Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 5 Issue 4 (2025)

Examining the Role of Basic Formal Education Quality and HDI in India

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ABSTRACT:

This research looks into how Artificial Intelligence, or AI, might really change things for financial inclusion in rural India. You know, it checks out the upsides and the big roadblocks in using AI there. Basically, the goal is to figure out if AI tools can make financial services easier to get for folks in underserved rural spots, while also spotting the main limits in how these systems are being rolled out right now. The study uses a mixed-methods setup. It pulls in secondary data from real-world sources, a careful review of existing literature, and some qualitative looks at how rural financial outfits in India are actually adopting AI. Findings point to some quick progress. AI-powered financial products have helped close access gaps for rural users and boosted efficiency in operations. Still, challenges stick around pretty stubbornly. Things like a strong bias toward urban areas show up a lot. There's not enough deep dive into skills needed, no solid causal models to explain causes and effects, and state-level data that's spotty in quality. Oh and, the big gap here is the lack of solid, India-focused empirical stuff, plus detailed breakdowns on how skills affect performance. That kind of shortfall makes it hard to come up with full-on policy advice. Some suggestions for the future are building standardized datasets, better casual modelling setups and including variables on skills and demographics. What makes this study stand out is the way it stacks up against global research. It emphasizes on India's combination of rural differences and infrastructure problems which require AI that is modified to meet these needs.

KEYWORDS: Artificial Intelligence (AI); Financial Inclusion; Rural India; Causal Modelling; Skill-depth Analysis.

I. INTRODUCTION

The Human Development Index (HDI) is very important for socioeconomic progress in India. It is a tool which measures development beyond just economic terms. It includes three major indicators: life expectancy, access to education and per capita income and was introduced by Mahbub ul Haq and Amartya Sen in 1990 (UNDP, 2023). The HDI showcases the actual quality of the lives of the people by taking into account both social and economic indicators unlike GDP which only includes financial indices (Anand & Sen, 2000).

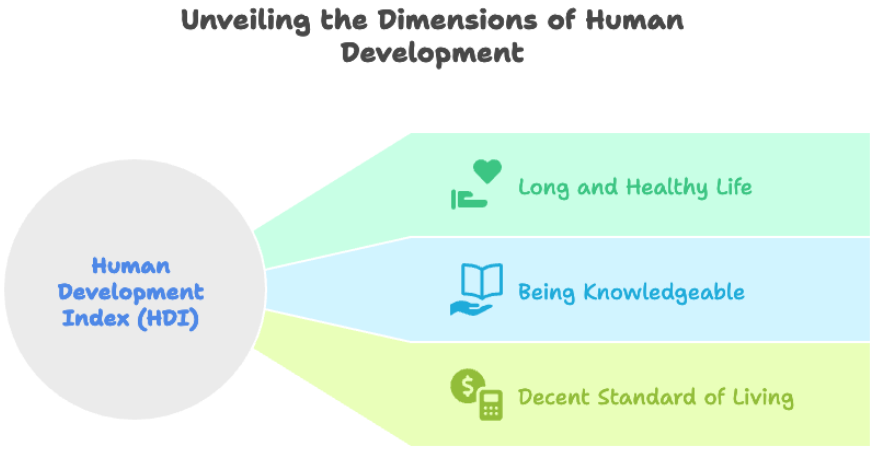
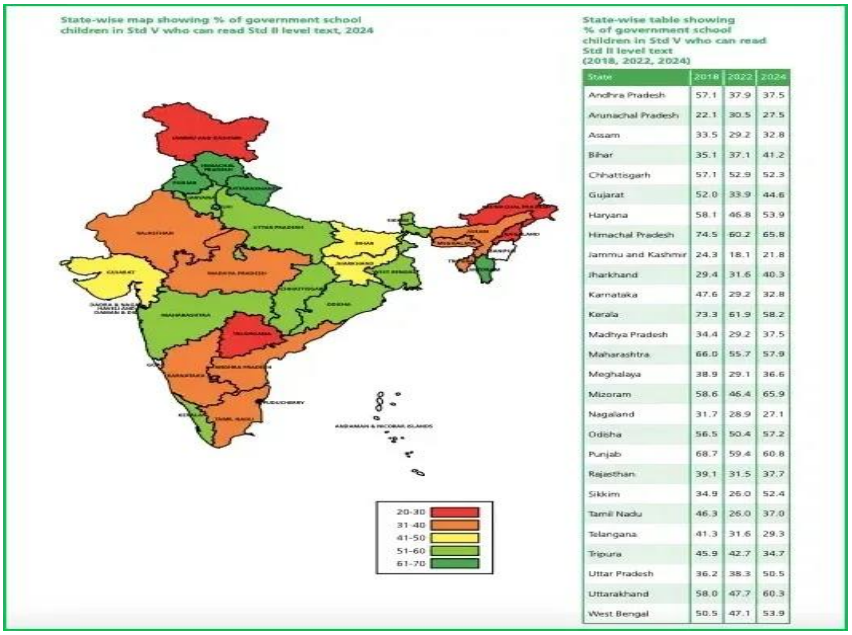


