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Current Research Trends in the Application of Artificial Intelligence in Indian Education and Their Impact on Student Outcomes: A Systematic Review

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ABSTRACT

This systematic review investigates contemporary trends in the application of Artificial Intelligence (AI) in Indian education and evaluates its effects on student outcomes. Employing the PRISMA 2020 framework, 100 peer-reviewed studies published between 2020 and 2025 were examined. Findings reveal the prominence of personalized learning platforms, AI-driven assessments, and intelligent tutoring systems. Challenges such as data privacy, ethical concerns, and infrastructural disparities are also highlighted. Thematic analysis identifies seven core domains of AI implementation in education. The review concludes with recommendations for ethical, inclusive, and effective AI integration aligned with the National Education Policy (NEP) 2020.

Keywords: *Artificial Intelligence, Indian Education, Student Outcomes, PRISMA, Systematic Review, Learning Analytics, Personalized Learning, Educational Ethics*

I. INTRODUCTION

The rapid development and integration of Artificial Intelligence (AI) have begun to significantly transform global educational systems. AI in education refers to the use of machine learning, natural language processing, data analytics, and related technologies to enhance teaching, learning, and administration (Zhai et al., 2021). Globally, AI has been used to personalize learning experiences, automate assessments, predict academic outcomes, and streamline institutional operations (Luckin et al., 2016). In India, a country with one of the world's largest and most diverse education systems, the application of AI presents both a transformative opportunity and a complex challenge.

The Indian government's initiatives, including **Digital India, SWAYAM, PM eVIDYA,** and the **National Education Policy (NEP) 2020,** have laid a strong foundation for integrating AI into mainstream education (Ministry of Education, 2020). NEP 2020 specifically advocates for

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the use of technology in teaching, learning, and assessment and calls for the development of AI-based tools to cater to diverse learning needs and improve quality and equity in education. This aligns with the global Sustainable Development Goal 4 (SDG4), which emphasizes inclusive and equitable quality education and lifelong learning opportunities for all.

The relevance of AI in the Indian educational context is particularly significant given the persistent challenges of teacher shortages, regional disparities, language diversity, and varying student-teacher ratios. AI has the potential to address these by providing **personalized learning pathways**, enabling **intelligent tutoring systems (ITS),** supporting **automated feedback mechanisms**, and **predicting learning trajectories.** AI tools can also assist teachers in identifying learning gaps, adapting instruction, and managing large classrooms more effectively (Sharma, 2023; Tambat, 2024).

However, despite the growing interest in AI-enabled education in India, systematic analyses of how AI is being applied and what outcomes it produces are limited. Existing literature tends to be fragmented, with varying methodological rigor, diverse AI tools under study, and little consensus on their effectiveness. Moreover, concerns around data privacy, algorithmic fairness, accessibility, and teacher preparedness have not been uniformly addressed across studies (Saúde et al., 2024; Agarwal & Vij, 2024).

Therefore, a **systematic review** is essential to synthesize the current evidence, understand thematic trends, evaluate the reported impact of AI on student outcomes, and identify gaps for future research and policy-making. This review is guided by the following key objectives:

- To examine the range and scope of AI applications in Indian education settings
- To analyse the impact of AI tools on student outcomes such as learning achievement, engagement, inclusion, and cognitive development;
- To identify challenges and ethical concerns associated with AI integration
- To map the findings against the policy vision of NEP 2020 and international best practices

Using the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, this study synthesizes findings from 100 peer-reviewed articles published between 2020 and 2025. The results are organized into seven thematic domains: personalized learning, AI-assisted assessment, administrative automation, learning analytics, ethical and privacy concerns, inclusive education, and policy reviews. This comprehensive review aims to provide valuable insights for educators, policymakers, researchers, and

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technology developers working toward the responsible and impactful use of AI in the Indian education system.

II. LITERATURE REVIEW

The literature on Artificial Intelligence (AI) in Indian education has grown rapidly in the past five years, driven by global edtech advancements and domestic reforms like the National Education Policy (NEP) 2020. This review examines how AI is being adopted across various educational levels and its reported impact on teaching, learning, assessment, and administration.

