

Access Without Parity in Achievement? Gender Gaps in School Participation and Learning Outcomes in Jharkhand

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ABSTRACT

This paper examines the gender-based structure of school education in Jharkhand by integrating the National Achievement Survey (NAS) for 2017 and 2021, which measures competency-based learning of students in Classes 3, 5, 8 and 10, and the Unified District Information System for Education Plus (UDISE+) administrative census from 2021–22 through 2024–25. The study provides a gender-disaggregated panel of achievement scores, Gross Enrolment Ratios (GER), the Gender Parity Index (GPI), transition rates and dropout rates. The empirical evidence uncovers a structural paradox: while targeted state interventions have effectively eliminated gender gaps in physical school access driving the GPI to or above unity across primary and upper-primary levels a persistent and widening gap emerges in quantitative learning. In mathematics, an initial gender parity at the foundational stage systematically gives way to a male advantage that peaks by Class 10, where the national female mean of 216 trails the male mean of 219 on a 500-point scale. The analysis situates these findings within Jharkhand's socio-economic landscape; a 26.2 percent Scheduled Tribe population, a 55.4 percent female literacy rate, seasonal labour migration and a fragile secondary-school network and develops a human-capital production framework to interpret them. The analysis identifies secondary-school retention and the in-classroom mathematics gap as the binding constraints on girls' educational attainment. The paper concludes with policy reorientations aligned with the National Education Policy (NEP) 2020 targets for 2030, synthesising recent macro-fiscal data indicating that state-level structural constraints, rather than household apathy, act as the primary impediment to bridging the quantitative skills deficit.

Keywords: Gender Parity Index; learning achievement; gender gap; human capital; Jharkhand

1. Introduction

Jharkhand, carved from southern Bihar on 15 November 2000, occupies a distinctive and

complex position in the political economy of Indian education. The state represents a classic developmental paradox, combining substantial mineral wealth and industrial capacity with some of the country's deepest human-development deficits. According to the 2011 Census, the state's overall literacy rate stood at 66.4 percent against a national average of approximately 73 percent, while female literacy reached only 55.4 percent (Office of the Registrar General & Census Commissioner, 2011). A Scheduled Tribe population constituting roughly 26.2 percent of residents and among the highest demographic shares of any major Indian state; coupled with extreme geographic fragmentation across more than 30,000 villages, endemic poverty and seasonal labour migration, has historically constrained the universalisation of schooling (NITI Aayog, 2025).

To contextualise these historical bottlenecks within contemporary demographic and economic realities, it is essential to review recent macroeconomic appraisals. As per the macro and fiscal landscape documented by NITI Aayog (2025), Jharkhand currently supports a population projected at 39.5 million. The state's real Gross State Domestic Product (GSDP) grew at an average rate of 5.1 percent during the period between 2012–13 and 2021–22, which is noticeably lower than the national average growth rate of 5.6 percent during the same timeframe. Furthermore, Jharkhand operates under stringent fiscal constraints; the Comptroller and Auditor General of India (CAG) has noted that the state frequently fails to meet targeted achievements for outstanding liabilities, constraining the fiscal bandwidth available for transformative infrastructure investments. This lack of fiscal maneuverability directly limits the state's capacity to aggressively expand educational facilities in remote districts, perpetually tying educational outcomes to broader economic stagnation.

Beyond these demographic and geographical bottlenecks, Jharkhand's educational infrastructure has long been constrained by chronic under-resourcing such as infrastructure shortfalls, teacher absenteeism and disrupted administrative supply chains which depressed both access and quality. A sustained strengthening of state capacity and local institutional structures over the past decade has plausibly contributed to the recent parity observed in elementary access. Converting restored physical access into higher-order learning, however, remains fragile, presenting a second-generation developmental challenge.

