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AI in the Classroom: Advancing equity, engagement, and excellence through personalization

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Abstract

In today's diverse and fast-evolving educational landscape, the demand for personalized learning has become more critical than ever. Traditional one-size-fits-all models often fail to address the unique needs of individual learners, leading to disengagement and educational gaps. Artificial Intelligence (AI) is emerging as a transformative force, enabling adaptive learning systems that dynamically tailor content, pace, and learning paths to suit each student.

Through intelligent algorithms and data-driven insights, AI can identify learning patterns, predict student challenges, and recommend targeted interventions. Furthermore, AI enables the automation of assessments and feedback mechanisms, allowing real-time evaluation and continuous improvement in student performance. This not only reduces teacher workload but also promotes timely support for learners.

AI is particularly impactful in bridging learning gaps among students with different linguistic, cognitive, and socioeconomic backgrounds. Tools such as AI-powered tutors, speech recognition, and translation services ensure inclusive and accessible education. Implementations of adaptive learning platforms in higher education settings have shown measurable improvements in student outcomes, including increased retention rates and higher test scores. Moreover, early intervention tools powered by AI have successfully reduced dropout rates by identifying at-risk students and initiating timely support.

Drawing from current case studies and applications, this article explores the growing role of AI in promoting equity, engagement, and excellence in digital classrooms, while also addressing ethical and infrastructural challenges. These promising results validate AI's potential to enhance learning experiences, though continued research and long-term assessments remain vital to ensure scalable and equitable impact.

Keywords: Artificial Intelligence in Education, Personalized Learning, Adaptive Learning Systems, Educational Equity, Digital Classrooms

1.Introduction

Today's classrooms are full of students from a wide variety of socio-economic, linguistic, cultural, and cognitive backgrounds, each bringing unique experiences, preferences, with different ways of learning and different needs (Farooqi, et al., 2024). But many schools still use the same traditional teaching methods for everyone. This "one-size-fits-all" system doesn't work for every student. Some students may fall behind, lose interest, or never get the chance to do their best.

This is where Artificial Intelligence (AI) can make a big difference. AI can help teachers better understand how each student is doing and adjust lessons to match their needs. For example, smart learning tools can give students personalized help, track their progress, and give feedback right when it's needed.

AI is not just a new tool it's a new way of thinking about teaching and learning. It can help make learning more fair, interesting, and effective. By spotting problems early, giving the right support at the right time, and helping teachers with useful information, AI can make classrooms better for everyone.

1.1 Enhancing engagement through Intelligent feedback and assessment

AI revolutionizes how to assess and respond to student learning. Using machine learning and natural language processing (NLP), AI can instantly evaluate student work—including essays and open-ended responses offering timely, personalized feedback (Manzoor & Mohammad, 2019).

Intelligent tutoring systems provide scaffolder instruction and formative feedback, mirroring human tutor interactions. Meanwhile, AI-powered grading tools reduce the burden on teachers, freeing them to focus on higher-order instructional strategies and individual mentoring.

By turning assessment into a continuous, responsive process, AI enhances student engagement. Learners benefit from instant feedback, which fosters a growth mindset and encourages perseverance.

1.2 Advancing equity and inclusion

AI holds immense promise in promoting educational equity, particularly for students from historically underserved backgrounds, those with linguistic differences, learning disabilities, or limited access to quality instruction.

Key AI tools supporting equity include:

Speech recognition and transcription for students with disabilities

Real-time language translation for non-native speakers

AI tutors that fill in instructional gaps in under-resourced schools (Melo-López, et al., 2025).

Furthermore, AI supports culturally responsive teaching by adapting content to reflect diverse perspectives, helping students see themselves represented in their learning journeys.

1.3 Data-driven early intervention and retention

AI also supports proactive educational support by detecting patterns that predict academic struggle. Through predictive analytics, AI systems identify students at risk of falling behind or dropping out and alert educators early

2. Dataset description

This analysis is based on data obtained from UDISE+ (Unified District Information System for Education Plus), India's most comprehensive, central, and official database on school education. Administered by the Department of School Education & Literacy, Ministry of Education, UDISE+ collects annual data from all recognized schools—government, aided, and private—across every state and union territory. The system covers more than 1.5 million schools, making it one of the largest school-level administrative datasets in the world.