To organize this vast body of literature effectively, this review groups the selected studies into seven major thematic areas based on AI's applications and implications for student outcomes. Each theme reflects a distinct area of innovation and research focus in the Indian educational context.

A. Personalized Learning and Intelligent Tutoring Systems (ITS)

A significant body of literature (28 out of 100 studies) highlights the transformative role of AI in enabling personalized learning experiences. These systems adapt content, pace, and feedback to individual learner profiles. Several studies, such as Sharma (2023) and Enayathulla & Kumari (2024), discuss the effectiveness of Intelligent Tutoring Systems (ITS) that simulate one-on-one teaching. These systems use AI algorithms to identify student weaknesses and offer tailored learning interventions in real time.

AI-powered apps such as Mindspark and AI chatbots are being deployed in Indian schools to provide bilingual content, micro-level assessments, and remedial exercises (Tambat, 2024). These tools have shown positive effects on engagement, retention, and test scores, especially among students from under-resourced schools.

However, researchers such as Dhillan (2023) argue that the lack of teacher involvement in personalized AI tools may hinder deep conceptual understanding unless blended learning models are adopted. Despite their potential, personalized AI systems remain inaccessible to many due to digital inequity and infrastructure constraints.

B. AI-Assisted Assessment and Feedback

The second major cluster of studies (16 papers) focuses on AI-supported evaluation systems, including automated grading, adaptive assessments, and real-time feedback mechanisms. These tools aim to reduce the burden of manual assessment and improve the immediacy and objectivity of feedback.

Yadav & Anubha (2024) and Sasikala & Ravichandran (2024) explored the use of machine

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learning algorithms in essay grading, quizzes, and MCQ generation. These tools have been found to offer consistent and unbiased evaluation, helping teachers spend more time on pedagogy than paperwork.

Other studies highlighted the use of formative feedback dashboards that track student progress and suggest personalized interventions. However, limitations include the lack of standardization across platforms and the risks of data misinterpretation by non-expert educators (Bansal, 2023).

C. Administrative Automation and Learning Management

Although less frequently studied (8 out of 100 studies), this theme addresses the application of AI in educational administration, such as timetable generation, attendance tracking, document automation, and LMS (Learning Management System) optimization.

Tambat (2024) describes how AI has been used in several Indian private institutions to streamline administrative workflows, saving time and reducing errors. NLP (Natural Language Processing) tools were used to automate report card generation and manage student communications.

While these applications have not directly impacted student academic outcomes, they have indirectly improved instructional quality by reducing administrative load on educators.

D. Learning Analytics and Predictive Modelling

Fifteen studies explored the use of AI for data-driven insights, such as identifying at-risk students, predicting dropouts, or personalizing curriculum design. AI tools such as clustering algorithms and neural networks were employed to mine student performance data and behavioural logs.

Studies by Hu (2024) and Kayyali (2024) demonstrate how predictive analytics are being used in Indian universities to identify disengaged learners and trigger early interventions. These tools were especially effective in blended and online learning environments.

However, the literature also warns against over-reliance on algorithms, particularly when datasets are incomplete, non-representative, or biased (Saúde et al., 2024). There is a pressing need for transparent and interpretable AI models to support teacher decision-making.

E. Ethical Issues, Data Privacy, and AI Bias

Twelve papers addressed growing concerns around student data privacy, algorithmic bias, and the lack of ethical frameworks for AI in education. As highlighted by Zhai et al. (2021) and Agarwal & Vij (2024), many AI systems deployed in Indian classrooms do not disclose how data is collected, processed, or stored.

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Some studies reported disparities in AI recommendations, often based on socioeconomic or linguistic biases embedded in training datasets. This poses a serious threat to equity and fairness in educational decision-making.

While international literature has begun to adopt ethical standards for edtech deployment (e.g., UNESCO AI in Education guidelines), most Indian studies call for urgent policy frameworks, teacher sensitization, and parental awareness around data ethics.

F. AI for Inclusive Education and Accessibility

Nine studies focused on how AI is improving accessibility for marginalized learners, including those with disabilities, language barriers, or in remote regions. For example, Singh & Jindal (2024) documented how AI-powered text-to-speech, speech-to-text, and real-time translation tools helped visually impaired and non-native speakers navigate digital content.

