Preserving Pedagogical Constants while Integrating AI in Architecture Education: An NEP 2020 Perspective

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***Abstract*— The growing presence of Artificial Intelligence (AI) in higher education is transforming teaching–learning practices across disciplines, including architecture. In India, the National Education Policy (NEP) 2020 outlines a vision for a learner-centred, multidisciplinary, and technology-enriched education system that nurtures creativity, critical thinking, and experiential learning (Ministry of Education, 2020). Architectural pedagogy, however, has traditionally been anchored in "pedagogical constants" such as studio-based learning, structured critiques, site visits, and interdisciplinary collaboration [1].These strategies, developed over decades, are vital for cultivating professional design competence and contextual understanding.**

This study adopts a qualitative approach to examine how AI can be meaningfully incorporated into architectural education without eroding these long-standing pedagogical foundations. Drawing from literature review, expert interviews, and thematic analysis, the research identifies opportunities for AI to support ideation, simulation, and feedback processes while maintaining the reflective, collaborative, and experiential nature of architectural learning. The resulting NEP–AI Aligned Pedagogical Framework proposes a hybrid model that preserves the role of human mentorship while leveraging AI for curriculum innovation, in line with NEP 2020's objectives.

***Index Terms*—AI in architectural education, constructivism, curriculum innovation, interdisciplinary collaboration, NEP 2020, pedagogical framework, studio-based learning,**

I. INTRODUCTION-

a. Background

Artificial Intelligence (AI) is rapidly reshaping the landscape of education worldwide, enabling more personalised learning, automated assessments, and sophisticated data-driven feedback systems [2].In creative disciplines such as architecture, AI applications—ranging from generative design platforms like Midjourney to parametric modelling and intelligent simulation—are beginning to play a role in both design practice and pedagogy[3] .

In the Indian context, the National Education Policy (NEP) 2020 provides a framework for transforming higher education into a technology-enabled, learner-driven, and multidisciplinary ecosystem [4]. It calls for fostering critical thinking, creativity, and problem-solving through experiential and project-based learning, all of which resonate strongly with architecture's educational traditions.

b. Importance of Pedagogy in Architecture Education

Architecture education differs from many other academic fields because it is grounded in constructivist learning approaches, where students develop knowledge through active engagement, reflective practice, and collaboration [1]. The discipline's core methods—studio-based learning, peer and faculty critiques, site visits, and interdisciplinary teamwork—form the backbone of professional preparation[5].These pedagogical constants cultivate not only technical proficiency but also spatial reasoning, contextual sensitivity, and creative problem-solving, which are central to an architect's role.

c. NEP 2020 Goals and the Role of AI

NEP 2020 places a strong emphasis on integrating technology into pedagogy while safeguarding the human and experiential dimensions of learning. For architecture, this presents an opportunity to harness AI as an augmentative tool—one that enhances ideation, visualization, and analysis without undermining the

reflective and iterative nature of studio work. Aligning AI with NEP 2020 requires strategies that allow technology to complement, rather than replace, the collaborative and mentorship-based culture of architectural education.

d. Problem Statement

While AI tools have the potential to enhance design education, they also shift the variables within traditional pedagogical processes. At the same time, certain constants—such as the design studio culture, critique sessions, site-based learning, and cross-disciplinary engagement—remain essential for cultivating a competent architect. Without careful integration, AI adoption could dilute these experiences, creating a misalignment with NEP 2020's holistic vision for education.

f. Research Objectives

1. To identify the pedagogical constants in architecture education that should be maintained during AI integration.
2. To explore how AI can support, rather than replace, these constants.
3. To propose an NEP 2020–aligned framework for integrating AI into architectural pedagogy.

g. Research Questions

1. What are the constant pedagogical strategies in architecture education?
2. How can AI be integrated without disrupting these constants?
3. How can such integration align with the vision of NEP 2020?

II.LIMITATIONS

The qualitative scope means findings are context-specific to Indian architectural education and cannot be generalised statistically. However, they provide deep, context-rich insights for future framework development and policy alignment under NEP 2020.