Conventional narratives of Indian education frequently assume a uniform and static female disadvantage across all metrics. Yet two decades of targeted state intervention the District Primary Education Programme (DPEP), Sarva Shiksha Abhiyan (SSA), the Kasturba Gandhi Balika Vidyalaya (KGBV) residential scheme for tribal and minority girls, the mid-day meal programme, and the integrated Samagra Shiksha mission since 2018 have materially altered the participation frontier for girls. The central empirical question this paper addresses is whether the well-documented closing of the gender gap in school participation has been matched by a

corresponding closing of the gender gap in measured learning achievement.

This difference between access and achievement is analytically central. Enrolment and retention measure whether girls are physically present in the schooling system; achievement measures the actual accumulation of cognitive human capital. A sub-national jurisdiction may approach absolute gender parity on the former while sustaining severe, hidden gaps on the latter. Disentangling these dynamics requires combining administrative-census data on participation with large-scale sample-assessment data on competencies exactly the integration this study undertakes.

The paper's organising hypothesis is that the binding gender constraint in Jharkhand has migrated from school access to two successor problems such as retention through a fragile secondary network and the classroom-level conversion of girls' attendance into measured competencies, specifically in mathematics. The paper makes three contributions. First, it assembles a coherent, gender-disaggregated panel drawing on two independent official data systems the NAS and UDISE+. Second, it tracks the temporal movement of participation and achievement indicators across the most recent assessment cycle (NAS 2017 to NAS 2021) and four consecutive UDISE+ rounds (2021–22 to 2024–25). Third, it interprets the observed gender patterns within a human-capital production framework that links school access, retention and in-classroom learning. The remainder of the paper is organised as follows: Section 2 develops the theoretical framework and reviews the literature; Section 3 details data and analytical approaches; Section 4 presents results; Section 5 provides an extended discussion of mechanisms; Section 6 states limitations and Section 7 concludes.

2. Theoretical Framework and Review of Literature

2.1 A Human-Capital Production Framework

The economics of gender and education in developing contexts emphasises that closing enrolment gaps is necessary but not sufficient for educational equity. The human-capital tradition pioneered by Schultz (1961) and Becker (1964) treats schooling as an investment whose economic returns depend on competencies acquired rather than years enrolled.

Gary S. Becker's monumental 1964 work, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, fundamentally redefined how economists view skill acquisition. Originally formulated during his tenure at the National Bureau of Economic Research (NBER) and refined through the legendary Columbia Labour Economics Workshop alongside scholars like Jacob Mincer, Becker's theory posited that investment in an individual's education and training is economically identical to business investments in physical equipment. Becker constructed a meticulous analytical framework to measure the incentive for such

investments by calculating the private and social rates of return, carefully factoring in the opportunity costs – primarily the foregone earnings of students attending school instead of participating in the labour market. The enduring influence of this framework lies in its distinction between general and specific training, proving that formal education generates a personal distribution of earnings inextricably linked to accumulated human wealth.

Theodore W. Schultz concurrently articulated these principles in his seminal 1961 paper, *Investment in Human Capital*, published in the *American Economic Review*. Schultz observed that increases in national output had historically been disproportionately large compared to the mere quantitative increases of land, man-hours, and physical reproducible capital. He identified deliberate investment in human capital – through direct expenditures on education, health, and internal migration – as the primary explanation for this residual growth, effectively cementing human capital as the central engine of macroeconomic progress.

It is useful to frame measured achievement as the output of a cognitive production function in which enrolment is one input among several. Let the achievement of child i be a function of school exposure (enrolment and retention), school quality (teachers, infrastructure, pedagogy), and household and time inputs (study time, domestic-labour burden, parental support). Under this formulation, gender parity in the enrolment input does not guarantee parity in output if the school-quality and household-input terms are themselves gendered. Where girls attend regularly but face higher domestic-labour burdens, weaker access to specialised teachers, or stereotype effects in quantitative subjects, the human-capital return to female schooling is attenuated – with consequences for labour-market sorting, lifetime earnings and household welfare.

