Counting the Cost: Socio-economic Status and Its Influence on Mathematical Learning Outcomes

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***Abstract*—This research investigates the relationship between socio-economic status (SES), parental involvement and access to technology on mathematical learning outcomes among secondary school students in Pune and Ahilyanagar, Maharashtra. The study examines four schools under the M.C.E. Society, analyzing data from 425 students participating in the "Math Yes We Can" program. The findings reveal significant disparities in educational resources and outcomes, highlighting the critical need for targeted interventions to promote educational equity**

***Index Terms*—mathematics education, socio-economic status (SES), parental involvement, technology access, Gandhian philosophy, Sustainable Development Goals (SDG)**

I. INTRODUCTION

Mathematics education serves as a fundamental pillar of STEM learning, fostering critical thinking, problem-solving, and analytical skills essential for 21st-century success. However, access to quality mathematics education remains inequitable, with socio-economic factors creating substantial barriers for disadvantaged students. This research aligns with the United Nations Sustainable Development Goals, particularly SDG 1 (No Poverty), SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 10 (Reduced Inequalities).

The study was conducted within the framework of Gandhiji's "Nai Talim" philosophy, which advocates for self-reliant education that ensures equal opportunities for all individuals regardless of their religious, caste, or economic background. This philosophical foundation emphasizes the transformative potential of mathematics education as a pathway to both personal empowerment and social justice.

II. METHODOLOGY AND SAMPLE STUDY DESIGN

The research employed a comprehensive mixed-methods approach, analyzing both quantitative performance data and qualitative socio-economic indicators across four educational institutions:

1. M.C.E. Society's English Medium School and Junior College, Pune, India (207 students)
2. M.C.E. Society's Anglo Urdu Girls High School, Pune, India (108 students)
3. P.A. Inamdar High School and Junior College, Ahilya Nagar, India (50 students)
4. M.C.E. Society's Anglo Urdu Boys High School and Junior College, Pune India (261 students)

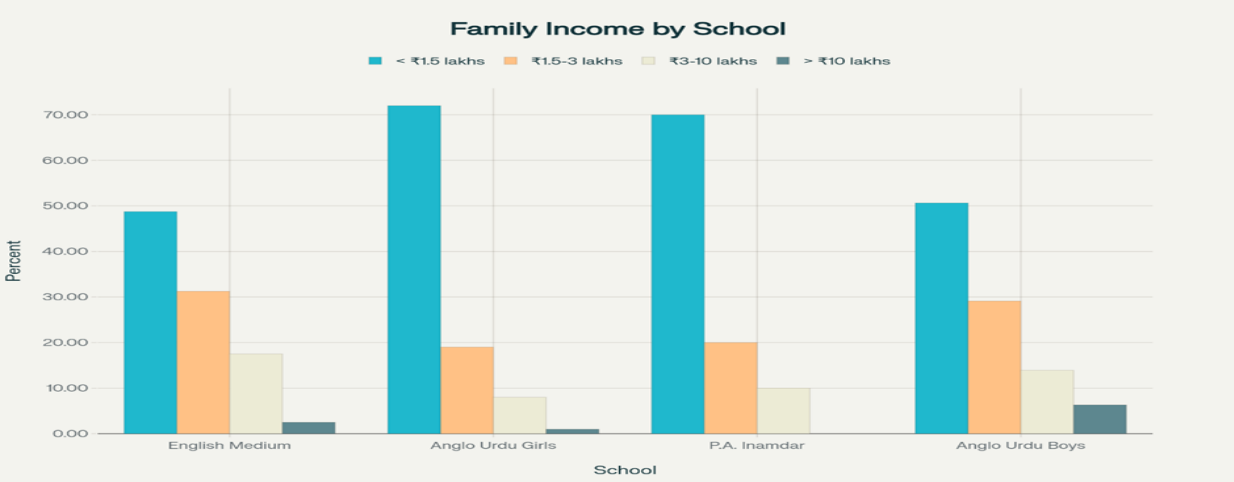
Data Collection Methods

- Socio-economic and demographic questionnaires
- Parental involvement surveys
- Technology access assessments
- Mathematics performance evaluation (pre- and post-"Math Yes, We Can" program)

Statistical analysis using descriptive statistics, correlation analysis, and paired t-tests.