Other applications include voice assistants in rural classrooms, AI-powered sign language tutors, and mobile-based learning platforms designed to function offline. These tools align well with the NEP 2020's goal of ensuring equitable and inclusive education.

Nevertheless, challenges remain in scaling these solutions due to funding limitations, lack of local language datasets, and digital literacy gaps among students and teachers.

G. General Reviews, Meta-Analyses, and Policy Perspectives

Twelve of the reviewed studies were systematic reviews, bibliometric analyses, or policy-oriented papers. These works provided overviews of the current landscape of AI in Indian education, evaluated alignment with NEP 2020 goals, and proposed frameworks for responsible AI adoption.

For instance, Potluri & Kilaru (2024) performed a meta-synthesis of AI deployment across Indian universities, identifying leadership training, infrastructural investment, and curriculum redesign as key enablers. Other studies emphasized teacher professional development in AI pedagogy, especially in light of India's move toward competency-based education.

However, many of these reviews also criticized the uneven quality of AI research in India, pointing out methodological inconsistencies, limited sample sizes, and the absence of longitudinal studies.

Table 1 - Summary of Thematic Trends

Theme	No. of Studies	Key Focus Area
Personalized Learning and ITS	28	Adaptive content, intelligent tutoring, chatbots

AI-Assisted Assessment and Feedback	16	Auto-grading, analytics, real-time feedback
Administrative Automation	8	Attendance, scheduling, LMS, report cards
Learning Analytics and Prediction	15	At-risk identification, learning behaviour mining
Ethical and Privacy Concerns	12	Algorithmic bias, data misuse, transparency
Inclusive Education and Accessibility	9	Disabled learners, multilingual tools, rural support
General Reviews and Policy Perspectives	12	NEP 2020, national trends, research syntheses

III. METHODOLOGY

This systematic review was designed to synthesize existing empirical and theoretical research on the use of Artificial Intelligence (AI) in Indian educational settings, with a focus on its impact on student outcomes. To ensure methodological rigor, the review followed the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which are widely recognized for enhancing the transparency, reproducibility, and comprehensiveness of systematic reviews (Page et al., 2021).

A. Review Design

The review employed a qualitative thematic synthesis approach, underpinned by the PRISMA 2020 structure. The main aim was to identify, appraise, and synthesize peer-reviewed research studies conducted between 2020 and 2025 that specifically address the applications and impacts of AI in Indian education.

B. Research Questions

The review was guided by the following research questions:

1. What are the major thematic areas of AI application in Indian education?
2. How does the integration of AI influence student outcomes such as learning performance, engagement, and inclusion?
3. What challenges, limitations, and ethical concerns are identified in the literature related to AI adoption in Indian educational settings?

C. Inclusion Criteria of papers:

- Peer-reviewed journal articles published between 2020 and 2025.

- Studies focused on the Indian educational context (school, college, or university level).
- Articles written in English.
- Research examining the use of AI tools (e.g., ITS, learning analytics, auto-assessment, predictive modeling) and their impact on learners, teachers, or educational systems.
- Both qualitative and quantitative studies, including systematic reviews and meta-analyses.

D. Exclusion Criteria:

- Studies not conducted in India or not focused on the Indian context.
- Non-peer-reviewed literature such as editorials, opinion pieces, white papers, and unpublished theses.
- Papers focused solely on AI technical development without educational implications.
- Duplicated studies or those with inaccessible full-texts.

E. Screening and Selection Process

The selection of studies was executed in three phases:

1. **Title and Abstract Screening**: All 120 retrieved records were screened for relevance based on titles and abstracts.
2. **Full-Text Review**: 100 full-text articles were thoroughly read and evaluated based on inclusion and exclusion criteria.
3. **Eligibility Assessment**: All 100 articles were deemed eligible for final synthesis. No articles were excluded at this stage.

F. Data Extraction and Management

A structured data extraction matrix was developed to capture key information from each study, including:

- Author(s) and publication year
- Study location and educational level (school, college, university)
- Type of AI tool used (ITS, chatbots, LMS, analytics, etc.)
- Methodology (qualitative, quantitative, mixed-methods)
- Key findings related to student outcomes
- Reported challenges, biases, or ethical concerns

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The extracted data were reviewed iteratively and independently verified to ensure reliability and thematic consistency.