Cross-country evidence further establishes that gender inequality in education itself retards aggregate growth, making the achievement margin a macro-relevant, not merely distributional, concern (Klasen, 2002; Duflo, 2012). Stephan Klasen's (2002) exhaustive cross-country and panel regressions robustly demonstrate that gender inequality in education directly truncates economic growth by systematically lowering the average level of human capital across a population. Beyond the direct cognitive deficit, Klasen proved that this inequality indirectly harms growth by distorting investment incentives and accelerating population growth rates. Crucially, his models calculate that 0.4 to 0.9 percentage points of the massive differences in annual per capita growth rates between economically successful regions like East Asia and lagging regions like Sub-Saharan Africa and South Asia can be directly accounted for by prevailing gender gaps in education.

Esther Duflo (2012) expanded upon these macroeconomic consequences by evaluating the bidirectional relationship between women's empowerment and economic development. Duflo contextualizes the stark reality of gender inequality by referencing Amartya Sen's (1990)

concept of "missing women," highlighting the millions of women who fail to be born, survive early childhood, or access education due to entrenched discrimination. While acknowledging that continuous economic development naturally relieves the paralyzing grip of poverty – thereby organically reducing fertility rates, maternal mortality, and freeing up women's time – Duflo forcefully argues that development alone cannot entirely eradicate the deeply rooted structural biases against women. Achieving true parity requires continuous policy commitment and targeted, multidimensional interventions that address inequality as an independent metric of societal health.

2.2 Schooling versus Learning in India

For India specifically, the World Development Report 2018 crystallised the distinction between schooling and learning, arguing that a generation of access gains had produced a “learning crisis” in which time in school is a poor proxy for human-capital accumulation (World Bank, 2018). The NAS, conducted by the National Council of Educational Research and Training (NCERT), provides the authoritative, competency-based assessment that disaggregates achievement by gender, location, social group and school management at the state level (Ministry of Education, 2022).

Critically for the present study, the NAS 2021 national findings established that girls match or outperform boys in almost all subjects across classes, with one systematic exception: a mathematics gap that is negligible at the foundational stage but widens with grade progression, becoming most pronounced by Class 10 (Press Trust of India, 2022). This exceptional outcome necessitates a shift in scholarly focus from merely ensuring that female students are present in the classroom to rigorously evaluating what pedagogical and social dynamics they encounter once seated inside it.

2.3 Participation and Sub-National Heterogeneity

On the participation side, the UDISE+ administrative census has become the primary source for enrolment, the GPI, and transition and dropout statistics. Analyses of recent rounds repeatedly identify Jharkhand, alongside Bihar and Assam, as a state requiring targeted intervention to strengthen secondary retention and transition, even as gender parity in enrolment has broadly been achieved (Mehta, 2025; Mehta, 2026).

The macro literature, however, often abstracts from sub-national structural heterogeneity. Infrastructure expansion can raise enrolment through supply-side elasticity, yet the link between such supply-side gains and higher-order learning is contingent and can move local outcomes in either direction depending on implementation and timing. Demand-side factors – domestic-labour allocation and gendered attitudes toward quantitative fields then create an uneven playing

field inside the classroom (Duflo, 2012). The present study is positioned at this intersection, joining assessment-based and census-based evidence to isolate the access–achievement divergence that aggregate national commentary obscures.

Comparative sub-national work on women’s development in the eastern states similarly stresses that structural and institutional determinants, not household demographics alone, drive equitable gender outcomes (Singh, 2022). Research specifically analysing the Empowered Action Group (EAG) states, which include Jharkhand and Bihar, demonstrates that geographical variance in structural health and nutritional infrastructure massively influences lifelong cognitive development. The overarching socio-economic reality of these states dictates that interventions must bridge deep-seated systemic inequalities to generate meaningful returns on educational investments.