III. LITERATURE REVIEW

a. Framework of Architecture education

Constructivism

Constructivism is a learning theory that posits that knowledge is actively constructed by learners through engagement with tasks, collaboration, and reflection, rather than passively received from an instructor [6]. In architectural education, constructivism manifests in studio-based learning environments where students iteratively develop design solutions, receive critique, and refine their work. These environments encourage problem-solving, critical thinking, and creativity—skills that are also emphasized in NEP 2020. When integrating AI tools into such settings, constructivism serves as a guiding principle to ensure technology acts as a facilitator for exploration, simulation, and ideation rather than a replacement for human-led dialogue and reflective learning.

Experiential Learning (Kolb)

Kolb's Experiential Learning Theory (1984) outlines a cyclical process of learning through concrete experience, reflective observation, abstract conceptualization, and active experimentation. Architecture pedagogy naturally aligns with this cycle: students engage in design-build projects (concrete experience), reflect on their outcomes during critiques (reflective observation), refine their design thinking through conceptual studies (abstract conceptualization), and test ideas through models or prototypes (active experimentation). AI tools can enhance this cycle by enabling rapid prototyping, generative design explorations, and immersive simulations—thereby expanding the scope and immediacy of experiential learning while maintaining its core iterative nature.

TPACK Model (Technological Pedagogical Content Knowledge)

The TPACK framework [7] provides a structured lens for integrating technology into education by balancing three domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). In architectural education, CK relates to design theory, building technology, and spatial analysis; PK includes methods such as studio critiques and collaborative projects; and TK encompasses AI-driven tools like generative design algorithms, virtual reality, or parametric modeling software. A TPACK-informed approach ensures that AI integration supports the learning objectives of architecture without overshadowing the pedagogical strategies or content

depth, aligning directly with NEP 2020's emphasis on meaningful technology integration.

Critical Pedagogy

Critical pedagogy, as articulated by Freire (1970), advocates for an education that is participatory, reflective, and transformative—aimed at empowering learners to challenge assumptions and address societal needs. In architecture, this involves designing with social, cultural, and environmental awareness. AI tools can either strengthen or weaken this objective depending on how they are employed. By applying critical pedagogy, educators can ensure AI adoption in architectural training remains aligned with ethical, contextual, and inclusive design practices. For example, AI can be leveraged to simulate sustainable urban scenarios or assess environmental impacts, thereby enhancing students' capacity for socially responsive design thinking.

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IV. ARCHITECTURE EDUCATION PEDAGOGICAL CONSTANTS

a.Studio-Based Learning in Architecture Education

Studio-based learning is widely regarded as the central pedagogical approach in architecture education. Rooted in the Bauhaus model of "learning by doing," it fosters iterative design development, critical reflection, and skill integration through a hands-on, project-based environment [1] The design studio functions both as a physical space and as a cultural framework where students engage in collaborative problem-solving and experiential design exploration [5] [9] argue that studios facilitate the synthesis of theoretical knowledge and practical application, enabling students to internalize design thinking as a habit of mind. In the Indian context, studio pedagogy has remained the cornerstone of architectural curricula, aligning with NEP 2020's emphasis on experiential, learner-centric education [4]

b.Peer and Faculty Critique in Architecture Education

Critique—both formal and informal—serves as a primary mode of formative assessment in architecture education. Peer reviews promote collaborative learning and broaden students' design perspectives, while faculty critiques provide expert guidance, challenging students to justify design decisions and refine conceptual clarity [9]. [1] describes this as a "reflective conversation" between student and tutor, wherein feedback is iterative and embedded in the design process. [5] emphasizes that critiques foster not only design quality but also resilience, professional communication, and the capacity to engage with multiple viewpoints. Within the NEP 2020 framework, critique culture directly supports critical thinking, problem-solving, and contextual responsiveness.

c.Site Visits and Experiential Learning

Site visits bridge the gap between theoretical instruction and real-world application, offering students direct engagement with built environments [10].They cultivate contextual sensitivity, environmental awareness, and an appreciation for socio-cultural factors influencing design. [11] note that field-based learning in architecture encourages observation, analysis, and critical documentation skills, which are difficult to replicate in classroom or digital simulations. In India, site visits are mandated by the Council of Architecture (COA) as part of the curriculum, aligning with NEP 2020's vision of experiential and place-based learning.