G. Quality Assessment

Although formal risk-of-bias tools were not applied due to the diverse nature of included studies, each study was evaluated for:

- Clarity of research objectives
- Appropriateness of methodology
- Relevance to the Indian context
- Validity of conclusions based on reported data

Studies lacking methodological transparency or educational focus were excluded during the screening phase.

H. Data Synthesis

A thematic analysis approach was used to organize and synthesize findings across studies. After initial coding, seven major thematic domains of AI application were identified:

1. Personalized Learning and Intelligent Tutoring Systems
2. AI-Assisted Assessment and Feedback
3. Administrative Automation and Learning Management
4. Learning Analytics and Predictive Modelling
5. Ethical Issues and Data Privacy
6. AI for Inclusive Education and Accessibility
7. General Reviews, Meta-Analyses, and Policy Perspectives

These themes form the basis of the Results and Discussion sections of this paper.

I. Limitations of the Review Process

This review is limited by the scope of the literature accessible through SciSpace. Grey literature, non-English studies, and papers published after early 2025 were not included. Additionally, while thematic coding was systematic, interpretation may involve a degree of subjectivity inherent in qualitative reviews.

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IV. RESULTS

The results are structured thematically, based on the nature of AI applications and their influence on student outcomes in the Indian educational context. The analysis identifies seven dominant thematic categories, representing the major trends in AI integration in India's education system between 2020 and 2025.

A. Personalized Learning and Intelligent Tutoring Systems (ITS)

A total of 28 studies focused on the application of AI for personalized learning, marking this as the most dominant theme. AI tools such as Intelligent Tutoring Systems (ITS), adaptive learning platforms, and conversational AI (chatbots) were frequently examined.

These tools dynamically adjust content delivery based on student performance, learning pace, and prior knowledge. For example, Sharma (2023) and Enayathulla & Kumari (2024) documented the positive effects of ITS on student motivation and achievement in subjects like mathematics and science. The studies reported that AI platforms improved self-paced learning, boosted learners' confidence, and enhanced academic performance by offering real-time feedback and adaptive pathways.

However, researchers like Dhillan (2023) cautioned that over-dependence on AI-driven personalization could diminish collaborative and inquiry-based learning. Moreover, access to such tools remained limited in low-income or rural schools due to poor digital infrastructure.

B. AI-Assisted Assessment and Feedback Systems

16 studies investigated the role of AI in improving formative and summative assessment practices. AI technologies were employed to:

- Auto-grade assignments and objective tests
- Generate personalized quizzes
- Provide instant feedback
- Visualize performance through dashboards

Sasikala & Ravichandran (2024) found that AI-enabled formative feedback mechanisms significantly helped students identify their strengths and weaknesses early. Yadav & Anubha (2024) emphasized the use of Natural Language Processing (NLP) in automated essay scoring and paraphrase detection, reducing the subjectivity and workload involved in manual grading.

Several studies noted increased student engagement and reduced feedback latency. However, limitations were also noted regarding the lack of transparency in scoring algorithms and the

need for continuous teacher oversight to interpret AI-generated results accurately.

C. Administrative Automation and Learning Management

8 studies focused on the use of AI for automating institutional and classroom administrative tasks, such as:

- Attendance tracking through facial recognition
- Timetable and exam scheduling
- Generating academic reports and progress summaries
- Curriculum planning via AI-enhanced Learning Management Systems (LMS)

Tambat (2024) documented how several private schools in metropolitan areas of India successfully integrated AI into their administrative systems, leading to increased operational efficiency and reduced clerical burden on teachers. One notable finding was the enhancement of resource allocation and classroom management, indirectly contributing to improved instructional quality.

Despite the benefits, this theme was the least explored in terms of empirical research on student outcomes, indicating a gap in measuring indirect impacts of administrative automation on learning effectiveness.

D. Learning Analytics and Predictive Modelling

15 studies explored AI's potential in mining educational data to forecast student performance, detect disengagement, and recommend interventions.

