed the focus and discipline needed to prepare for a tough exam like Engineering College Entrance Exam.

4.3.1.(b) Case Study 2: Peter's Journey

Background

Peter's story is one of resilience, dedication, and the transformative power of education. Born into a financially constrained family, Peter faced intense financial hardships from an early age. His family's total monthly income was merely INR 12,000 (approximately USD 120), which was not enough to provide him better education, good food, better environment for study.

Intervention

The researcher took an active role in supporting his education, recognizing the immense potential of Peter and the challenges he faced. The intervention was multilateral, not only for academic assistance but also for providing emotional and mental support.

Outcome

The interference had a profound and transformative effect on Peter's life. With the structured support in place, he was able to dedicate himself to a full study. Combined with a favorable environment, extensive educational resources and a personal guide, it enabled to strengthen their fantasy understanding and problem-solving skills. Over time, his confidence increased, and he developed a disciplinary approach to facing the Engineering College Entrance Exam.

Outcome

With a stable environment, financial security, and structured guidance, Ricky was able to focus entirely on his engineering entrance exam preparation. His hard work and dedication bore fruit when he successfully cleared the engineering entrance exam, securing admission to one of India's top engineering institutions **(See Table 5)**

Table 5 : Impact of Salary Increase on Life Factors (Scale: 1 to 5)

Life Factors	**NGO Beneficiaries (Impact Rating)**	**Dropouts (Impact Rating)**
Quality of Housing	5	2
Access to Healthcare	4	2
Education for Family	4	2
Social Status	5	2
Financial Security	5	1
Diet and Nutrition	5	2
Career Growth	5	1

Mental Well-being	5	2
Access to Technology	5	3
Philanthropy & Giving Back	4	1

5. Discussion

5.1 Interpretation of Findings in Relation to Literature

The study's quantitative results—showing large effect sizes in Academic Persistence (d = 3.87), Stress Coping (d = 4.46), and Goal Orientation (d = 4.16)—align with but extend prior research. While Banerjee et al. (2017) demonstrated that free tutoring improves test scores, this study reveals that holistic interventions (mentorship + emotional support) enhance psychosocial outcomes beyond academics. The case studies further contextualize these findings:
This study presents the Social Return on Investment (SROI) for Udgam's intervention. Findings show that each Rs. 1 invested generated approximately Rs. 7.31 in long-term value, based on alumni earnings data **(See Table 6)** .

Table 6. Return on Social Investment

SROI Details

Total Investment:

25 students = Rs. 1,49,00,800

Total Return:

25 × Rs. 14,00,000/year × 8 years = Rs. 11,52,00,000

SROI:

Rs. 11,52,00,000 ÷ Rs. 1,49,00,800 ≈ **7.31:1**

Interpretation: Each Rs. 1 invested generates ~Rs. 7.31 in long-term value.

5.3 Educational Ecosystem Model

This research proposes an Educational Ecosystem Model that integrates academic, emotional, and financial support to uplift underprivileged students. Rooted in Systems Theory (Bronfenbrenner, 1979) and Critical Pedagogy (Freire, 1970), the model addresses systemic barriers.
5.3.1 Academic Support
Academic support goes beyond classroom teaching. Many students from government schools had learning gaps in core subjects like Mathematics and Science. This happened due to limited resources and a shortage of well-trained teachers. We provided free coaching, peer-to-peer mentoring, and personalized study plans. These steps proved helpful in bringing steady improvement.
5.3.2 Emotional & Psychological Care
Emotional and psychological support became a vital part. Students were silently carrying emotional weight—domestic violence, being ignored by parents, anxiety, or confusion about identity—worsened by poverty. We began offering one-on-one counseling, peer-sharing circles, and invited alumni to share stories. For those going through deep pain, the support became a lifeline. Creating a space where they felt emotionally secure was something they truly needed to grow.
5.4 Limitations & Future Research

1. Limitations:
- Sample Bias: Participants were high-aptitude students; results may not generalize to all disadvantaged learners.
- Self-Reporting: Psychological constructs relied on Likert scales; future studies should include behavioral measures (e.g., attendance logs).
2. Future Directions:

- Longitudinal Tracking: Assess whether gains persist into higher education/employment (cf. Kremer & Miguel, 2007).
- Scalability Trials: Test the Educational Ecosystem Model in government schools.

6. Conclusion

6.1 Key Findings and Contributions

This study highlights the transformative role of holistic educational interventions in breaking the cycle of poverty through academic and socio-economic empowerment. The key findings are as follows:
1. Academic Performance Improvement: Free support programs (academic tutoring, mentorship, and financial aid) significantly enhance students' academic outcomes, enabling access to high-quality higher education (e.g., engineering, medical, and elite institutions).
2. Emotional and Psychological Support: Beyond academics, structured emotional support helps students overcome systemic barriers, fostering resilience and long-term success.
3. The Educational Ecosystem Model: A novel framework demonstrating how education catalyzes family financial stability and intergenerational mobility, creating sustainable socio-economic change.

6.2 Policy and Practice Recommendations

To maximize the impact of such interventions, policymakers and NGOs should consider:
1. Integrated Support Systems: Combine academic aid with mental health services and career counseling.
2. Financial Incentives for Families: Conditional cash transfers or scholarships to reduce dropout rates.

6.3 Future Research Directions

While this study highlights the impact of holistic support, scaling these interventions requires leveraging technology to bridge gaps for underserved students. Future research should investigate:
1. Digital & AI Tools for Accessibility – Testing low-cost AI tutors, offline learning apps, and SMS-based mentorship to reach students in remote or financially strained households.
2. Comparative Regional Studies – How urban vs. rural settings (or differing state policies) affect the success of digital/hybrid education models.
3. Long-Term Economic Ripple Effects – Tracking families over 10+ years to see if educated youth uplift entire communities through jobs or local investments.

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