Data collection follows a standardized procedure through the UDISE+ Data Capture Format (DCF), ensuring consistency, timeliness, and validation through multiple levels (school → block → district → state → national). This makes UDISE+ exceptionally robust for policy research and cross-state comparisons.

For this study, UDISE+ datasets from the 2023–24 academic year were extracted. This period reflects the most recent post-pandemic data cycle, offering critical insights into infrastructure recovery, digital education expansion, and equity-related gaps across India.

Using UDISE+ ensures that all insights presented in this analysis are grounded in nationally verified, large-scale administrative data, enabling meaningful conclusions about infrastructure readiness, digital divides, gender disparities, accessibility, and school-level transitions. These indicators are particularly important for assessing how AI-powered educational solutions can be equitably integrated into Indian classrooms.

The following csv files are extracted for this analysis (Ministry of Education, 2024).

Infrastructure.csv

Captures the presence and functionality of key school facilities such as Internet access and computer availability (essential for digital and AI-based learning), Inclusive infrastructure (ramps, handrails, toilets), Basic utilities (electricity, water, medical checkups)

Level of school education.csv

Contains the number of schools at each level (Primary, Upper Primary, Secondary, Higher Secondary), helping to contextualize educational access across states and regions.

Projection by gender.csv

Provides projected enrollment numbers for boys and girls across three age groups (3–5, 6–10, 11–13), enabling gender-based analysis of participation and drop-offs across schooling levels (Ministry of Education, 2024).

3. Results and discussion

As education systems around the world explore the potential of Artificial Intelligence (AI) to transform learning, it is essential to understand the ground realities of school infrastructure and student demographics. For AI-powered tools to truly enhance equity, engagement, and excellence, the foundation must be strong including schools need reliable infrastructure, inclusive environments, and consistent student participation across all groups.

In this study, concentrated on key indicators that directly influence the success of personalized, AI-driven learning in Indian classrooms:

Digital infrastructure (Internet and functional computers): Without working computers and internet access, AI tools cannot be implemented, regardless of their potential.

Inclusive facilities (Ramps and handrails): AI in education must serve all learners, including children with disabilities. Accessibility gaps can leave many students behind.

Electricity access: Functional electricity is a basic requirement for using any digital tool in classrooms, including AI platforms.

Enrollment trends (by school level and gender): Understanding where and why students drop out helps us identify critical intervention points where AI personalization could re-engage and support learners.

Internet vs Functional computers: A digital divide

Fig 3.1 shows the top 10 states with the biggest gap between internet access and working on computers in schools, based on UDISE+ 2021–22 school infrastructure data (Ministry of Education, 2024). While many schools in India now have internet, a major problem still exists that most of them do not have enough working computers for students and teachers to use. For example, in states West Bengal and Bihar, more than 90% of schools are connected to the internet, but less than 20% have computers that actually work for teaching.

In states such as Manipur, Mizoram, and Tripura, internet availability is improving, but the lack of usable computers makes it hard to bring technology into classrooms effectively (Ministry of Education, 2024). Even large states like Uttar Pradesh and Telangana face similar issues, which means AI-based learning tools will not be used equally across all schools.

In Arunachal Pradesh, where the terrain is difficult, even moderate internet access is not enough, because computer availability is very low due to transportation and setup challenges.
This shows that before AI tools can truly help in education, schools must first have the basic digital equipment in place.