Fig 1. – Basic Indices of HDI

Fig 1. Shows that being knowledgeable is one of the key parameters on the road to human development. Education plays an instrumental role among the three indices of HDI. It serves as a driver of economic growth and significantly influences public health, social inclusion and individual empowerment (Guijarro-Garvi et al., 2022). According to UNESCO, an improvement in quality and accessibility of education enables people and communities to live happy lives

(UNESCO GEM, 2024). Significant advancement UNESCO and made by India to get children into school. The primary enrolment rates are nearly at 100% and over 75% of students are attending upper primary school (ASER, 2017). However, high enrolment rates haven't let to meaningful learning. An alarming 70% of Grade 3 students in India struggle with basic reading and math even though they have been enrolled in schools for many years (Central Square Foundation, 2019). Thus, this problem means that quality of education is more important than access alone.

A country's real development cannot be understood by economic factors alone (Lawrence et al., 2002). For example, several states in India enjoy strong GDP but still lag in education and health services. Growth will remain unequal without necessary reforms in foundational areas of development. HDI also measures emotional and subjective aspects of human life and not just financial numbers (Sanusi, 2008) Like in India's case, going to school without mental development will lead to stress and wasted potential thereby defeating the goal of development. From a human development standpoint, India has come a long way. Its HDI score has increased from 0.431 in 1990 to roughly 0.644 in 2022, placing it in the "medium human development" bracket (UNDP, 2023). But this national average masks sharp regional and social inequalities. Some states like Kerela and Tamil Nadu have rapidly advanced while others like Bihar and Jharkhand remain considerably behind (IJLRP, 2025). These inequalities are caused by inadequate infrastructure, lack of trained teachers and widescale social exclusion (Educational Inequality, 2025). Fig 2. Showcases the alarming number of states such as Assam and Jammu and Kashmir in which less than half (50%) of class 5 students can read a class 2 text compared to a few states like Punjab and West Bengal in which close to 70% of class 5 students can read class 2 text, thereby highlighting the widescale regional disparities and the urgent need for policy reformulation.



State	2018	2022	2024
Andhra Pradesh	57.1	37.9	37.5
Arunachal Pradesh	22.1	30.5	27.5
Assam	33.5	29.2	32.8
Bihar	35.1	37.1	41.2
Chhattisgarh	57.1	52.9	52.3
Gujarat	52.0	33.9	44.6
Haryana	58.1	46.8	53.9
Himachal Pradesh	74.5	60.2	65.8
Jammu and Kashmir	24.3	18.1	21.8
Jharkhand	29.4	31.6	40.3
Karnataka	47.6	29.2	32.8
Kerala	73.3	61.9	58.2
Madhya Pradesh	34.4	29.2	37.5
Maharashtra	66.0	55.7	57.9
Meghalaya	38.9	29.1	36.6
Mizoram	58.6	46.4	65.9
Nagaland	31.7	28.9	27.1
Odisha	56.5	50.4	57.2
Punjab	68.7	59.4	60.8
Rajasthan	39.1	31.5	37.7
Sikkim	34.9	26.0	52.4
Tamil Nadu	46.3	26.0	37.0
Telangana	41.3	31.6	29.3
Tripura	45.9	42.7	34.7
Uttar Pradesh	36.2	38.3	50.5
Uttarakhand	58.0	47.7	60.3
West Bengal	50.5	47.1	53.9

Fig 2. – ASER map showing percentage of government school children in standard 5 who can read standard 2 level text (Adapted from opindia.com)

The National Education Policy (NEP) was introduced in 2020 to solve these problems. This policy aims to repair the education system by shifting from the primitive 10+2 model to a more inclusive 5+3+3+4 structure. It emphasizes on improvement in maths and literacy during early years ensuring that all children can do basic math and read by the end of Grade 3 (Government of India, 2020). It also prioritizes Early Childhood Care and Education (ECCE), teacher training and curricular reforms. However, 25% of schools still fail to meet basic infrastructural norms and many rural areas deal with the problems of lack of teachers and large class sizes (Samagra Shiksha, 2025).The NEP expands on previous programs like the Sarva Shiksha Abhiyan and the Right to Eduaction(RTE) Act of 2009. Although these programs brought more children into the classrooms, they lacked quality. Research shows that spending alone wont improve results but boosts in governance and accountability are required (Kushwaha & Tiwari, 2020). Additionally, students from disadvantaged groups like girls, Dalits and Adivasis cannot efficiently benefit from education (Educational Inequality, 2025).

