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## Reimagining and Transforming Teaching and Learning in Education 5.0: AI Integration and Transformative Classrooms

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### ABSTRACT

This paper critically explores the imperative to reimagine and transform teaching and learning in the era of Education 5.0, where human-centric, technology-enabled, and values-driven approaches must converge to prepare learners for an increasingly demanding world. Moving beyond conventional models, the study highlights the shift toward learner-centered, AI-integrated, and transformative pedagogical practices that position teachers as designers of meaningful, dynamic learning experiences and classrooms as adaptive, participatory ecosystems. Through a focused examination of artificial intelligence in education, the paper illustrates how technologies such as adaptive learning platforms, intelligent tutoring systems, learning analytics, and generative AI tools like ChatGPT are reshaping the educational process. Transformative classrooms, as envisioned here, go beyond digital infrastructure. They are ecosystems that foster agency, collaboration, inquiry, creativity, and emotional well-being. The paper also addresses critical challenges and presents strategic responses rooted in Indian educational priorities, including public digital infrastructure and open-source AI solutions. Grounded in contemporary educational discourse, this paper argues that AI-integrated, transformative pedagogy is no longer an option but a necessity. To truly realize the promise of Education 5.0, education

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systems must invest in inclusive digital ecosystems, culturally responsive pedagogies, and context-aware innovation—ensuring that classrooms become equitable, empowering, and future-ready learning spaces.

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### **Introduction:**

Education has never remained fixed; it has continually evolved to reflect the prevailing needs, values, and technological advancements of its time. Across centuries, we have witnessed a progression through distinct educational phases, each marking a transformation in its core goals and methods of delivery. Education 1.0, emerging in the pre-industrial age, was primarily characterized by oral instruction and rote learning, with knowledge restricted to elite and religious institutions that served a select few. The advent of the Industrial Revolution introduced Education 2.0, defined by standardized curricula, mass schooling, and a model of instruction that mirrored the hierarchical and efficient structure of factory systems (Serdyukov, 2017).

By the late 20th century, educational reform driven by constructivist approaches gave rise to Education 3.0. This phase emphasized student agency, collaborative learning, and a shift toward individualized educational experiences. It marked a growing understanding of learning as an active and social process (Redecker et al., 2011). The more recent Education 4.0 responded to the digital revolution, embedding technologies such as e-learning platforms, big data, and learning analytics into educational environments. Yet, despite its innovative tools, Education 4.0 often fell short of challenging the foundational structures and assumptions of traditional schooling systems (Miranda et al., 2021). alongside the earlier sections on Education 1.0 to 5.0:

Education 4.0 brought a much-needed transformation by integrating advanced digital technologies such as IoT, automation, and data analytics into the learning process. It made education more flexible, personalized, and connected, preparing learners for a technology-driven world. However, despite these advancements, Education 4.0 often remained focused on upgrading existing systems and skill sets, without fully embracing the broader development of human qualities like creativity, empathy, and ethical judgment. Education 5.0 addresses this gap by going beyond technology integration to create a more holistic learning environment. It envisions classrooms where artificial intelligence works hand in hand with human values to nurture critical thinking, emotional intelligence, and collaborative problem-solving. While Education 4.0 excels at enhancing technical competencies, Education 5.0 strives to balance these



with deeper personal growth and social responsibility, aiming to prepare learners not just for jobs, but for life in an unpredictable and rapidly changing world. This shift invites educators to rethink their roles and design transformative classrooms that harmonize cutting-edge technology with the essential human touch.

Currently, we are entering the era of Education 5.0, a transformative paradigm that goes beyond technological adoption to reimagine the fundamental purpose of education itself. At its core, this model is human-centered, seeking to balance technological progress with ethical responsibility, social consciousness, and holistic growth (UNESCO, 2021). Education 5.0 shifts the focus away from simply preparing learners for employment and instead aims to equip them for meaningful, purpose-driven lives in a complex and interconnected global society.