3. Data Sources and Empirical Strategy

3.1 Data Sources

The study is based mainly on three secondary data sources. The National Achievement Survey (NAS) serves as the primary measure of student learning outcomes. The 2017 round, conducted on 13 November 2017, assessed students in Classes 3, 5 and 8 using matrix-sampled test booklets containing 45 questions for Classes 3 and 5 and 60 questions for Class 8, with achievement reported both as scaled scores on a 500-point metric and as percentage-correct (NCERT, 2017). This massive undertaking represented one of the largest assessment surveys globally, assessing over 2.2 million students across 1.1 lakh schools in 701 districts. Methodologically, NAS 2017 departed from traditional content-based testing, opting instead to employ Item Response Theory (IRT) to align test items directly with the competency-based learning outcomes embedded within the Right to Education (RTE) Act.

The 2021 round, conducted on 12 November 2021, extended coverage to Class 10 and assessed approximately 3.4 million students across 1,18,274 schools in 720 districts spanning all 36 States and Union Territories, with performance disaggregated by gender, area, school management type and social group (NCERT, 2021; Ministry of Education, 2022).

The second major source is the UDISE+, an annual administrative census of schools maintained by the Department of School Education and Literacy (DoSEL) under the Ministry of Education; this study uses published UDISE+ reports covering the years 2021–22 through 2024–25 to capture school infrastructure, enrolment and institutional characteristics (Ministry of Education, 2024; Mehta, 2025; Mehta, 2026). Representing a state-of-the-art digital infrastructure, UDISE+ captures exhaustive data from millions of learning facilities, confirming monumental systemic milestones such as the Indian school teacher workforce surpassing the 1 crore mark for the first

time.

Finally, supplementary demographic and contextual variables are derived from the 2011 Census of India (Office of the Registrar General and Census Commissioner, 2011) and the NITI Aayog state report (NITI Aayog, 2025), which together provide background indicators necessary for contextualising district and state-level patterns in educational outcomes.

3.2 Variables and Definitions

The Gender Parity Index (GPI) is the ratio of the female to the male GER at a given level; 1.00 denotes parity, above 1.00 female advantage, below 1.00 female disadvantage. The gender gap in achievement is the female mean score minus the male mean score, so a positive value indicates female outperformance. Transition rate measures progression from one stage to the next; dropout rate the proportion leaving a stage without completing it; and GER enrolment at a level as a percentage of the official age-group population.

3.3 Methodological Cautions and Comparability

Two cautions govern interpretation. First, the NAS instrument was redesigned between 2017 and 2021 (altered item composition and booklet length: 50, 60 and 70 questions for Classes 3/5, 8 and 10 in 2021), so cross-cycle score levels are not strictly comparable and are reported directionally; only officially published cross-cycle comparisons of group means are cited as such (NCERT, 2017; Ministry of Education, 2022; Press Trust of India, 2022).

Second, UDISE+ shifted from a school-wise consolidated format (reference date 30 September) in 2021–22 to individual student-level tracking (reference date 31 March) from 2022–23, introducing structural discontinuities in dropout, transition and retention series, which are flagged where relevant (Mehta, 2026). This requisite reform, initiated to align with the recommendations of the National Education Policy (NEP) 2020, eliminated duplicate entries and modernized the data capture format. Consequently, the statistical moderation of population projections based on recent birth rate trends renders data from 2022-23 onward not strictly comparable with pre-2021 aggregated statistics, meaning longitudinal tracking of dropouts must be interpreted carefully.

4. Empirical Results

4.1 Learning Achievement: Jharkhand Relative to the Nation

Table 1 reports Jharkhand's mean NAS scores alongside the national average for the 2021 cycle for Class 10. Two structural features stand out. First, Jharkhand's achievement tracks close to, but systematically below, the national benchmark, with the shortfall concentrating in quantitative

and conceptual subjects. Second, the gender differential within the state is modest relative to this state–nation gap, indicating that aggregate socio-economic and structural constraints, rather than gender alone, drive low absolute achievement.

Table: 1 Class 10 Achievement Scores in Jharkhand and at the National Level

Subject (Class 10)	Jharkhand (%)	National avg. (%)	Gap (J – N)
Mathematics	63	65	–2
Language	86	86	0
Science	52	59	–7
Social Science	58	64	–6

Source: NCERT (2021). National Achievement Survey 2021: State Report Card, Jharkhand, Class 10. National Council of Educational Research and Training.