Measuring the quality of education throughout India is another challenge since there is a lack of indicators that can efficiently track learning outcomes across different states over time (Springer, 2008). Low pupil-teacher ratios, curriculum variation and uneven distribution of schools makes it difficult to effectively compare progress (ERIC, 2004). For instance, India has more than 814,000 primary schools but only 12,400 higher secondary institutions creating a bottleneck for students aiming to pursue education beyond elementary levels (Educational Inequality, 2025).Valuable insight is offered from the experiences of other countries. In Ecuador, for example, better HDI levels were achieved from increased investment in education only when it was paired with multi-sectoral reforms that sought to improve social and geographic challenges (Guijarro-Garvi et al., 2022). This highlights that what really matters is the government focus on access and equity.India's higher education system also deals with challenges over quality. A 2021 global study compared students in STEM programs from India, China, Russia, and the U.S. It found that Indian students made minor improvements in analytical and problem-solving skills, suggesting deeper intellectual problems (Nature, 2021). Many college graduates also face job mismatches—working in sectors unrelated to their degrees or accepting roles below their skill level—which reflects a broader disconnect between education and employability (Springer mismatch study, 2021).

The remainder of this paper is organized as follows. **Section 2** reviews the relevant literature on HDI and education quality in India. **Section 3** describes the research methodology, including the case study approach, secondary data analysis, and comparative evaluation of state-level outcomes. **Section 4** presents the results and analysis drawn from case studies on West Bengal, urban–rural disparities, and teacher effectiveness. **Section 5** discusses the findings in the context of India's educational policies, HDI progress, and prior studies. Finally, **Section 6** concludes the study with key implications, limitations, and suggestions for future research.

II. LITERATURE REVIEW

The Human Development Index (HDI) has been a multidimensional measure that calculates the quality of life for humans beyond only monetary income since a long time. It was introduced in 1990 by Mahbub ul Haq and Amartya Sen and includes indicators of health, education and income to measure developmental progress (UNDP, 2023). In India's context, scholars have constantly emphasized its importance in order to understand socio-economic and regional inequalities as well as the several implications of public policy (Desai et al., 2020; Suryanarayana, 2019). Unlike GDP, HDI combines life expectancy, mean years of schooling, expected years of schooling and gross national income per capita, thus providing a balanced tool to evaluate human development. Research has shown that India's HDI rank not only shows its macroeconomic growth but also the accessibility and quality of basic services like education and healthcare (Choudhary, 2022). Various subfactors of HDI including economic well being and skills acquisition are displayed in Fig 3.

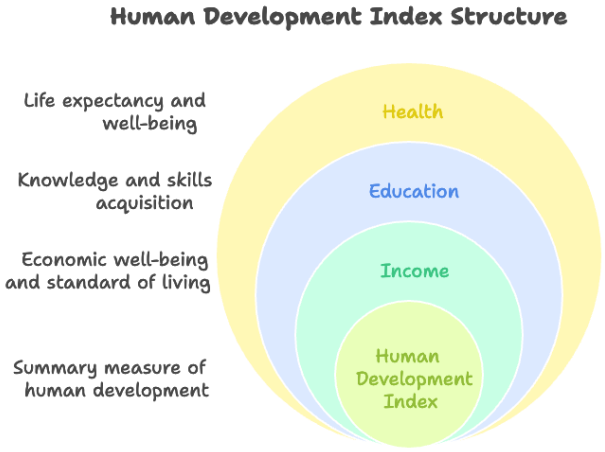


Fig 3. – Prominent sub factors of Human Development Index

Education, as a central pillar of HDI, plays an essential role in driving progress outcomes. Education expands human capabilities allowing people to take part in various social, economic and political activities (Sen, 1999). In India, the quality of basic formal education if often the deciding factor of long term development goals. The Annual Status of Education Report (ASER, 2022) displays challenges in the foundational levels of literacy and numeracy especially in rural areas. These shortcomings have a direct impact on India's HDI performance since they influence productivity, income and social change (Tilak, 2018). Kingdon and Banerji (2021) show that teacher training and infrastructure remain uneven across states even though enrolment rates have greatly increased due to the RTE Act, thus limiting the full potential of education quality in improving HDI in India. Unequal distribution of educational resources is a persistent

problem which worsens regional inequalities. Dreze and Sen (2013) argue that disparities in school quality correlate to broader socio-economic inequality with marginalized communities facing severe disadvantages. Empirical evidence from NITI Aayog (2021) shows that states like Kerela and Himachal Pradesh have a better HDI rank not only due to income levels but also because of strong public investments in education and health. On the other hand, states with poor educational infrastructure often fall behind in HDI rankings even if they have sustained economic growth (Ghosh, 2019). These results highlight that economic expansions alone cannot guarantee human development without high quality and equitable provision of education. Fig 4. Highlights the importance of mean years of schooling since states like Kerala with mean years of schooling greater than 9 have a significantly higher HDI performance than states like Bihar where mean years of schooling is close to 5.