Central to this new vision is a dual imperative: to reimagine and to transform. Reimagining involves critically interrogating long-standing assumptions about what we teach, how we teach, and why we teach. It envisions education as personalized, interdisciplinary, and deeply attuned to societal challenges. Transformation, on the other hand, demands systemic change—aligning educational practices with this new vision through pedagogical innovation, progressive policy, and the meaningful integration of emerging technologies (Fullan & Langworthy, 2014).

This paper focuses on two key drivers of this transformation: the integration of artificial intelligence and the evolution of transformative classroom practices. When implemented ethically, AI can personalize learning, offer real-time feedback, and provide support in ways previously unimaginable (Holmes et al., 2019). Rather than replacing educators, AI serves to enhance their ability to focus on the relational, creative, and critical aspects of teaching. In parallel, transformative classroom practices advocate for active learning, inquiry-based approaches, collaboration, and student agency. These methods aim to nurture not just knowledge acquisition, but the development of skills and mindsets essential for navigating an unpredictable future (Mehta & Fine, 2019).

The primary objective of this paper is to explore how AI integration and transformative pedagogy together can fulfill the promise of Education 5.0. It asserts that the current moment calls not for small-scale reforms, but for imaginative, bold, and values-driven change. The future of education is not a distant vision—it is an urgent and present responsibility.



## 2. Reimagining Teaching and Learning in Education 5.0

Education 5.0 goes beyond the introduction of new technologies—it represents a fundamental shift in how we understand the purpose and process of teaching and learning. Departing from the rigid models of the past, it adopts a human-centered, holistic, and values-oriented perspective, equipping learners for a world that is interconnected, uncertain, and ethically complex. This vision challenges teachers, institutions, and learners to rethink long-established goals, methods, and relationships in education.

### Challenging Conventional Pedagogies

For many years, mainstream education has relied heavily on a teacher-centered model that emphasizes content delivery, memorization, and standardized testing. While this approach served the needs of the industrial and information ages, it falls short in addressing the complexities of our current social and technological realities (Fisk, 2017). Education 5.0 disrupts this outdated model by shifting the focus toward meaning-making, relevance, and adaptability.

Progressive pedagogies like experiential learning, project-based learning, flipped classrooms, and inquiry-based instruction are steadily gaining traction. These methods offer students more personalized, engaging, and flexible learning experiences (Fullan & Langworthy, 2014). Instead of simply transmitting information, teachers now aim to build vibrant learning environments that encourage collaboration, critical thinking, and innovation. However, the actual implementation of these pedagogies remains uneven, revealing a gap between policy ambitions and day-to-day educational practice.

### Toward Learner-Centered Models: A Gradual Shift

A key aspiration of Education 5.0 is the move from teacher-directed instruction to a model that prioritizes learner engagement. Although this concept has been part of education reform discussions for some time, its real-world application remains limited. In many classrooms, the conventional model—where teachers hold authority and students passively absorb knowledge—continues to dominate (UNESCO, 2021).

The Education 5.0 movement is helping to push this transformation forward by emphasizing learner agency. Students are encouraged to ask questions, follow their interests, and take an active role in constructing their own understanding. Educators, in turn, are increasingly adopting the role of facilitators and mentors, guiding learners rather than directing them (OECD, 2019).

Yet, this transition is far from complete. Structural challenges such as rigid assessment systems, inflexible curricula, and a lack of professional development opportunities often hinder meaningful



change. Still, emerging trends in personalized learning, student voice, and digital engagement suggest that the shift toward learner-centered education is gradually gaining momentum.

### **Emerging Expectations in a digital Society**

In a world deeply shaped by digital technologies, both learners and educators face evolving expectations. The digital divide is no longer defined by access alone—it now involves how individuals interact with, contribute to, and ethically navigate digital spaces.

Today's educators are expected to go beyond delivering content. They must be digitally competent, capable of using technology to tailor instruction, and attuned to the emotional and ethical dimensions of learning (Redecker, 2017). At the same time, they are called upon to model global citizenship, cultural sensitivity, and ethical reasoning—qualities that are essential in an interconnected world.