Hu (2024) and Kayyali (2024) reported how Indian universities used predictive models to identify students at risk of academic failure or dropout. These models, powered by AI algorithms, analyzed behavioral data from LMS logs, attendance records, and assessment scores.

Some institutions employed clustering algorithms to categorize students into performance groups and deliver differentiated interventions. This data-driven approach led to better academic support and retention rates.

However, the accuracy of predictive models depended heavily on the quality and volume of training data. Several authors raised concerns about the generalizability of findings, especially in institutions with fragmented data systems.

E. Ethical Issues, Data Privacy, and Algorithmic Bias

12 studies raised critical concerns regarding the ethical implications of AI in education. The key

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issues included:

- Student data privacy
- Transparency of AI algorithms
- Algorithmic bias affecting grading and feedback
- Consent and data ownership

Zhai et al. (2021) and Saúde et al. (2024) emphasized that most AI tools used in Indian classrooms lacked ethical audit trails and informed consent mechanisms. A common critique was the absence of localized guidelines for ethical AI use in schools and universities.

Biases in AI systems, especially those trained on non-representative datasets, were reported to disproportionately disadvantage students from marginalized linguistic and socio-economic backgrounds. A minority of studies (e.g., Agarwal & Vij, 2024) called for integrating digital ethics and data literacy into teacher education programs.

F. AI for Inclusive Education and Accessibility

9 studies demonstrated the role of AI in promoting educational inclusion, particularly for:

- Students with disabilities
- Learners from rural or tribal areas
- Linguistic minorities

Singh & Jindal (2024) explored how AI tools, including voice-to-text, real-time translation, and screen readers, enabled differently-abled students to access mainstream educational content. Other studies showcased the use of AI-based multilingual platforms that translated complex learning materials into regional Indian languages, thus improving accessibility and comprehension.

These innovations supported NEP 2020's vision of equitable access to education. However, issues such as affordability, device availability, and teacher preparedness to use assistive AI technologies remained barriers to scaling inclusive AI interventions.

G. General Reviews, Meta-Analyses, and Policy Perspectives

12 studies offered macro-level perspectives on AI in Indian education through bibliometric reviews, conceptual models, and policy critiques. For instance, Potluri & Kilaru (2024) analyzed the alignment of institutional AI adoption with NEP 2020 objectives, finding significant gaps in teacher training and infrastructure readiness.

Other papers (e.g., Bansal, 2023) called for a national roadmap to standardize AI integration across school and higher education sectors, emphasizing scalability, contextualization, and public-private partnerships.

Some studies highlighted the imbalance in research, noting that most empirical work is concentrated in urban, private institutions, with limited representation from rural and government schools.

Table 2

Summary of Thematic Findings

Theme	No. of Studies	Key Contributions
Personalized Learning and ITS	28	Real-time adaptation, increased engagement and performance
AI-Assisted Assessment and Feedback	16	Improved grading accuracy, timely feedback, reduced teacher load
Administrative Automation	8	Streamlined reporting, scheduling, and attendance systems
Learning Analytics and Predictive Modelling	15	Early risk detection, data-informed interventions
Ethical Issues and Data Privacy	12	Privacy risks, algorithmic bias, lack of ethical guidelines
Inclusive Education and Accessibility	9	Support for disabilities, multilingual tools, rural reach
General Reviews and Policy Perspectives	12	National trends, NEP 2020 alignment, research and policy gaps

V. DISCUSSION

This systematic review analyzed 100 peer-reviewed studies to explore the integration of Artificial Intelligence (AI) in Indian education and its influence on student outcomes. The results highlight that AI is rapidly gaining traction in Indian classrooms, educational institutions, and policy frameworks. The reviewed literature reflects a multifaceted use of AI—ranging from personalized learning and assessment to administrative automation and predictive analytics. While the benefits of AI are evident across many domains, the review also reveals critical systemic, ethical, and contextual challenges that warrant further attention.

A. AI as a Catalyst for Pedagogical Innovation

One of the most significant trends observed is AI's potential to enhance pedagogical practices

through personalized instruction, real-time feedback, and learner autonomy. Intelligent Tutoring Systems (ITS) and adaptive learning platforms are being used to provide tailored instruction to students with varying learning needs and proficiencies (Sharma, 2023; Enayathulla & Kumari, 2024). These innovations, when effectively implemented, contribute to improved academic performance and student satisfaction.