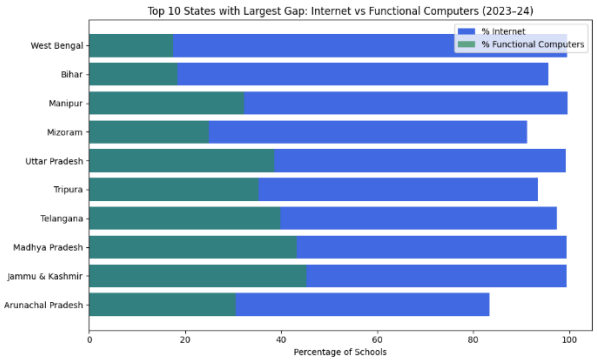

Fig.3.1 Top 10 States with Largest Gap: Internet vs Functional Computers (2023–24)

Inclusive infrastructure for children with special needs (CWSN): Ramps and handrails for all

The analysis of inclusive infrastructure across the top 10 states reveals based on UDISE+ 2021–22 school infrastructure data (Ministry of Education, 2024), reveals significant disparities between

basic and fully accessible school facilities. A school with just a ramp might technically be accessible, but without handrails, it may still pose challenges. A ramp with handrails is a better indicator of inclusive infrastructure that shows the school is more ready to accommodate children with physical disabilities.

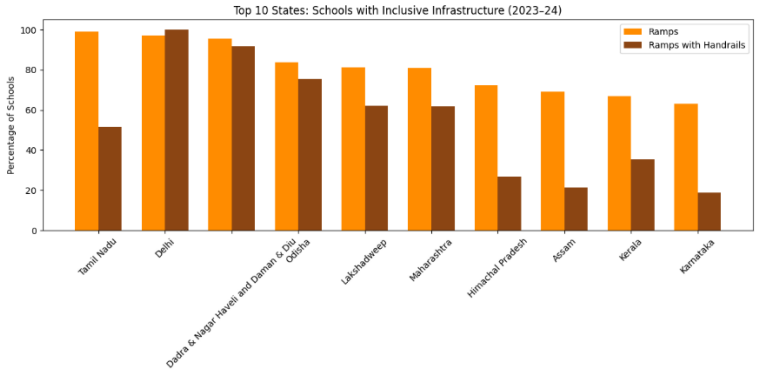

Fig 3.2. Top 10 States with Largest Gap: Ramps vs Handrails

From the result shown in Fig.3.2 it is observed that Delhi emerges as a clear leader, with nearly 100% of schools equipped with both ramps and handrails, setting a benchmark for true accessibility. In contrast, Tamil Nadu, despite having ramp access in almost all schools (~99%), provides handrails in only about 52%, highlighting a critical gap in usability and safety for children with mobility challenges. Dadra & Nagar Haveli, Daman & Diu, and Odisha perform relatively well, though they still exhibit an 8–10 percentage point gap between basic ramp access and full accessibility. Similarly, Lakshadweep and Maharashtra have over 80% ramp coverage but fall short on handrails, with coverage around 62%, indicating the need for improvement. The most significant gaps are observed in Himachal Pradesh, Assam, Kerala, and Karnataka, where ramp availability ranges from 60% to 73%, but handrail presence drops sharply, especially in Karnataka and Assam, where fewer than 25% of schools have handrails. These disparities emphasize the importance of not just providing infrastructure but ensuring its functionality for all learners.

Electricity access — Basic need for Digital learning

Access to electricity is a basic yet vital requirement for digital learning and the successful integration of AI in classrooms. Without reliable and functional electricity, even schools equipped with internet and computers cannot fully utilize digital tools or ensure uninterrupted learning. This analysis, based on UDISE+ 2021–22 school infrastructure data (Ministry of Education, 2024), highlights the gap between electricity availability and its actual usability in schools.