Socio-Economic Status Analysis:

The research reveals profound economic disparities across the four schools, with the majority of students belonging to economically disadvantaged backgrounds.



Family Income Distribution Across Four Schools in the Study:

Key Findings:

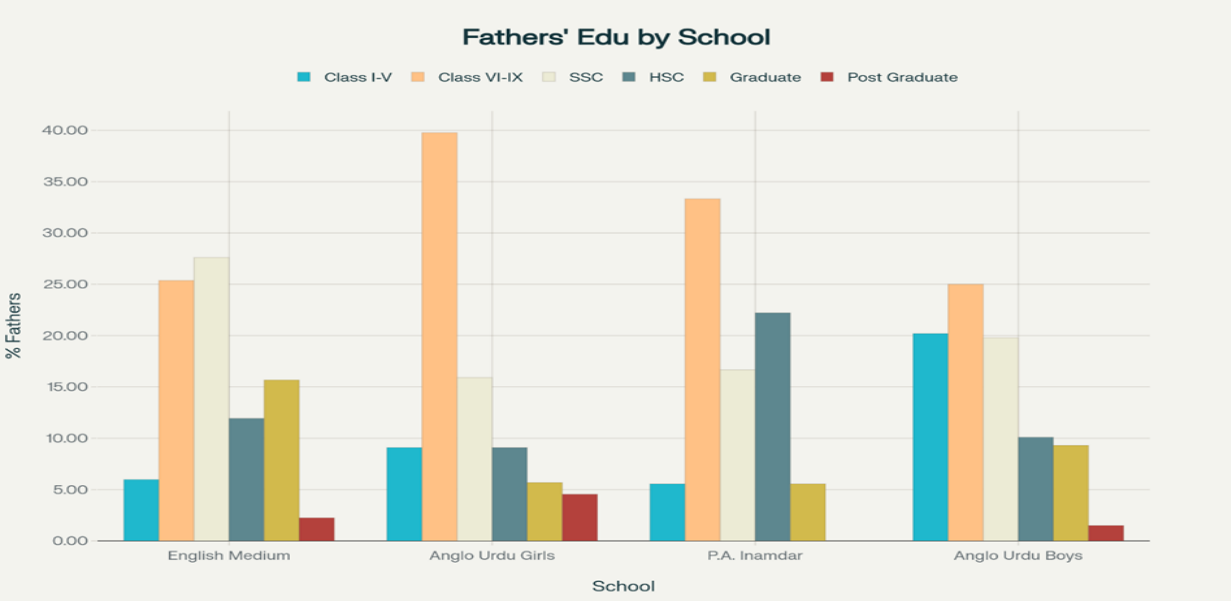
- M.C.E. Society's Anglo Urdu Girls High School: 91% of students have family incomes below ₹1.5 lakhs annually.
- P.A. Inamdar High School and Junior College: 90% of families earn less than ₹3 lakhs per year.
- M.C.E. Society's English Medium School and Junior College: 80% of students from economically weaker sections.
- M.C.E. Society's Anglo Urdu Boys High School and Junior College: 79.74% of families in lower income brackets.

Parental Occupation Patterns:

The study identifies a predominance of informal employment among parents:

- Anglo Urdu Boys High School: 57.1% of parents in unspecified occupations (daily wage workers, hawkers, auto-rickshaw drivers)
- Anglo Urdu Girls High School: 53.4% in informal sectors.
- English Medium School: 38.5% in unspecified occupations.
- Government employment remains minimal across all schools (0-2.2%).