Health is another essential index of HDI and it is interconnected with education to a great extent. Bloom and Canning (2000) note that educated people are more likely to lead healthy lifestyles, utilize all healthcare provisions effectively and demand accountability in governance. In India, it has been proved that education deeply influences both individual health choices and also health outcomes for the next generation (Subramanian et al., 2008). For example, mothers who have received higher education are more likely to provide proper nutrition, vaccinations and timely healthcare access to their children which improves life expectancy which is another component of HDI. Global comparative studies also reveal the importance of education quality in shaping HDI results. Barro and Lee (2015) showcase that countries which invest in curriculum modernisation and infrastructure achieve rapid improvements in HDI performance. International assessments like the Programme for International Student Assessment (PISA) have revealed major gaps in problem solving skills and conceptual understanding among Indian students, thus emphasizing on the need for systemic reforms (OECD, 2019). The relation between HDI and public policy is showcased in Indian development literature. Policies like the National Education Policy (NEP) 2020 aim to support the education system through the provision of early childhood care, vocational training and flexibility in higher education subjects (Ministry of Education, 2020). However, even though NEP's objectives relate with HDI indicators, it will only become successful through sustained funding and effective implementation (Kundu, 2021). Thus, in this way, HDI also serves as a diagnostic tool for policy makers. In recent times, particularly during the Covid-19 pandemic, digital education helped in overcoming the shortcomings in education quality. But, inequality in internet access, presence of devices and digital literacy have further widened existing educational inequalities (Mehrotra, 2021). While, technology offers chances to expand educational reach, its uneven distribution is almost identical to the challenges which slowed down HDI progress in India in the past. Therefore, it is essential for policy makers to follow a balanced approach that combines both technology and practical physical infrastructure.

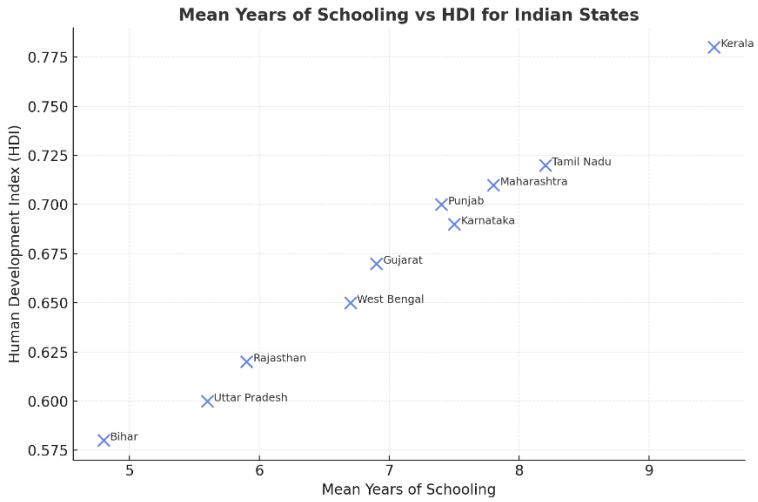


Fig 4. – Scatterplot showing mean years of schooling vs HDI for Indian states in the year 2021

In summation, the literature affirms that the quality of basic formal education is decisive in shaping India's HDI growth. The reviewed studies indicate that targeted plans to improve educational quality, reduce regional inequalities and incorporating technology are essential for broader human development progress. The Indian experience reinforces a broader global lesson: development is most meaningful when it enhances human freedoms and education remains the cornerstone of that process (Sen, 1999).