d. Interdisciplinary Collaboration in Architecture Education

Interdisciplinary collaboration is increasingly essential in architectural practice, as complex design challenges require inputs from structural engineers, urban planners, environmental scientists, and sociologists [12] In educational contexts, collaborative

projects across disciplines expose students to diverse perspectives, promoting holistic problem-solving and integrative design thinking [13] [1] emphasises that interdisciplinary studios not only enhance creativity but also prepare students for professional realities where architecture is part of a broader ecosystem of stakeholders. NEP 2020 underscores the importance of multidisciplinary engagement, positioning it as a key driver of innovation and sustainable design solutions.

e.AI Integration in Architectural Pedagogy

Emerging research highlights AI's potential to enhance, rather than replace, traditional architectural pedagogy. Tools such as generative design algorithms, AI-driven simulations, and natural language processing models can support ideation, automate routine tasks, and provide data-rich feedback [10] suggest that AI in education is most effective when used as a complementary tool that respects discipline-specific pedagogical principles. However, literature also warns of the risk of de-emphasising human-centred, reflective practices if AI integration is not carefully structured (Holmes et al., 2019). The gap lies in developing AI–pedagogy integration frameworks that safeguard the experiential, collaborative, and iterative learning methods central to architecture education.

V. METHODOLOGY

a. Research Design

This study employs a qualitative research design, deemed appropriate for examining the intricate relationship between emerging AI technologies and established pedagogical practices in architectural education. The research adopts an exploratory and interpretive stance, prioritizing the understanding of perceptions, lived experiences, and expert insights over hypothesis testing. Such an approach is particularly relevant for investigating how AI integration can align with the objectives of NEP 2020, while simultaneously safeguarding the traditional modes of learning that form the foundation of architectural pedagogy.

b. Data Collection Methods

Literature Review

A systematic literature review was conducted to identify core pedagogical strategies—studio-based learning, critique sessions, site visits, and interdisciplinary collaboration—and to assess existing discussions on AI integration in architectural pedagogy. Sources included peer-reviewed publications from Scopus, Springer, ScienceDirect, and Council of Architecture guidelines.

Questionnaire Survey

Participants were from S. B. Patil College of Architecture & Design, Pune, including which were architecture faculty , Questionnaire Survey conducted for in-depth exploration of the integration of AI capabilities and traditional pedagogical constants.

- Perceived strengths and risks of AI in architectural education
- Strategies for integrating AI without disrupting constructivist learning
- Alignment with NEP 2020 goals such as multidisciplinary learning and experiential education

Student Focus Groups

Students from 3rd & 4th Year undergraduate architecture students were selected for questionnaire survey focused on student experiences with AI tools (e.g., ChatGPT, Midjourney, parametric design software) and their perceived impact on design thinking, creativity, and learning depth.

VI.DATA ANALYSIS

The data collected through the Google Form survey provided valuable insights from architecture educators regarding the integration of AI into architectural pedagogy under the NEP 2020 framework. A total of 26 responses were analyzed, primarily from Assistant and Associate Professors with 0 to 10 years of teaching experience. The analysis focused on core pedagogical methods, perceptions of AI's role, usage of AI tools, and alignment with NEP 2020 goals.

A. Core Pedagogical Methods in Architectural Education

Respondents overwhelmingly identified studio-based learning as the central pedagogical method, followed by design-build projects, site visits and field documentation, and peer learning and critique sessions. These responses reinforce the established constructivist framework of architectural education, which emphasizes active engagement, reflective

practice, and collaborative learning as essential for developing design competence.

B. Pedagogical Strategies Remaining Constant Over Time

The strategies most commonly regarded as constant over time were hands-on model making, studio-based learning, and jury critique. This consensus reflects a strong belief that these foundational methods continue to play an irreplaceable role in shaping an architect's ability to reason through complex design problems, develop contextual awareness, and critically reflect on work in a collaborative environment.

C. AI Tools Usage in Teaching and Studio Environment

Among AI tools, ChatGPT, Revit AI / BIM 360, Midjourney / DALL·E, and Figma AI / Adobe Firefly were frequently cited as being used or observed in the teaching or studio environment. Notably, a subset of respondents indicated they had not used any AI tools, suggesting significant variation in the level of AI adoption across different institutions.