Parental Education and Involvement



Father's Education Levels Across Four Schools

Educational Attainment Patterns:

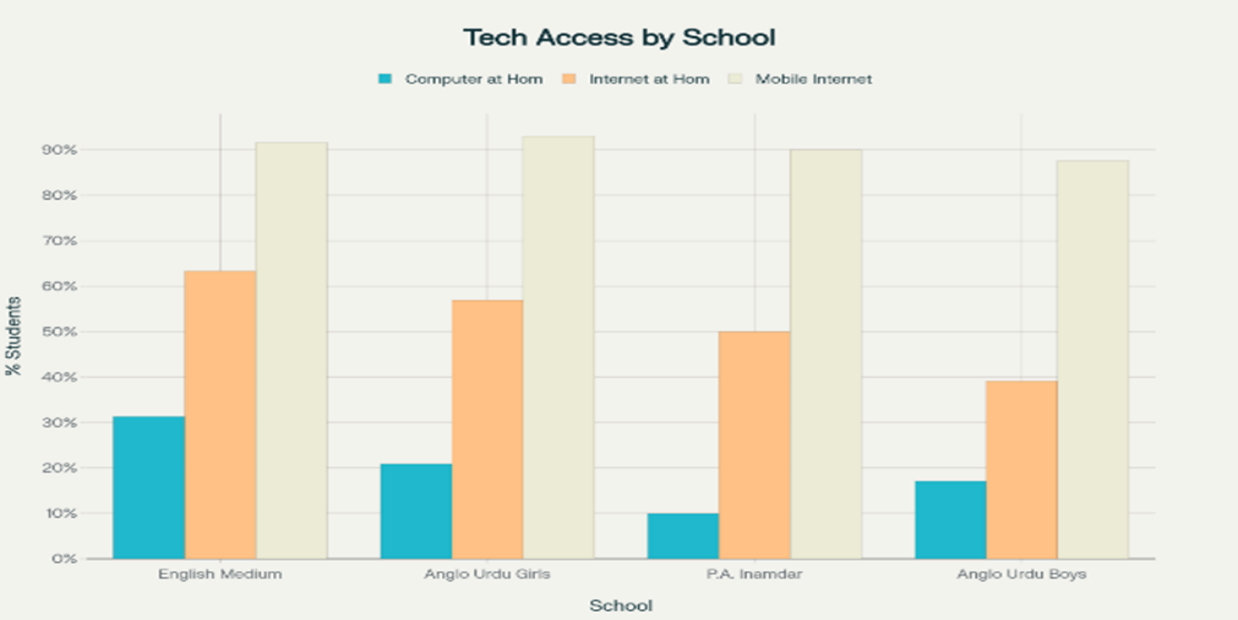
The research demonstrates consistently low parental education levels across institutions:

- Fathers' Education: 31-49% have education only up to Standard IX across schools.
- Mothers' Education: Similar patterns with 29-52% educated up to Standard IX.
- Higher Education: Only 1-4.5% of parents hold postgraduate qualifications.

Parental Engagement Levels

Despite limited educational backgrounds, parental involvement remains substantial:

- Homework Support: 55-75% of parents assist with homework.
- Parent-Teacher Meetings: Attendance varies from once yearly to more than twice yearly.
- Extracurricular Activities: 8-22% of parents enroll children in additional programs.



Technology Disparities:

Technology Access at Home Across Four Schools

- Anglo Urdu Boys High School: 17.1%

The study reveals significant gaps in technology access:

Computer Access at Home:

- M.C.E.S. English Medium School: 31.3%
- Anglo Urdu Girls High School: 20.9%
- P.A. Inamdar High School: 10%

Mobile Internet Access:

- Universally high (87-93%) across all schools.
- Represents primary digital learning platform for most students.