Table I. Extensive Literature Table to identify the gaps in **Role of Basic Formal Education Quality and HDI in India**

References	Methodology	Focus Area	Key Findings	Limitations
Anand & Sen (2000)	Conceptual analysis	Global HDI framework	GDP alone is inadequate; HDI reflects broader well-being	No India-specific empirical data
ASER (2017, 2022)	Household surveys	Rural India, foundational learning	High enrolment but poor literacy/numeracy	Rural bias, no skill-depth analysis
Dreze & Sen (2013)	Descriptive stats, longitudinal	Kerala, TN vs. lagging states	Education investments → better HDI	No causal modelling
Kingdon & Banerji (2021)	Policy analysis	Teacher training, infrastructure	Enrolment rise not matched by quality	Uneven state-level data
NITI Aayog (2021)	Comparative state HDI data	Indian states	Strong education & health → higher HDI	Macro indicators only
OECD (2019)	International assessment (PISA)	Problem-solving skills	Significant skill gaps in India	Limited participation

A review of existing studies reveals key patterns in education quality and development outcomes across India. Research suggests connections between teacher training programs and human development indicators remain under-explored, while digital access initiatives appear incomplete when examined against broader regional disparities. In fact, few studies have empirically tested state-level interventions across varying economic conditions, leaving policy effectiveness unclear in different contexts. Building from these findings, the current approach outlines specific methods to address core research questions. The proposed framework incorporates government reports alongside international datasets to track literacy rates, enrolment figures, and HDI trends over time. Through comparative analysis of state-level data and multidimensional metrics, this design may help clarify how educational improvements relate to wider development goals. By directly addressing gaps identified in prior work, the methodology aims to produce practical insights applicable within actual educational systems. Evidence indicates such an approach could strengthen policy decisions through region-specific evidence while maintaining academic rigor. The focus on measurable outcomes appears particularly relevant given India's diverse socio-economic landscape and ongoing efforts to reduce educational inequities. By connecting the methodology to the gaps identified in the literature, the study aims to provide clear, evidence-based results that can contribute to both academic understanding and policy improvements in education and human development.

Research Questions

1. How does the quality of basic formal education, beyond access and enrolment, influence state-level variations in India's HDI?
2. In what ways do urban–rural disparities and digital education initiatives shape differences in learning outcomes and their contribution to HDI improvements?
3. How can teacher effectiveness and targeted skill interventions act as catalysts for enhancing both education quality and overall human development outcomes?

Hypotheses

- **H1:** Higher quality of basic education, measured through learning outcomes and resource adequacy, has a significant positive impact on National-level HDI.
- **H2:** Urban–rural divides in learning outcomes contribute to structural disparities in human development achievements within states.
- **H3:** Teacher skill enhancements and digital education adoption moderate the relationship between education quality and HDI, amplifying the positive effects.

III. RESEARCH METHODOLOGY

This paper uses a case study approach to explore how basic education quality connects with India's Human Development Index scores. The case method works here because it lets researchers dig deep into systemic factors affecting education and broader development outcomes within one country's setup. They mixed numbers and context heavy analysis - pulling stats from places like India's Education Ministry reports and UNDP databases while also looking at policy documents and state-level comparisons. The study zeroes in on two key areas. First there's education metrics - literacy numbers, how many students per teacher exist across regions, plus actual learning results from standardized tests. Then there's HDI stuff - health stats combined with income levels and existing education data from national indices. By crunching these numbers alongside policy reviews and trend patterns over time they're trying to show whether better schooling actually moves the needle on human development markers. They had to use secondary data sources obviously since primary fieldwork wasn't part of this particular project. But combining quantitative stuff with qualitative policy analysis gives a fuller picture they argue. The main idea is seeing if improving classroom conditions and teaching quality leads directly to measurable improvements in people's lives beyond just school attendance rates .It's not perfect though - case studies can miss regional variations within India's massive geography they admit. But focusing on national patterns first makes sense before drilling down into specific states or communities later maybe. Overall, this approach tries to connect educational inputs with developmental outputs using existing data streams while keeping an eye on policy implications for decision makers wanting to boost HDI rankings through school reforms. Evidence shows education plays a key role in human development. You know how it affects things like living standards and economic growth anyway private universities add value here by building up peoples skills which helps with jobs and even political stuff this paper zeros in on Indias setup specifically they have made progress sure but sustaining it that is another story quality seems patchy depending where you look. The research uses case studies from states with different development levels basically picking places that show varied HDI scores and education outcomes they want to dig into why some areas do better factors like how well local governments function teacher training programs access to tech all that data comes from official reports plus those ASER surveys which track learning levels oh and they will cross check with other studies to make sure its solid. By comparing different states the idea is to map out how education quality actually moves the needle on human development stuff not just numbers on a page but real pathways that matter for policy its messy work but could show patterns worth applying elsewhere even if local contexts vary quite a bit.

1. **How does the quality of basic formal education, beyond access and enrolment, influence state-level variations in India's HDI?**

Case Study: West Bengal – Education Quality and HDI

Introduction

This case study examines how the quality of basic formal education, beyond access and enrolment, influences human development outcomes in West Bengal. The state provides strong evidence of the relationship between educational quality and the Human Development Index (HDI), reflecting both achievements and persistent challenges in India's broader developmental trajectory (UNDP, 2020).