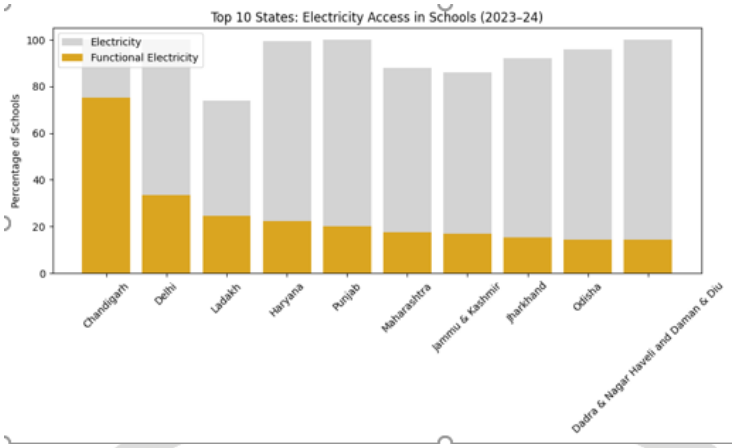

Fig.3.3 Top 10 States with Largest Gap: Installed vs Not Working

The Fig 3.3 illustrates the gap between electricity availability and functional electricity in schools across the top 10 states/UTs in terms of access in 2023–24. While many of these regions report near-universal electricity connections, a significant number of schools lack functional electricity, highlighting a critical infrastructure reliability issue. Chandigarh stands out with ~75% of schools having functional electricity, closely aligning with its total electricity availability which indicates high reliability. In contrast, Delhi, despite reporting high electricity availability in schools, shows only ~34% of schools with *functional* electricity that raise concerns about maintenance and infrastructure quality. States like Ladakh, Haryana, and Punjab report 100% or near-100% electricity coverage, but only 20–25% of that electricity is actually usable, suggesting severe issues in power consistency, wiring, or energy supply. The situation worsens in states like Odisha and Dadra & Nagar Haveli and Daman & Diu, where despite full electricity installation, only ~15% of schools have access to electricity that is operational and useful. This disparity underscores that mere installation of electric connections does not guarantee educational utility. The presence of non-functional infrastructure could hinder digital learning, operation of basic classroom equipment, and even safety systems and ultimately undermining education quality and inclusive goals.

School-level enrollment analysis

The school-Level Enrollment Analysis reveals a sharp drop in student numbers as they move from primary to higher secondary levels. This indicates challenges in student retention and highlights the need for targeted interventions to support continued education. This pattern is clearly observed from the UDISE+ 2023–24 Level of School Education and Enrollment dataset (Ministry of Education, 2024), which provides school-wise and class-wise student counts across different levels

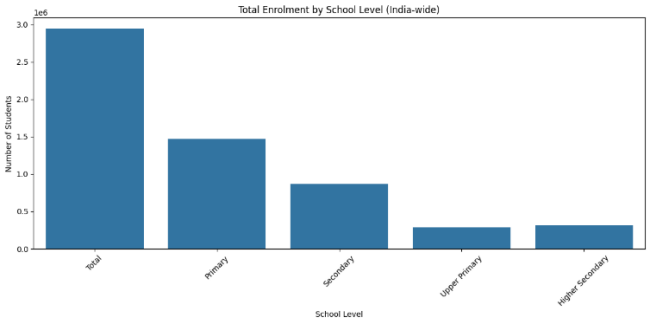

Fig3.4: Total Enrolment by School Level

From the results shown in Fig 4, the school-level enrollment data reveals a steep decline in student numbers as education progresses to higher levels. Primary education accounts for the largest share of enrollments after the total count, indicating a strong foundation in early education access across India. However, enrollment nearly halves at the secondary level and drops even further in upper primary and higher secondary stages. This sharp fall suggests significant retention challenges beyond the primary years, pointing to systemic barriers such as socio-economic factors, inadequate infrastructure, or lack of motivation and support. To ensure AI-driven personalization truly advances equity and excellence, interventions must target these transition points, especially between primary and upper primary to prevent student attrition and promote continuous engagement throughout the schooling journey.

State-wise enrolment drop across school levels

This focuses on how different states experience these enrollment drops comparing which states retain students better across education levels based on UDISE+ 2023–24 Level of School Education dataset (Ministry of Education, 2024), it highlights regional differences in retention and transition between school stages.