D. Perception of AI's Impact on Creativity

The survey revealed mixed opinions regarding the statement "AI tools enhance student creativity":

- A majority responded Agree or Strongly Agree, recognizing AI's capacity to facilitate ideation and visualization.
- However, a significant number remained Neutral, Disagree, or Strongly Disagree, expressing concerns about over-reliance on AI potentially diminishing critical thinking and core skill development.

This diversity indicates cautious optimism toward AI as a pedagogical tool, tempered by an awareness of its limitations.

E. AI Integration in Institutional Curriculum

Most respondents reported that AI is either not well-integrated or partially integrated in their institution's design curriculum. This indicates a significant implementation gap and reflects a need for structured frameworks and faculty support to enhance AI integration aligned with NEP 2020 objectives.

F. Alignment of AI with NEP 2020 Vision

Participants identified several areas where AI could align with the NEP 2020 vision of technology-enhanced experiential learning:

- Studio-based critiques supported by AI visualization.
- AI-assisted design process simulations.

However, some respondents selected "None of the above", indicating uncertainty or lack of clear policy frameworks guiding integration at their institutions.

G. Areas Where AI Can Support Architectural Education

Respondents identified key areas where AI could support educational objectives:

- Skill development in design computation.
- Critical thinking and problem solving.
- Multidisciplinary and flexible learning.

These insights correspond with NEP 2020's goals of fostering creativity, problem-solving ability, and interdisciplinary approaches.

H. Challenges in AI Integration

Significant barriers to integrating AI into architectural pedagogy were consistently reported:

- Resistance to change in pedagogy.
- Lack of faculty training.
- Lack of institutional infrastructure.

These findings emphasize the need for strategic planning, faculty development programs, and investment in infrastructure to support effective AI adoption.

I. Emphasis for Future AI-Pedagogical Framework

When asked about priorities for a future AI-pedagogical framework, respondents strongly supported:

- Alignment with existing studio pedagogy to preserve core pedagogical constants.
- Ethical use of AI in design education.
- Student training in AI tools.

These priorities suggest broad consensus that any AI integration strategy must be balanced, contextually

sensitive, and ethically grounded, safeguarding traditional pedagogical values while embracing technological innovation.

VI. DATA ANALYSIS

This study analyzed survey responses from 41 undergraduate architecture students to assess their awareness, usage, and perceptions of AI integration in architectural pedagogy under the framework of NEP 2020. The data provides valuable insights regarding the role of AI in design learning, alignment with NEP goals, pedagogical preferences, and openness to hybrid teaching and assessment models.

A. Awareness of NEP 2020

A significant portion of students reported limited awareness of NEP 2020, with responses such as "No, I'm not aware of it" and "I've heard of it, but not in detail". This indicates that despite NEP 2020's emphasis on technology-driven, experiential learning, effective communication of policy initiatives has not reached the student level adequately.

B. AI Tool Usage in Architectural Studies

Students reported varying levels of AI tool usage:

- Many used AI tools frequently or occasionally during their coursework.
- Common tools include ChatGPT / Gemini, Revit (AI-integrated features), and Midjourney / DALL·E.
- Some students indicated no exposure to AI tools, highlighting inconsistency in institutional adoption.

These findings suggest increasing AI adoption primarily for tasks that aid creative expression and technical workflows.

C. Role of AI in Learning

Students predominantly found AI helpful for:

- Generating conceptual visuals.
- Preparing presentations and reports.
- Design ideation and brainstorming.

This demonstrates that students view AI primarily as an enabler of creativity and communication, rather than as a replacement for critical thinking or design problem-solving.

D. Perception of AI's Impact on Design Learning

Responses showed mixed perceptions:

- Many viewed AI as a supportive tool enhancing creativity.
- Others remained neutral, often emphasizing that its effectiveness depends on appropriate usage and pedagogy.

This reflects cautious optimism towards AI's potential, emphasizing the need for guided and pedagogically structured integration.

E. Alignment with NEP 2020 Objectives

Regarding the alignment of AI integration with NEP 2020 goals such as critical thinking and multidisciplinary learning:

- Some students agreed that AI contributes positively to these objectives.
- Others remained neutral, likely due to insufficient understanding of NEP's specific goals.

This underscores a need for greater awareness among students regarding NEP 2020's vision.