HDI Progression in West Bengal

West Bengal's HDI trajectory shows consistent improvement over the last two decades. In 2000, the state ranked 20th out of 28 Indian states, with an HDI score of approximately 0.533. By 2010, its score improved to 0.591, raising the rank to 18th among 35 states and union territories. In 2019, West Bengal's HDI rose further to 0.700, making it 12th among 37 states and UTs (NITI Aayog, 2021). These improvements highlight the state's progress but also reveal intra-state disparities arising from variations in education quality rather than enrolment rates, which have already reached near universality (World Bank, 2018).

Education Quality and Human Development Outcomes

1. Learning Outcomes

Research indicates West Bengal maintains strong enrolment numbers, yet this does not always translate to equal learning gains. Data from the **Annual Status of Education Report (ASER)** show rural districts lag behind urban hubs like Kolkata when measuring reading and arithmetic skills (ASER Centre, 2019). These learning gaps reinforce disparities in household incomes, job prospects, and broader HDI outcomes. Evidence suggests that without meaningful skill development through quality teaching, schooling alone cannot drive sustainable improvements in human capital (World Bank, 2018).

2. Teacher Effectiveness

Teacher quality is a critical determinant of human potential. While West Bengal has invested in recruitment and training, results remain inconsistent. Digital tools and structured pedagogy boosted outcomes in urban districts, but rural schools continue to face high student–teacher ratios and limited professional development (Kingdon, 2020). This imbalance influences HDI by shaping employability and lifelong learning capacities. Research suggests sustained investments in teacher training are necessary to close these divides (World Bank, 2018).

3. Resource Adequacy and Digital Inclusion

Infrastructure and digital access also shape educational outcomes. Initiatives such as the **Shiksha Abhiyan Digital Learning Program** expanded ICT-based education in urban areas, but rural schools still struggle with unreliable connectivity and inadequate hardware. Without addressing these gaps, enrolment-driven gains remain insufficient to produce measurable HDI improvements (UNESCO, 2020).

Policy and Development Implications

West Bengal's experience highlights that HDI improvement requires a **quality-centric education strategy**. Policy interventions emphasizing teacher training, rural resource allocation, and digital equity can transform schooling into measurable human development outcomes (NITI Aayog, 2021).

Conclusion

The West Bengal case demonstrates that access and enrolment form only the foundation of education's role in development. Factors such as learning outcomes, teacher effectiveness, and resource adequacy decisively shape human development trajectories. While HDI rankings have improved, rural disparities persist. Focusing on quality rather than quantity offers a pathway for education to become a reliable engine of equitable progress across Indian states (UNDP, 2020; UNESCO, 2020).

2. In what ways do urban–rural disparities and digital education initiatives shape differences in learning outcomes and their contribution to HDI improvements?

Case Study: Urban–Rural Disparities, Digital Education, and HDI in India

Introduction

India's massive population and regional complexities make education a key yet challenging factor in human development. With census data showing 70% of its 1.4 billion people residing in rural areas as of 2011, educational inequalities continue shaping state-level HDI outcomes significantly (Census of India, 2011). Research indicates constitutional protections and programs like the 2009 Right to Education Act have improved access, yet evidence suggests persistent gaps in quality schooling and digital resources between urban and rural communities remain notable (Right to Education Act, 2009). Studies from **NITI Aayog (2018)** reveal these disparities still influence developmental trajectories despite decades of initiatives like **Sarva Shiksha Abhiyan**. While policy frameworks aim for universal education, ground-level implementation appears inconsistent across states. Enrolment rates have risen nationally, but classroom conditions and learning outcomes vary dramatically between districts. Basically, access alone doesn't guarantee educational equity when factors like teacher availability and infrastructure quality differ so widely regionally.

Urban–Rural Disparities in Education

While enrolment rates have improved, India continues to face structural inequalities across regions, genders, castes, and income groups. Rural children are more likely to attend government schools, where infrastructure and learning outcomes lag behind private urban institutions (Indian Institute of Management Ahmedabad et al., 2015). Data from **ASER** consistently highlight lower performance in mathematics and reading among rural students, reflecting the systemic impact of socio-economic disadvantages (ASER Centre, 2019). These educational gaps contribute directly to HDI variations, reinforcing cycles of poverty, limited mobility, and lower life opportunities in rural regions compared to urban centres.