Jharkhand performs at par with the national average in language (86%) but falls progressively behind in subjects demanding quantitative reasoning and specialised instruction- a deficit of 2 percentage points in mathematics (63% vs. 65%), widening to 6 points in social science (58% vs. 64%) and 7 points in science (52% vs. 59%). This pattern suggests that the state's learning gap is not uniform but is concentrated in domains where teacher subject-specialisation and laboratory infrastructure are critical inputs, consistent with the broader human capital constraints documented for low-income states in India (NITI Aayog, 2025). To appreciate the severity of this lag, one must look at the scaled scores across other geographical zones from the same survey: while the national average scaled score for mathematics in Class 10 is 220 out of 500, states like Punjab reported a scaled average of 273, and Rajasthan reached 256, demonstrating that Jharkhand remains deeply mired in an educational performance trough relative to its northern counterparts.

4.2 The Gender Dimension of Achievement: The Mathematics Exception

The official NAS 2021 national finding is unambiguous: the average performance of girls was better than that of boys in almost all subjects across the classes, both nationally and at the state level (Press Trust of India, 2022). The breadth of female outperformance also widened between cycles- in Class 3 language, girls outperformed boys in 33 States and UTs in 2021, up from 18 in 2017; in Class 5 language the count likewise rose to 33 (Press Trust of India, 2022). Against this baseline of female advantage, mathematics constitutes a single, systematic and widening exception. Table 2 presents the national gender-disaggregated mathematics means by class on the 500-point scale.

Table: 2 Gender Gap in Mathematics Achievement by Class: National Level, NAS 2021

Class	Girls	Boys	Gap	Statistical significance
Class 3	301	300	+1	Not statistically significant
Class 5	280	281	-1	Statistically comparable
Class 8	Equal	Equal	0	Parity nationally
Class 10	216	219	-3	Significant male advantage

Source: Press Trust of India (2022), reporting NAS 2021 national figures. Ministry of Education / NCERT.

Table 2 reports scaled scores on a 500-point metric and reveals that the gender gap in mathematics is not a fixed attribute of the entering cohort but an acquired divergence that compounds across grade levels. At the foundational stage (Classes 3 and 5), girls and boys perform at statistical parity, with differences of no more than 1 scaled score point. By Class 8 scores are equal, but a significant male advantage of 3 points emerges by Class 10 – a gap recorded in 28 States and Union Territories. This trajectory carries an important policy implication: because the divergence opens within the schooling career rather than at the point of entry, access-focused interventions alone are insufficient to address it – the girls in question are already enrolled and attending.

Jharkhand's state-level results mirror this national pattern, with elementary parity giving way to a secondary male advantage in mathematics, positioning the state squarely within the majority of States and UTs where boys outperform girls by Class 10 (NCERT, 2021; Ministry of Education, 2022). The severity of this within-school inequality is further compounded by the pandemic-era learning losses examined in Table 3, which disproportionately affected public education systems.

Table: 3 Cross-cycle Change in Class 10 mean achievement by School Management at National Level

School management / subject	2017	2021	Change
State-gov. schools (Mathematics)	252	210	-42
Private schools (Mathematics)	263	228	-35
State-gov. schools (Science)	251	195	-56
Private schools (Science)	259	229	-30

Source: Press Trust of India (2022), reporting NAS 2017 and 2021 national figures. Ministry of Education / NCERT.

Table 3 reports scaled scores on a 500-point metric and documents the differential impact of pandemic-era disruption across school management types between 2017 and 2021. Declines in mean achievement were recorded across all categories, but state government schools experienced substantially steeper losses than their private counterparts a fall of 42 points in mathematics and 56 points in science, compared with 35 and 30 points respectively in private schools. This asymmetry is particularly consequential for Jharkhand, where the overwhelming majority of low-income, Scheduled Tribe and rural students are enrolled in state government schools. The steeper decline in science relative to mathematics across both management types further reinforces the subject-specific vulnerability identified in Table 1, suggesting that pandemic-era school closures compounded pre-existing structural disadvantages in domains requiring laboratory access and specialist teachers rather than affecting all learning outcomes uniformly (NCERT, 2021; Ministry of Education, 2022).