Students, likewise, are expected to be more autonomous, adaptable, and critically engaged. Education 5.0 envisions them not as passive recipients but as creators, innovators, and responsible citizens. They must learn to handle uncertainty, collaborate across cultures, and align their personal development with broader social and ethical responsibilities (Anderson & Rainie, 2018). This shift redefines what it means to be educated—placing emphasis on purpose, ethics, and empathy over simple academic achievement.

So, to reimagine teaching and learning through the lens of Education 5.0 is to embrace a deeper transformation—one that involves more than updated tools or revised syllabi. It requires a redefinition of roles: learners as active participants, teachers as facilitators of inquiry, and classrooms as adaptive, living environments. While traditional models continue to hold sway in many areas, the movement toward learner-centered education is unmistakable. Education 5.0 challenges us to see education not just as a system of content delivery, but as a dynamic, value-based ecosystem that nurtures both individual potential and collective responsibility.

### **3. Transforming Pedagogical Practice through AI Integration**

Within **Education 5.0**, AI is not just a technological add-on—it is fundamentally reshaping pedagogy by delivering personalized, adaptive, and data-informed instruction that aligns with holistic, future-ready learning for instance two examples of this have been stated below:

#### **AI for Adaptive Learning and Intelligent Tutoring**



Intelligent Tutoring Systems (ITS) and adaptive learning platforms consistently demonstrate **strong, measurable learning gains**. Meta-analyses show that ITS interventions outperform traditional teaching methods in nearly all evaluations, with effect sizes around 0.66—placing many students from the 50th to the 75th percentile in performance [en.wikipedia.org](https://en.wikipedia.org). A systematic review of over 60 peer-reviewed studies confirms AI tools' effectiveness in enhancing cognitive and affective outcomes in higher education settings [link.springer.com](https://link.springer.com).

### **AIoT Integration in School Curriculum — A Collaborative Pilot by NITI Aayog, CBSE, and Intel India**

In September 2022, NITI Aayog, in collaboration with the Central Board of Secondary Education (CBSE) and Intel India, launched a pilot program to integrate Artificial Intelligence and Internet of Things (AIoT) concepts into the school curriculum. This initiative aligns with the National Education Policy (NEP) 2020's emphasis on fostering technological integration in education. The pilot aimed to bridge the future skills gap and optimize existing infrastructure, such as Atal Tinkering Labs (ATLs), to make India AI-ready. The program included the development of AIoT-based lesson plans by teachers, demonstrations of AI-enabled social impact projects by students, and the release of a compendium featuring 70 exemplar lesson plans to guide educators in building digital readiness in the country (Press Information Bureau, 2023).

Not only this AI has been now at this point of time consistently been used in the below educational processes like:

#### **AI-Enhanced Formative Assessment**

AI-enabled formative assessment systems automate feedback delivery, reduce teacher workload, and support student self-regulation. Research highlights AI's ability to produce **high-quality, personalized feedback** at scale, leading to improved writing and comprehension skills in diverse contexts [frontiersin.org/language-testing-in-asia.springeropen.com](https://frontiersin.org/language-testing-in-asia.springeropen.com). These technologies also promote **longitudinal learner modelling** enabling teachers to identify gaps and trajectory trends across time [arxiv.org+15frontiersin.org+15mdpi.com+15](https://arxiv.org+15frontiersin.org+15mdpi.com+15).

#### **Teachers as Designers, Guides, Mentors and Facilitators with**

AI does **not replace** educators; rather, it reshapes their role. Teachers must critically evaluate AI tools, interpret analytics, and guide students in **ethical use** of technology. Recent systematic reviews emphasize



the need for teacher readiness in digital pedagogy and AI literacy as central to effective AI integration in classrooms [arxiv.org](https://arxiv.org)+[7sciencedirect.com](https://www.sciencedirect.com)+[7timesofindia.indiatimes.com](https://www.timesofindia.indiatimes.com)+7.