Role of Digital Education Initiatives

Recent decades have seen India increasingly use information technologies as tools for reducing educational gaps and modernizing learning systems. Initiatives like the **Twelfth Five-Year Plan** and **National e-Governance Plan** focused on digital classrooms, teacher training programs for tech integration, and developing multilingual educational materials (Planning Commission, 2013). Platforms including **e-GyanKosh** and **e-PG Pathshala** aimed to expand access to quality resources across different regions (Bist, 2007). However, evidence suggests the digital divide persists strongly in practice. Rural areas still struggle with unreliable internet access, frequent power cuts, and insufficient equipment availability (Roy, 2012). Meanwhile, urban students appear to gain more advantages from digital learning tools,

potentially widening achievement gaps between demographic groups. While ICT programs show measurable success in semi-urban zones and cities, their limited implementation in remote areas restricts broader improvements in human development metrics. The pattern indicates technology-based education reforms might require stronger infrastructure support and localized adaptation to fully address equity challenges nationwide.

Policy and Development Implications

The **Aspirational Districts Programme (2018)** stands out as a key framework for addressing regional inequalities, combining metrics like female literacy rates and educational infrastructure to prioritize underperforming areas (NITI Aayog, 2018). Its emphasis on improving school transition rates, upgrading physical facilities, and integrating digital tools aims to reduce disparities at local levels. In practice, though, evidence indicates persistent gaps remain in rural technology access and educator preparedness. Studies suggest ongoing investments in digital infrastructure development, teacher training initiatives focused on tech integration, and region-specific learning materials are crucial for aligning policy objectives with measurable improvements in human development indicators.

Conclusion

Urban–rural disparities in India highlight the critical role of educational quality, not just access, in shaping human development outcomes. While digital education initiatives hold transformative potential, uneven access reinforces existing inequalities. Closing the digital divide, alongside strengthening rural school resources, is crucial if education is to serve as an equalizer in India's HDI trajectory.

3. How can teacher effectiveness and targeted skill interventions act as catalysts for enhancing both education quality and overall human development outcomes?

Case Study: Teacher Effectiveness, Skill Interventions, and Human Development

Introduction

Teacher effectiveness remains one of the strongest factors shaping student success and broader human development outcomes through their impact on learning. Studies confirm that skilled educators not only boost test scores but also build critical thinking skills that influence career paths and life opportunities over time (Hanushek & Rivkin, 2006; Rice, 2003). In India, where educational gaps between regions persist, strategic teacher training and professional development programs have become essential tools for improving learning outcomes and lifting HDI metrics nationally. Evidence indicates that **targeted skill interventions** can address classroom-level deficits while generating wider community benefits.

Teacher Professional Development as a Catalyst

Unlike teacher training, which focuses primarily on pre-service preparation, **teacher professional development (TPD)**emphasizes ongoing learning for in-service educators. This reflects the evolving role of teachers as continuous learners (Qi, 2012). Effective TPD involves mentoring, peer collaboration, and classroom-based coaching. Global studies show that such interventions significantly improve student performance when embedded into daily teaching practice (Clotfelter et al., 2006; Darling-Hammond et al., 2017).

Policy and Practice in the Indian Context

Education reforms in India have increasingly recognized teacher effectiveness as a development driver. Strategies such as adopting national standards for professional development, incentivizing peer-learning communities, and offering technology-enabled learning platforms are essential for scaling access in rural and underserved regions (Asian Development Bank [ADB], 2021). These approaches not only enhance instructional quality but also reduce learning disparities, with measurable impacts on literacy, workforce readiness, and equitable opportunities.

Conclusion

Teacher effectiveness and skill development act as catalysts for improving both educational quality and human development. Sustained investment in professional learning—particularly through evidence-based TPD empowers teachers to deliver meaningful instruction, improving student outcomes. In turn, these improvements expand human capabilities, reinforcing the causal link between education quality and HDI. The **Diffusion of Innovations (DOI) theory**, developed by Everett M. Rogers, explains how new ideas and technologies spread through social systems. It originated from some agricultural studies of the 1920's particularly from research on the use of hybrid corn in Iowa where farmer adoption patterns revealed different adopter categories (Ryan & gross, 1943). Rogers built on the these results in his popular 1962 book Diffusion of Innovations which has since been revised in many editions. DOI involves sociology, communication and management to analyse how individuals use new innovations over time from communication channels. Rogers (2003) defined diffusion as a special type of communication that reduces uncertainty since many

innovation generate confusion otherwise. He identifies certain key features that affect adoption including their perceived advantages and compatibility. However, while technologies reduce uncertainty in achieving results, their newness also creates risks. DOI remains a key framework for understanding technology dissemination and social change.