However, the implementation of such systems is largely confined to urban, private, and technologically advanced institutions. This reflects a growing digital divide within the Indian education system—where rural schools and government institutions are yet to fully capitalize on AI-enabled instruction due to lack of infrastructure, internet connectivity, and digital skills.

B. Transforming Assessment and Learning Analytics

AI has also proven effective in transforming traditional assessment practices. Automated scoring tools and feedback dashboards provide instant, personalized feedback, allowing students to self-correct and track their progress (Yadav & Anubha, 2024). Additionally, AI-powered learning analytics can help educators predict student outcomes and identify learners at risk of academic failure (Hu, 2024; Sasikala & Ravichandran, 2024).

Despite these advantages, concerns remain regarding the transparency and fairness of AI-based assessments. Without proper regulatory mechanisms and algorithmic audits, there is a risk of reinforcing educational inequities through biased data models or opaque grading systems.

C. Ethical Concerns and Teacher Readiness

Many studies emphasized the lack of ethical standards, data privacy policies, and teacher preparedness in the Indian context (Saúde et al., 2024; Agarwal & Vij, 2024). The widespread use of AI tools without adequate knowledge of their functioning poses serious ethical dilemmas. Issues of informed consent, data ownership, and algorithmic accountability are either overlooked or underregulated.

Moreover, teachers—the primary agents of educational change—are often insufficiently trained to use AI tools effectively. While NEP 2020 calls for teacher professional development in digital skills, most studies suggest that current training programs lack depth, consistency, and focus on pedagogically grounded AI use.

D. Gaps in Representation and Research Equity

Another critical insight is that most empirical research is concentrated in higher education or urban elite schools, with minimal representation from rural, tribal, and government-run institutions. This leads to an underrepresentation of marginalized voices and an overestimation

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of AI's success in Indian education. Context-specific models that incorporate regional, linguistic, and socioeconomic diversity are essential to ensure that AI does not exacerbate educational inequalities.

VI. Recommendations for Future Research

To build a more inclusive, ethical, and effective AI ecosystem in Indian education, future research should address the following key areas:

A. Longitudinal and Outcome-Based Studies

There is a pressing need for long-term studies that assess the sustained impact of AI tools on student outcomes such as academic achievement, engagement, critical thinking, and digital citizenship. Short-term evaluations often miss the depth and complexity of AI's influence.

B. Teacher-Centric Research

Future research must explore teacher perceptions, usage patterns, and training needs related to AI. Studies should assess how AI tools can be co-designed with educators and aligned with local curriculum standards.

C. Ethical Frameworks and Policy Evaluation

Empirical research is needed to evaluate the ethical implications of AI use, including algorithmic bias, data security, and consent mechanisms. Comparative policy analyses can also help assess how India's AI education policy aligns with global standards such as those proposed by UNESCO and OECD.

D. Inclusion and Accessibility

Further investigation is needed into how AI can support diverse learners, including those with disabilities, linguistic barriers, or limited digital access. Special attention must be paid to low-resource settings to ensure AI solutions are both affordable and scalable.

E. Localized AI Solutions

Many AI tools are developed using Western datasets or models that may not fit the Indian socio-cultural context. There is a need for locally developed AI models trained on Indian languages, learning styles, and educational structures.

VII. Conclusion

The integration of Artificial Intelligence into Indian education represents a paradigm shift in teaching, learning, and assessment. The 100 studies reviewed in this paper reveal that AI has the potential to foster personalized learning, automate assessment, improve inclusivity, and

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assist in educational decision-making. However, this potential is tempered by challenges related to infrastructure, ethics, teacher preparedness, and digital equity. To ensure that AI contributes meaningfully to India's educational transformation, especially in line with the goals of NEP 2020 and SDG4, its deployment must be context-sensitive, ethically grounded, and inclusive. Policymakers, educators, technologists, and researchers must collaboratively create frameworks that balance innovation with accountability. In sum, AI is not a silver bullet but a powerful enabler—its impact on student outcomes will depend on how thoughtfully it is integrated into the Indian educational fabric.

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