4.3 School Participation by Gender: UDISE+ Evidence

In contrast to the learning data, the administrative participation data presents a highly favourable picture for female access. Table 4 tracks headline system indicators for Jharkhand across the four most recent UDISE+ rounds.

Table: 4 Jharkhand School-System Indicators, UDISE+ 2021–22 to 2024–25

Indicator	2021–22	2022–23	2023–24	2024–25
Total operational schools	44,855	-	-	44,376
Total enrolment (lakh)	79.71	-	71.43	-

Source: Mehta (2026); Ministry of Education, DoSEL UDISE+ reports.

The enrolment declines from 79.71 lakh in 2021–22 to 71.43 lakh in 2023–24 reflects in part the 2022–23 transition to individual student-level tracking, which removed duplicate entries, alongside real demographic shifts and migration patterns; it does not therefore represent a straightforward deterioration in participation. Reports explicitly link this overarching volume contraction to naturally falling birth rates across most Indian states, leaving only a few states largely exempt from demographic plateauing. The central equity finding concerns the Gender Parity Index (GPI).

At the national level, girls comprised 48.4 percent of total enrolment in 2024–25, up from 48.1 percent in 2023–24, with the GPI of the Gross Enrolment Ratio exceeding 1.00 across levels – signalling higher female retention relative to males. For Jharkhand, the GPI has likewise been sustained at or near parity across the entire period, a substantial structural achievement for a tribal-majority state where the female literacy rate stood at only 55.4 percent as recently as 2011

(Office of the Registrar General and Census Commissioner, 2011; Mehta, 2026). The convergence of the participation gap stands in clear contrast to the persistence of the mathematics achievement gap documented in Section 4.2, underscoring that enrolment parity and learning parity are empirically distinct outcomes requiring distinct policy responses.

Transition and dropout dynamics, however, reveal where the system remains structurally fragile. At the national level, the transition rate from primary to upper-primary declined from 93.2 percent in 2021–22 to 88.8 percent in 2023–24 and the elementary-to-secondary transition fell further from 88.8 percent to 83.3 percent over the same period, with a small but consistent gender gap emerging specifically at the secondary transition stage boys at 83.7 percent against girls at 82.9 percent (Mehta, 2025). However, subsequent UDISE+ 2024-25 data showcases a promising rebound in retention resilience across all phases; national retention numbers improved dramatically from the prior year, elevating to 98.9 percent at the foundational level, 92.4 percent at the preparatory level, 82.8 percent at the middle level, and 47.2 percent at the secondary level.

Jharkhand is repeatedly identified among the states with elevated dropout incidence and weak secondary transition rates, indicating that the secondary stage rather than the elementary stage is where female educational careers remain most exposed to attrition. Encouragingly, recent systemic improvements have radically altered these localized statistics; state-specific data highlights that Jharkhand successfully reduced its primary dropout rate from 6.41 percent in prior periods to a functionally negligible 0 percent by 2024-25. Concurrently, the upper primary dropout rate shrunk to 1.7 percent, and the historically massive secondary dropout rate, which hovered over 23 percent, compressed down to an impressive 3.5 percent. The state thus presents a dual paradox: near-parity enrolment at the system level coexists with concentrated female vulnerability at the secondary transition, and participation parity coexists with a persistent male advantage in mathematics achievement. Table 5 maps these gendered vulnerabilities of participation against the learning metrics to assess the degree to which they overlap across the state's population (Mehta, 2025; Mehta, 2026).