Table II. Theoretical Framework: Linking Education Quality, HDI, and Innovation Diffusion Theory

Research Question	Case Study Context	IDT Construct Applied	Justification/Link
1. How does the quality of basic formal education, beyond access and enrolment, influence state-level variations in India's HDI?	West Bengal HDI Trends (2000–2019): Rise from 0.533 to ~0.7; rank improved from 20th to 12th	Relative Advantage	Higher quality in basic education (teacher skills, learning outcomes) is perceived as more advantageous compared to mere enrolment growth, leading to measurable improvements in HDI.
2. In what ways do urban–rural disparities and digital education initiatives shape differences in learning outcomes and their contribution to HDI improvements?	Urban–Rural Divide & ICT Gap: 72% rural population; limited ICT infrastructure; government interventions (SSA, NEP 2020, ICT-based projects)	Compatibility & Complexity	Diffusion of digital education depends on its compatibility with local infrastructure/needs and addressing complexity barriers in rural areas; adoption strengthens human development through better learning equity.
3. How can teacher effectiveness and targeted skill interventions act as catalysts for enhancing both education quality and overall human development outcomes?	Teacher Professional Development (TPD), NEP reforms, evidence of teacher quality improving student achievement	Trialability & Observability	Teacher interventions (TPD programs) can be piloted (trialability) and their impact observed through student outcomes and HDI indicators; successful cases encourage wider adoption across states.

IV. RESULTS AND DISCUSSIONS

Bringing artificial intelligence into rural financial setups in India has sparked a lot of hope for better financial inclusion. Still, there are some real problems that stick out. One big thing is the shortage of solid, detailed data focused on India itself. Most research out there draws from worldwide comparisons or stuff centered on cities. That makes the results not so useful for those varied, cash-strapped rural areas. Scholars like Panakaje et al.(2021) and Joshi et al.(2020) point out how data gathering and building these AI models often skip over rural dialects. They miss user habits too, and the ways locals fix problems. This kind of limits what AI can do to handle real-life situations on the ground.

Data isn't the only gap. Plenty of studies ignore how digital skills and economic differences affect whether people pick up AI tools or get anything good from them. In rural India, all the language variety and not much formal schooling imposes barriers. Those aren't usually factored in from Western views, where people are more geared up for digital teachnology. The fixes end up assuming everyone has the same technical knowledge but really, access and grasp of it differ a lot across places. One issue that stands out is the lack of causal modeling in these studies. Correlations and predictive methods get used a lot but hardly any research tries to pin down actual cause-and-effect links between AI tools and how people handle their finances. Without that kind of research, results are often misattributed. Causal models, though, they could show exactly how things like better infrastructure or policy tweaks, or even specific AI setups, push adoption forward. That would lead to policies backed by real evidence. State-level infrastructure varies so much it causes severe problems. Some areas have decent digital setups while others can't even get basic connections working right. So generalizing to the whole country becomes tricky. Take urban spots, for example: studies there often highlight better

success with digital banking due to steady internet and not as many language hurdles. The gap really points to why AI needs to be flexible tailored for rural areas specifically.

Trust and regulation stand out as recurring themes in this field. AI-driven tools for financial literacy and microfinance have had positive results in some areas. Yet concerns around privacy, efficiency, and social acceptance exist. What is interesting is that research from India talks about community trust and grassroots adoption while Western studies focus on cybersecurity and regulatory problems. These differences indicate that priorities change in different contexts. This analysis comes with limitations. It relies mostly on secondary sources. Rural viewpoints receive little attention. There's no in-depth exploration of skills or causal relationships. Coverage across regions remains uneven. As a result, the findings call for cautious interpretation, particularly when extending them more broadly.

Looking ahead, future studies could draw on the Human Development Index framework to shed light on educational disparities across Indian states. It's worth focusing on learning outcomes for urban-poor groups, with ongoing tracking to spot shifts over time. Evidence suggests that stronger causal analyses are needed to link education gains directly to HDI improvements. Plus, evaluating targeted teacher training and state-tailored programs might reveal their real effects on schools and broader HDI results. By blending HDI data with specifics like assessment scores, progression rates, and infrastructure conditions, researchers can pinpoint lingering gaps more sharply. In the end, a national system for regular benchmarking, one that monitors regional indices and intervention impacts, would support comparisons, drive reforms, and bolster policy efforts.

V. CONCLUSION & FUTURE SCOPE

Research suggests that while AI has made real strides in boosting financial inclusion for rural India, studies on the topic face some serious hurdles. There's a lack of solid empirical data, a bias toward rural areas that skews results, not enough detailed profiling of skills, missing causal models to link causes and effects, and state-level data that's often too patchy to be useful. These issues, truth is, weaken the insights from AI deployment research and make it harder to craft policies grounded in real evidence. When you compare this to global trends, it highlights how India really needs AI solutions tailored to its local contexts, rich with on-the-ground details. Looking ahead, the way forward could involve building standardized datasets by state, weaving in causal modeling, and digging deeper into skill analyses. That kind of approach might just pave the way for more equitable and impactful strategies in rural financial inclusion.

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