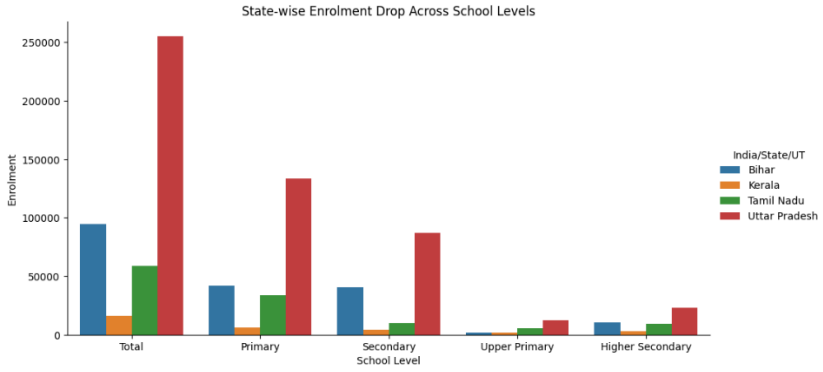

Fig 3.5: State-wise enrollment drops across school levels

The Fig 3.5 on state-wise enrollment drop across school levels highlights significant disparities in student retention as education progresses. Uttar Pradesh dominates in absolute enrollment across all levels but also shows a noticeable decline from primary to higher secondary, pointing to retention issues despite large initial enrollment. Bihar follows a similar pattern, with substantial drop-offs from secondary onwards. In contrast, Kerala and Tamil Nadu, while having lower total enrollments, show relatively steadier transitions between levels indicating stronger student retention and possibly better support mechanisms through the schooling years. This trend underscores the urgent need for targeted interventions in states like Uttar Pradesh and Bihar, where high early-stage enrollment doesn't translate into sustained academic progression. Addressing these drop-offs is critical for ensuring that AI-powered personalization benefits learners consistently throughout their educational journey.

Gender-based projection analysis: Projected student population by Age and Gender

This analysis helps to identify where the highest demand for educational resources and infrastructure will be in the coming years. This is crucial for planning AI-driven personalization and inclusive facilities, especially for the large 6–10 age group

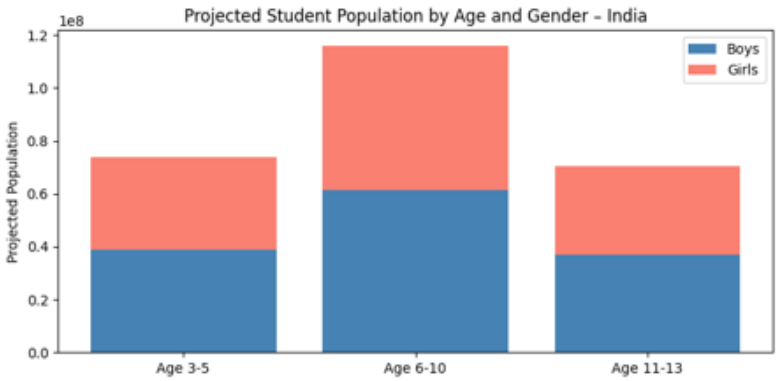

Fig 3.6: Projected Student Population by Age and Gender – India

The Fig 3.6 presents a snapshot of the expected number of school-age children across three critical age groups: 3–5, 6–10, and 11–13 years derived from the UDISE+ 2023–24 Projection by Gender dataset (Ministry of Education, 2024). The 6–10 age group which corresponds to the primary school years has the largest projected population, with over 110 million students, fairly balanced between boys and girls. This peak indicates the highest demand for foundational education infrastructure and resources. The 3–5 (pre-primary) and 11–13 (upper primary/lower secondary) age groups show nearly identical population projections, both significantly lower than the 6–10 group. Despite the lower total, the gender distribution across all age groups appears relatively balanced, signaling no major gender disparity in projections at the national level.

This data is essential for educational planning: while AI personalization can enhance learning outcomes, the sheer scale of the 6–10 cohort highlights the urgency of implementing scalable, equitable solutions especially in early learning environments where foundational gaps are hardest to recover from.

States with lowest Female share (age 6–10)

This analysis is based on UDISE+ 2023–24 Projection by Gender dataset (Ministry of Education ,2024) and highlights regions where fewer girls are enrolled during the critical primary school years. This insight is important for addressing gender-based gaps and ensuring AI tools and education policies reach all learners equally.