Table: 5 Gender Pattern of Key Participation and Learning Indicators

Indicator	Observed gender pattern	Structural reading & policy implication
Gender Parity Index (GER)	At or above 1.00 across levels	Access parity achieved; supply-side barriers cleared
Primary–upper-primary transition	Girls broadly at par with boys nationally	Elementary retention stable; not the binding constraint
Elementary–secondary transition	Small female shortfall nationally; Jharkhand weak	Secondary entry is the fragile institutional juncture

	overall	
Secondary dropout rate	Jharkhand among high-incidence states	Retention, not entry, threatens final completion
Class 10 mathematics score	Clear male advantage (national G 216 / B 219)	In-classroom learning gap, driven by pedagogical variables

Source: Mehta (2025, 2026); Press Trust of India (2022); Ministry of Education, UDISE+ 2021–22 to 2024–25 and NAS 2021.

4.4 Synthesis: The Access–Achievement Paradox

Bringing the two data systems together yields the paper’s central empirical claim. In Jharkhand the gender gap in school participation has effectively closed as the GPI sits at or above unity and girls are retained through the elementary stage at rates comparable to boys – and girls match or outperform boys in the large majority of NAS subjects. Yet two gendered vulnerabilities persist. First, at the secondary stage, where Jharkhand’s network is weakest, retention threatens the educational careers of adolescent girls. Second, in mathematics, an acquired and widening gap leaves girls trailing boys by Class 10 even where both are enrolled. The binding constraint on female educational attainment has therefore migrated from access to a combination of secondary retention and in-classroom learning – neither of which enrolment-focused policy can resolve.

5. Discussion and Mechanism Disentanglement

The access–achievement paradox documented in this study is deeply embedded in Jharkhand's political economy. The long-term supply-side focus on primary schools under the Sarva Shiksha Abhiyan and the targeted expansion of the Kasturba Gandhi Balika Vidyalaya network succeeded in bringing rural and tribal girls into the education system. However, secondary expansion under the Rashtriya Madhyamik Shiksha Abhiyan did not keep pace, creating an institutional bottleneck that threatens girls' education precisely at the transition to secondary school (Mehta, 2026; NITI Aayog, 2025). The reality remains that while elementary coverage achieved near-universal metrics, the physical distance to functional secondary institutions expands dramatically for rural adolescents, exacerbating existing safety concerns and logistical barriers.

The mathematics divergence warrants separate emphasis because it is the one dimension on which the otherwise favourable female trajectory reverses. Since girls and boys perform identically in Class 3, the emergence of a male advantage by Class 10 demonstrates that the gap is produced within the schooling process rather than inherited from any baseline disparity at school entry. The micro-economic literature attributes such acquired gaps to several intersecting

mechanisms.

First, intra-household resource and time allocation plays a significant role. Under economic or climate shocks, including the seasonal migration common in Jharkhand, adolescent girls face disproportionate domestic labour and caregiving burdens that reduce the out-of-school study time essential for mastering cumulative quantitative subjects (Duflo, 2012). Second, pedagogical bias and stereotype threat operate within the classroom itself. Interactions in higher-grade mathematics can carry implicit biases favouring boys in quantitative reasoning, triggering stereotype threat and progressively reducing mathematics-related self-confidence among adolescent girls (World Bank, 2018). Third, rural government schools face acute shortages of qualified female mathematics and science teachers who could serve as institutional role models and counteract these confidence deficits (World Bank, 2018).

These classroom mechanisms do not operate in isolation from broader development conditions. Cognitive capital accumulation depends on health, nutrition and safety as direct inputs, and comparative sub-national analysis of the eastern Indian states indicates that structural and institutional determinants rather than household demographics alone drive equitable gender outcomes in education (Singh, 2022). An evaluation of the Empowered Action Group (EAG) states, specifically contrasting Bihar and Jharkhand, emphasizes that maternal mortality ratios, nutritional deficits, and systemic anaemia explicitly undermine human development potential from birth. The chronic reality of household food insecurity and severely low calorific intakes among tribal demographics ensures that a substantial cross-section of female students approach their foundational educational years battling profound physiological and cognitive hurdles.