Mathematics Performance Analysis

Mathematics Performance Before and After "MathYes We Can" Program

"Math Yes We Can" Program Impact:
The seven-book mathematics intervention program showed varied results across institutions:
Positive Outcomes:

- English Medium School: Significant improvement from Standard VII (mean: 59.63) to Standard VIII (mean: 64.15), $p < 0.05$
- Anglo Urdu Girls High School: Statistically significant improvement from 68.21 to 71.17, $p << 0.05$

Concerning Trends:

- P.A. Inamdar High School: Significant decline from Standard VIII (86.38) to Standard IX (67.98), $p << 0.05$
- Anglo Urdu Boys High School: Decline from 62.79 to 52.93, $p << 0.05$

Statistical Analysis Summary

School	Before Mean	After Mean	Standard Deviation	P-value	Significance
M.C.E.S English Medium School	59.63	64.15	19.60 → 16.58	<0.05	Significant improvement
Anglo Urdu Girls High School	68.21	71.17	7.37 → 7.59	<<0.05	Highly significant improvement
P.A. Inamdar High School	86.38	67.98	7.19 → 19.45	<<0.05	Significant decline
Anglo Urdu Boys High School	62.79	52.93	13.51 → 12.09	<<0.05	Significant decline

COVID-19 Impact on Mathematics Performance: The research acknowledges the substantial impact of the COVID-19 pandemic on mathematics learning, with studies indicating 5-10 percentile point declines in performance during fall 2020. Students from lower SES backgrounds faced disproportionate challenges due to limited technology access and inadequate home learning environments.

Key Research Insights:
Correlation Between SES and Academic Performance
The study confirms strong correlations between socio-economic status and mathematics achievement, consistent with international research findings. Students from higher SES backgrounds demonstrate superior performance due to:

- Better access to educational resources
- Higher parental education levels
- Enhanced technology availability
- More stable home learning environments

Gender and School-Type Differences:
The research reveals interesting gender dynamics, with girls' schools (Anglo Urdu Girls) showing improvement despite economic constraints, while boys' schools (Anglo Urdu Boys) showed decline, suggesting the need for gender-specific interventions.

Technology as Educational Equalizer:
While computer access remains limited, the near-universal mobile internet availability (87-93%) presents opportunities for innovative digital learning approaches that can transcend traditional resource barriers.

Recommendations:

1. Enhanced Parental Engagement Programs
- Develop programs to increase parental involvement, especially in communities with lower parental education
- Provide training for parents on supporting children's mathematics learning
- Create multilingual resources to overcome language barriers

2. Bridge the Digital Divide
- Provide affordable or subsidized computers and internet access for disadvantaged students
- Leverage mobile technology for educational content delivery
- Develop mobile-first learning applications

3. Targeted Academic Support
- Offer remedial and enrichment programs, particularly during transitions to higher grades
- Implement early intervention strategies for struggling students
- Provide additional support for Standard IX students experiencing curriculum complexity

4. Sustain and Scale Effective Interventions
- Expand successful programs like "Math Yes We Can" with adaptations for local needs
- Develop teacher training programs to

maximize intervention effectiveness
- Create sustainable funding mechanisms for long-term program implementation

III.CONCLUSION

This research demonstrates that socioeconomic status, parental involvement, and access to technology are critical determinants of mathematics achievement among secondary school students in Maharashtra. The findings highlight the intricate relationship between economic disadvantage, educational resources, and academic outcomes.

The "Math Yes We Can" program shows promise as an intervention tool, with success varying based on implementation context and support systems. The research highlights the urgent need for targeted approaches that address:

- Economic barriers to educational access
- Digital divide challenges
- Parental engagement limitations
- Institutional resource disparities

By implementing evidence-based interventions that combine resource provision, family engagement, and targeted academic support, educational systems can work toward more equitable mathematics education outcomes. The study's alignment with Gandhian educational philosophy and UN Sustainable Development Goals, particularly SDG 1 (No Poverty), SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 10 (Reduced Inequalities). provides a framework for transformative change that promotes both individual empowerment and broader social justice.

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