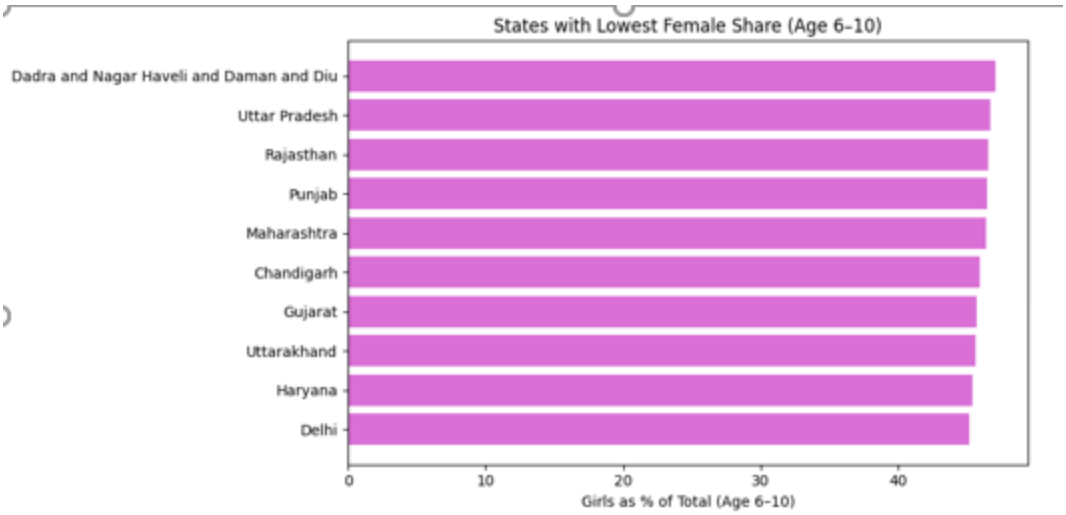

Fig 3.7: States with Lowest Female Share (Age 6–10)

The Fig 3.7 highlights regions in India where girls constitute the smallest percentage of the school-age population in the critical 6–10 age group, which typically aligns with primary education. Across the listed states and union territories including Delhi, Haryana, Uttar Pradesh, Rajasthan, and Maharashtra the female share drifts just below 47%, reflecting a persistent gender gap in early educational access or demographic representation.

Particularly notable is Dadra and Nagar Haveli and Daman and Diu, which sits at the bottom, suggesting the lowest female enrolment share in this age group. While the percentage differences may appear narrow, even small gaps at this scale imply tens of thousands of missing girls in classrooms either due to social biases, early dropouts, or enrolment barriers. This insight underscores the importance of targeted interventions especially in northern and western states where AI-driven tools could help monitor at-risk groups, personalize learning to re-engage dropouts, and flag gender disparities early for corrective action.

4. Challenges: Ethical, technical, and pedagogical

Despite its benefits, integrating AI in education is not without challenges. Key concerns include Privacy and data security, Algorithmic bias, Over-reliance on automation. To navigate these risks, schools and developers must emphasize transparency, accountability, and inclusivity in the design and deployment of AI tools.

5. Conclusion

As artificial intelligence (AI) continues to develop, it opens new possibilities for making learning more personalized, inclusive, and engaging. AI can help tailor lessons to individual student needs, provide timely support, and improve accessibility, helping to overcome many of the challenges faced in today's education system. However, for AI to truly make a difference, it must be implemented thoughtfully, with strong ethical guidelines and ongoing evaluation. Success will depend on collaboration between teachers, technology experts, policymakers, and students to ensure that AI support does not replace educators, and reaches every learner, no matter their background or ability.

Through this analysis, aimed to highlight both the potential and the gaps in using AI in Indian schools. The findings show where improvements in infrastructure, accessibility, and equity

are most needed. This helps to focus on building a system where personalized learning tools benefit all students, not just a select few. Ultimately, the goal of this study is to explore how AI can enhance not only academic achievement, but also fairness, access, and student participation in diverse classroom environments.

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