On the resourcing side, sustained and targeted public education expenditure is a precondition for upgrading secondary infrastructure and strengthening teacher training, and long-run expenditure analysis underscores that the level and composition of state education spending shape the feasible quality frontier (Singh, 2019). Examining fragmented trends in public financing models reveals that while massive allocations are predictably channeled into elementary frameworks, subsequent allocations for necessary secondary expansions face a plateau, artificially throttling the growth trajectory of adolescent female students who require advanced laboratory access and specialist mentorship.

Closing the mathematics gap is also instrumentally important for female labour market integration, since quantitative competencies underpin access to technical and higher-return occupations. Cross-country evidence further links gender equality in education directly to aggregate economic growth, positioning the learning gap not merely as a social equity concern but as a binding constraint on Jharkhand's long-run development trajectory (Klasen, 2002). Depriving female cohorts of critical mathematical parity systematically throttles subsequent

innovation, entrepreneurship, and industrial adaptability within the state's broader economic architecture.

6. Limitations and Institutional Constraints

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While the structural constraints outlined above define the macro-level reality, the study acknowledges significant methodological limitations inherent in the datasets utilized. Primarily, the reliance on the NAS datasets provides a purely cross-sectional snapshot of learning achievements across isolated temporal checkpoints (2017 and 2021) rather than a longitudinal mapping of individual student progress. This prevents the rigorous causal tracking of specific cohorts over time to explicitly isolate unobservable household and pedagogical variables contributing to the mathematics gap. Additionally, the UDISE+ framework's transition to a granular, student-level tracking architecture in the 2022-23 cycle introduces an inescapable baseline discontinuity. Consequently, the reported statistical compressions in dropout rates, though directionally positive, reflect moderated population projections and strict deduplication protocols that inhibit perfect statistical alignment with pre-2021 administrative aggregates.

7. Conclusion

This study challenges the assumption of a uniform female educational disadvantage in Jharkhand. On the participation dimension, the state has achieved remarkable gender parity, with the GPI sitting at or above unity and girls being retained through the elementary stage at rates broadly comparable to boys. This is a notable structural accomplishment for a tribal-majority state that recorded a female literacy rate of just 55.4 percent as recently as 2011 (Office of the Registrar General and Census Commissioner, 2011).

On the achievement dimension, girls match or outperform boys across the large majority of subjects, with a single systematic exception in mathematics, where an initial parity at the foundational stage gives way to a statistically significant male advantage that becomes most pronounced by Class 10. The policy frontier has accordingly migrated from access to two successor challenges: secondary-school retention and equitable in-classroom competency conversion.

To meet the NEP 2020 targets by 2030, policy should advance along three complementary lines. First, targeted secondary infrastructure expansion is needed, concentrating state capital expenditure on high-dropout districts to bridge the upper-primary-to-secondary transition gap where female educational careers are most structurally exposed to attrition. Second, gender-informed quantitative pedagogy must be institutionalised through remedial mathematics

programmes, structured interventions to address teacher bias, and the active recruitment of qualified female mathematics and science teachers capable of dismantling classroom-level stereotype threat. Third, education policy should be integrated with skill development and resourcing infrastructure, sustaining targeted public education expenditure while linking secondary schooling to local skill and entrepreneurship networks so as to maximise the economic returns on girls' education and strengthen household-level incentives for female retention (Singh, 2019).

These three lines of intervention are not substitutes; the evidence presented in this study suggests they must operate simultaneously to address both the retention and the learning dimensions of female disadvantage. True transformation necessitates multidimensional empowerment that tackles physiological deficits, optimizes public financial expenditures, and actively dismantles systemic biases. As district-level micro-data accumulate over successive NAS and UDISE+ cycles, future research should move from the descriptive and directional analysis offered here toward causal identification of the drivers of the gendered learning gap, supplemented by classroom-level enquiry into the pedagogical and social mechanisms generating the mathematics divergence. Such work would provide the evidentiary foundation needed to design and evaluate targeted policy instruments with precision sufficient for the scale of the challenge Jharkhand faces.

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