### **Institutional Support and Policy Alignment**

According to UNESCO (2023), AI can significantly improve student outcomes—but only when integrated within thoughtfully designed curricula and guided by skilled educators [languagetestingasia.springeropen.com](https://www.languagetestingasia.springeropen.com)+[4frontiersin.org](https://www.frontiersin.org)+[4onlinelibrary.wiley.com](https://onlinelibrary.wiley.com)+4. Strong institutional frameworks and professional development are essential to ensure AI complements human instruction, rather than replacing it.

### **'AI for All' Program by the Ministry of Education — Promoting AI Awareness**

The Ministry of Education's 'AI for All' program, launched in August 2021, is a self-learning online platform designed to raise public awareness about Artificial Intelligence. The program aims to demystify AI for individuals from all walks of life, including students, professionals, and senior citizens, thereby fostering a 'Digital First Mindset.' The initiative has witnessed widespread participation, contributing to increased public understanding of AI's applications and implications (India.gov.in, 2021).

## **4. Toward Transformative Classrooms: Characteristics and Innovations**

Within **Education 5.0**, classrooms transform into learner-centered spaces characterized by flexibility, collaboration, and personalized inquiry. These **transformative classrooms** are not simply enhanced with tools—they are restructured ecosystems where pedagogy and technology converge to empower learner agency and meaningful engagement.

### **Defining Features**

- **Adaptivity and Interactivity:** Classrooms employ AI-driven adaptive platforms that tailor learning trajectories based on individual student responses and pace. These adaptive systems systematically demonstrate improved student outcomes, with numerous studies reporting significant learning gains ([turn0search25]) [Wikipedia](#).
- **Collaborative, Inquiry-Based Learning:** Educational tasks blur disciplinary boundaries, centre on real-world issues, and centre student-led projects—hallmarks of Authentic Learning theory and the aims of Education 5.0 [Wikipedia](#).



- **Learner Agency and Knowledge Co-Creation:** As students assume active roles, classrooms shift toward co-constructed learning experiences that elevate autonomy and engagement.
- **Technological Amplification:** AI tools such as chatbots, automated peer-assessment systems, and analytics platforms enhance—not replace—pedagogy by facilitating timely feedback and real-time insights.

### AI-Supported Personalization and Assessment

- **Tailored Instruction:** Systematic reviews of K–12 AI intervention studies indicate significant gains in learner performance and engagement, particularly using chatbots and adaptive features when integrated with pedagogy-oriented teaching systems [Scientific Publishing Institute](#).
- **Formative Feedback at Scale:** AI-driven formative assessment platforms provide high-quality, actionable feedback, reduce teacher workload, and support student self-regulation—especially in writing-intensive contexts [educationaltechnologyjournal.springeropen.com+15mdpi.com+15languagetestingasia.springeropen.com+15](#).

### Equity and Ethical Integration

- **Inclusivity through Design:** Scoping reviews highlight how AI systems, when intentionally designed, foster inclusive learning ecosystems that respond to diverse learner needs while protecting against bias [mdpi.com](#).
- **Teacher Preparedness and Critical Agency:** Teachers' AI literacy is central. Studies show that educator confidence and competence with AI tools correlate strongly with successful pedagogical transformation and ethical integration in the classroom [mdpi.com+4link.springer.com+4mdpi.com+4](#).

Below are two examples cited proving that Transformative classrooms have already been in use with the aid of AI in our country.

### NCERT's Digital Learning Initiative and Curriculum Transformation

The National Council of Educational Research and Training (NCERT), headquartered in New Delhi, has actively worked on transforming Indian classrooms through digital integration and curriculum reforms. According to the *Annual Report 2022–2023*, NCERT developed interactive digital modules particularly



in subjects like mathematics and science, which incorporated multimedia content, quizzes, and self-assessment tools aimed at fostering critical thinking and active learning among students. These modules were piloted and implemented in select schools across several states, including Uttar Pradesh and Rajasthan, promoting student-centered learning environments. Additionally, NCERT emphasized extensive teacher capacity building through virtual training programs to ensure educators are skilled in leveraging these digital tools effectively, thus facilitating a shift from rote learning to a more analytical and participative classroom culture (National Council of Educational Research and Training, 2023).