F. Pedagogical Constants in the Age of AI

Students consistently highlighted the importance of retaining:

- Studio-based learning.
- Faculty critiques and jury sessions.
- Peer collaboration and feedback.

These responses confirm that core pedagogical constants remain highly valued, even in the context of technological advancement.

G. Preferred AI-Supported Activities

Students preferred AI to support activities such as:

- 3D modeling and rendering.
- Concept development and design presentation generation.
- Text-based report writing and self-evaluation.

This indicates that students see AI as most beneficial in tasks that are technical or repetitive, allowing more focus on creative and reflective aspects of learning.

H. Support for Hybrid Pedagogical Models

Most students expressed support or conditional support for a hybrid model in which AI tools assist teachers rather than replace traditional methods. Responses such as "Yes, definitely" and "Maybe, if balanced well" suggest openness to balanced integration that enhances learning without undermining human mentorship.

I. Formal Inclusion of AI in Curriculum

A majority supported the formal inclusion of AI in the architecture curriculum, preferably as a full subject/module or as an optional skill workshop. This reflects student interest in structured and formalized AI education.

J. Openness to Hybrid Assessments

Students generally showed receptiveness to assessments combining manual and AI-assisted components, though many selected "Maybe", signaling the need for carefully designed assessment models that are perceived as fair and pedagogically sound.

VII. FINDINGS AND DISCUSSION

a. Preservation of Pedagogical Constants
Insights from expert interviews and student questionnaires highlight a strong consensus among faculty and curriculum designers: studio-based learning, peer and faculty critique, and site visits remain indispensable elements of architectural education. These strategies, consistently emphasised in the literature, form the backbone of constructivist pedagogy in architecture[1]

While AI tools can rapidly generate visualisations or automate drafting, participants stressed that core aspects of design education—such as reasoning through complex problems, developing contextual awareness, and engaging in human critique—cannot be delegated to machines.

Key Takeaway: AI should serve as a supportive tool that enhances experiential, reflective, and collaborative practices, rather than replacing them.

b. Perceived Benefits of AI Integration
Respondents pointed to improved visualisation, greater efficiency during design ideation, and easier access to multidisciplinary resources as the most significant benefits of AI. These findings correspond with earlier discussions on AI-assisted design thinking (Lawson & Dorst, 2009) and align with NEP 2020's call for technology-enabled, experiential modes of learning [4].

Simulation platforms, for example, can create immersive and data-rich virtual site experiences. Such tools are particularly valuable when physical site visits are limited, offering students exposure to spatial and environmental factors in alternative formats.

c.Risks and Challenges

Despite the potential benefits, several concerns emerged consistently:

There is growing concern that core traditional skills, such as freehand sketching and physical model-making, may gradually decline within architectural education. Relying too heavily on AI-generated outputs could also limit students' ability to engage in critical reflection and independent analysis. Alongside this, questions of ethics and accessibility remain significant, particularly in terms of unequal access to advanced digital tools. Oxman (2017) cautions that such trends may contribute to the "de-skilling" of designers, while Selwyn (2016) emphasises the importance of creating equitable opportunities for students to benefit from emerging technologies.

d. Alignment with NEP 2020
The study indicates that AI has strong potential to support NEP 2020's priorities when integrated thoughtfully:

- Multidisciplinary learning → Linking architecture with fields such as data science, environmental analytics, and cultural heritage documentation.
- Experiential learning → Extending site-based pedagogy through AI-powered simulations, augmented reality (AR), and virtual reality (VR).
- Critical and creative thinking → Positioning AI as a co-ideator, while faculty ensure reflective dialogue and critique remain central.

However, meaningful alignment requires structured use of AI—where its application is deliberate, pedagogically justified, and always mediated by faculty guidance.

e. Proposed NEP–AI Integration Framework
Drawing on these insights, the study proposes a Hybrid Pedagogical Model structured around three pillars:

1. Preserve – Safeguard studio culture, critique traditions, site-based immersion, and mentorship.
2. Augment – Employ AI selectively for ideation, visualisation, and environmental simulations.
3. Regulate – Develop ethical guidelines, ensure equitable access, and integrate AI into curricula through clear policy frameworks.

This model aims to advance the transformative vision of NEP 2020 while protecting the enduring identity of architectural pedagogy.

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