### **Pratham's Blended Learning Model in Rural and Urban India**

Pratham Education Foundation, one of India's largest NGOs based in Mumbai with projects spanning across 20+ states, has been pivotal in implementing transformative classroom strategies, especially in rural and underserved urban communities. The *Annual Report 2022–2023* highlights Pratham's post-pandemic blended learning approach, which combined online digital content with community-based offline support to reach children in remote villages of states like Bihar, Madhya Pradesh, and Maharashtra. This model not only enhanced student engagement but also resulted in measurable improvements in literacy and numeracy skills. The initiative integrated local language content, contextual examples, and periodic assessments to ensure inclusivity and relevance. This approach addressed barriers such as lack of internet access and digital literacy, making it a practical and scalable transformative classroom strategy in India's diverse education landscape (Pratham Education Foundation, 2024).

## **5. Challenges and Strategic Possibilities in AI-Integrated Transformative Classrooms**

The integration of Artificial Intelligence (AI) into transformative classroom practices presents a dual reality: immense promise on one hand and significant challenges on the other. In the context of Education 5.0, where the emphasis lies on personalization, collaboration, and ethical engagement, Indian classrooms must navigate structural, pedagogical, and socio-cultural hurdles to fully realize AI's potential.

A key challenge remains the **digital and infrastructural divide**, especially between urban and rural areas. Despite the National Education Policy (NEP) 2020 advocating for equitable technology access, disparities persist in connectivity, device availability, and digital literacy among both students and educators. Moreover, **teacher preparedness** for AI integration remains limited. Many educators lack exposure to the pedagogical affordances of AI tools, necessitating ongoing capacity-building programs rooted in Indian teaching realities.



Another significant concern is the **ethical deployment of AI** in schools. Issues such as student data privacy, algorithmic bias, and surveillance risks must be addressed through regulatory frameworks that are sensitive to the Indian socio-cultural context. Furthermore, the **overdependence on algorithmic recommendations** could compromise human agency in pedagogical decisions, thereby diluting the teacher's role as a facilitator of critical thinking and contextual understanding.

Despite these challenges, strategic possibilities are emerging. The **National Digital Education Architecture (NDEAR)**, envisioned by the Ministry of Education, provides a federated, open, and interoperable framework that can support scalable AI integration across diverse educational contexts. Additionally, the **National Initiative for School Heads' and Teachers' Holistic Advancement (NISHTHA)** includes modules on emerging technologies and can be leveraged for continuous professional development on AI-enhanced pedagogies.

Another promising model is the **DIKSHA platform**, which offers personalized learning experiences using data-driven insights and can serve as a foundation for AI-powered content delivery and learner tracking. Further, **AI-for-All**, an initiative by the CBSE in collaboration with Intel, is helping democratize AI awareness and literacy at the school level, laying the groundwork for broader AI integration.

To address pedagogical transformation, it is important to draw on indigenous curricular approaches rather than importing foreign models. The **Four-Quadrant Model of e-Content Development** by UGC and **Experiential Learning frameworks** promoted by NCERT can be adapted to AI-integrated settings, offering learner-centric and contextually relevant pathways for teaching and learning.

In advancing AI-integrated transformative classrooms, a multi-stakeholder approach is essential. Strategic partnerships among government bodies, teacher training institutions, AI developers, and community stakeholders can foster sustainable ecosystems for innovation. Moreover, placing **teachers at the heart of this transformation**—as co-creators of content, interpreters of data, and ethical agents—will ensure that AI serves humanistic and inclusive educational goals, true to the spirit of Education 5.0.

### **Challenges and Positive Pathways in AI-Integrated Transformative Classrooms**

Integrating AI into classrooms and creating truly transformative learning environments is no small feat. It's a journey filled with real obstacles that teachers, students, and schools face every day. Limited infrastructure, like unreliable internet and outdated devices, can make AI tools hard to access, especially in rural or under-resourced areas. Many educators also feel overwhelmed by the rapid pace of



technological change, lacking the training and confidence needed to seamlessly blend AI into their teaching practices. Beyond technology, there are deeper concerns about maintaining the human touch — ensuring that technology supports rather than replaces the personal connection so vital for effective learning. These challenges are real, but they are also invitations to grow, adapt, and innovate.

What makes this journey inspiring is how these hurdles open doors to fresh possibilities. Schools and communities are finding creative ways to overcome infrastructure gaps — from shared resource centers to mobile learning labs — making AI and digital tools more reachable. Teacher training is becoming more hands-on and ongoing, emphasizing peer support and practical application rather than just theory. Most importantly, the focus remains on human-centered education, where AI acts as a powerful assistant helping teachers personalize learning, track progress, and free up time for meaningful student interactions. With every challenge, there's a lesson in resilience and a chance to rethink how education can be more inclusive, engaging, and future-ready. The path forward isn't just about technology

## 6. Conclusion

This paper has examined the evolving imperatives of reimagining and transforming teaching and learning within the framework of **Education 5.0**, with a central focus on **AI integration and the development of transformative classrooms**. At the heart of this shift lies a deeper philosophical and pedagogical transition—one that moves beyond rigid content delivery to nurture learner agency, ethical awareness, and contextual adaptability.

As explored throughout the preceding sections, **reimagining the teaching and learning process** entails a departure from traditional, teacher-centered models toward **participatory and co-creative educational experiences**. AI, when used thoughtfully and responsibly, becomes a transformative enabler—facilitating personalized learning, real-time feedback, and differentiated instruction. However, its integration must be guided by intentional teacher agency and contextual ethics, ensuring that it enhances rather than replaces human pedagogical judgment.

**Transformative classrooms**, within the Indian context, are envisioned as dynamic, inclusive, and interactive environments. They must go beyond the use of digital tools to cultivate spaces that promote critical thinking, collaboration, and learner autonomy. Frameworks such as the **National Digital Education Architecture (NDEAR)**, platforms like **DIKSHA**, capacity-building initiatives under **NISHTHA**, and AI literacy programs like **AI for All** collectively provide the structural support to facilitate this transformation at scale.



Despite these possibilities, the path forward is not without challenges. The **digital divide**, disparities in **infrastructure and access**, and **insufficient teacher preparedness** remain pressing concerns. Ethical issues around **data privacy, surveillance, and algorithmic bias** must also be addressed proactively. Importantly, the temptation to adopt foreign pedagogical frameworks must be resisted in favor of **indigenous, culturally grounded models**, such as the **UGC's Four-Quadrant Model for e-Content Development** and **NCERT's Experiential Learning Framework**—both of which align more authentically with the socio-educational realities of India.

In essence, this shift is **not technological alone—it is fundamentally pedagogical and systemic**. Without addressing infrastructural gaps, ethical concerns, and teacher capacity, even the most advanced AI systems will fail to bring about deep, equitable transformation.

To realize the full promise of **Education 5.0**, it is essential that we invest meaningfully in **digital equity**, foster **teacher empowerment**, and pursue **contextually relevant innovations**. AI must be positioned not as a technological fix, but as a tool to support **inclusive, humanistic, and future-ready learning environments**. When designed with care and rooted in Indian educational priorities, **transformative classrooms can emerge as fertile ground** for the kind of education that not only imparts knowledge but also **inspires imagination, ethical reasoning, and lifelong learning**.

We're at a really important moment in education—where AI and transformative classrooms can truly change the way students learn and grow. But for this to happen, policymakers and education leaders need to look beyond just the technology itself. It's about investing in teachers, giving them the support and training they need to feel confident using these new tools. It's about making sure every child, no matter where they live, has fair access to digital resources so that no one is left behind. What's also needed is a real partnership—between governments, tech experts, and those working on the ground in classrooms—to create solutions that fit the unique needs of different communities. The future of learning depends on choices we make today—choices that put people first, balance innovation with care, and prepare students not just to keep up, but to lead in a fast-changing world. Now is the time for all of us to come together, be bold, and reimagine education as something truly exciting and inclusive for everyone.

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