Smart Design Policies

2026, Volume 3, Number 1, pages 45–64

Original scientific paper

Posthuman Learning in the Age of AI: Rethinking Agency, Knowledge, and Policy in Architectural Education

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ARTICLE INFO:
Received: 28 May 2026
Revised: 29 July 2026
Accepted: 3 August 2026
Available online: 15 August 2026

Keywords:
Posthuman Pedagogy,
Artificial Intelligence,
Architectural Education,
Design Education Policy,
Curriculum Governance,
Ecological Intelligence.

ABSTRACT

Architectural education is being reshaped as Artificial Intelligence (AI) challenges human-centered conceptions of creativity, authorship, and knowledge production. However, current discussions on AI-supported architectural education remain largely focused on tool adoption, productivity, creativity, and student perception, while the policy implications of AI for curriculum design, studio governance, assessment, educator training, and ethical accountability remain underdeveloped. Addressing this gap, the study develops a policy-oriented posthuman framework for interpreting AI integration in architectural pedagogy and translating it into responsible design education principles. The study adopts a two-stage review design that combines a conceptual framing review of posthuman pedagogy with a systematic synthesis of empirical and pedagogical studies on AI, computational design, and architectural education published between 2010 and 2025. The review identifies three interrelated dimensions of AI-supported posthuman learning: distributed agency, in which design intelligence is shared across students, educators, AI systems, datasets, interfaces, materials, and studio environments; situated knowing, in which AI becomes pedagogically meaningful only when embedded in reflective, material, and context-sensitive design inquiry; and ethical entanglement, in which authorship, bias, accountability, originality, dependency, and environmental responsibility become core educational concerns. Based on these findings, the paper proposes ecological intelligence as a design education policy principle: the capacity to think, design, evaluate, and act responsibly within interconnected human, technological, material, environmental, and institutional systems. The contribution of the study is twofold. First, it clarifies the theoretical relevance of posthuman pedagogy for AI-supported architectural education. Second, it translates this theoretical perspective into a policy-oriented pedagogical framework that can inform curriculum development, studio pedagogy, assessment criteria, and ethical governance in architectural education.

SMART DESIGN POLICIES (2026), ***3***(1), 45–64.
https://doi.org/10.38027/smart.v3n1-4

www.smartdpj.com

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How to cite this article: (APA Style)
Tong, H., Kıdık, A., & Alaçam, S. (2026). Posthuman learning in the age of AI: Rethinking agency, knowledge, and policy in architectural education. *Smart Design Policies, 3*(1), 45–64. https://doi.org/10.38027/smart.v3n1-4

1. Introduction

The rapid advancement of artificial intelligence (AI) is transforming higher education, challenging long-established assumptions about knowledge production, creativity, and learning processes. Within architectural education, this transformation is particularly significant, as design has conventionally been framed as a human-centered, creative, and cognitive activity. However, the implications of AI extend beyond individual creativity or tool-based productivity. They raise policy-level questions about how curricula, studio structures, assessment criteria, educator roles, and ethical governance mechanisms should be reorganized when design processes are increasingly mediated by intelligent systems. More specifically, the increasing integration of AI technologies, ranging from generative design systems to large language models, is reshaping how architectural knowledge is produced, interpreted, and evaluated (Jin et al., 2024).

Recent research suggests that AI is no longer limited to supporting design tasks but is increasingly involved in conceptual generation, optimization, and decision-making processes. For instance, AI-assisted design studios have demonstrated improvements in students' innovative capacity and work efficiency, while also revealing challenges related to fragmented tool usage and limited control over generated outputs (Jin et al., 2024). Similarly, the integration of AI into architectural education has been shown to enhance students' adaptability and strategic thinking, while raising critical questions regarding authorship, algorithmic bias, and accountability (Wang et al., 2025). These findings indicate that AI integration in architectural education cannot be reduced to technical adoption; it requires a pedagogical and policy framework capable of addressing agency, responsibility, curriculum design, and institutional decision-making together.

Despite these developments, the integration of AI into architectural education remains uneven. Empirical evidence suggests a significant gap between widespread adoption and formal pedagogical integration. While a large majority of students report familiarity with and use of AI tools, only a small proportion have received structured training, indicating a lack of systematic educational frameworks (Dullinja & Jashanica, 2025). This discrepancy highlights a critical tension: architectural education is rapidly becoming technologically enriched, yet its pedagogical foundations remain largely unchanged. From a design education policy perspective, this tension can be understood as a governance gap: AI tools are already entering design learning practices informally, but architectural curricula often lack explicit policies for responsible use, critical evaluation, authorship, bias awareness, environmental accountability, and assessment of AI-supported design work.

At the same time, architectural education has historically been characterized by studio-based learning environments, where knowledge emerges through iterative critique, experimentation, and situated practice (Ciravoğlu, 2014). The introduction of digital and algorithmic tools has already expanded these processes by enabling the generation of multiple design alternatives and enhancing visualization capabilities (Yavuz & Yıldırım, 2012). However, the emergence of AI represents a substantial shift, one that extends beyond tools and techniques to reconfigure how learning and design processes are structured. Unlike earlier digital tools, AI systems participate in design processes through prediction, generation, classification, recommendation, and simulation. Therefore, the educational challenge is not only to teach students how to operate AI tools, but also to define how these tools should be positioned within studio pedagogy, curriculum governance, and design assessment.

Existing studies primarily focus on the technical integration of AI, its impact on efficiency, or student perceptions. However, they have not yet produced a sufficiently policy-oriented theoretical framework that explains how AI transforms architectural education at the levels of agency, curriculum design, studio governance, assessment, and ethical responsibility. In particular, the literature tends to discuss AI either as a technical tool that improves design production or as a pedagogical innovation that enhances creativity and efficiency. Less attention has been given to how AI-supported architectural education should be governed as a design education policy problem, especially when knowledge, authorship, decision-making, and responsibility are distributed across students, educators, AI systems, datasets, interfaces, materials, and institutional contexts. Broader higher education literature reinforces this governance problem. Recent studies on generative AI in education show that AI integration requires not only technical competence, but also critical literacy, fact-checking practices, human oversight, transparent assessment criteria, and institutional guidance (Kasneci et al., 2023; Bearman & Ajjawi, 2023). Similarly, studies focusing on higher education policy and assessment argue that generative AI challenges conventional assumptions about originality, authorship, academic integrity, and assessment validity (Cotton et al., 2024; Luo, 2024). Assessment-focused reviews further indicate that higher education institutions need to redesign assessment practices, align AI use with learning outcomes, and clarify the acceptable levels of AI-supported work (Xia et al., 2024; Weng et al., 2024; Perkins et al., 2024). These debates strengthen the need to examine AI integration in architectural education not only as a studio innovation, but also as a curriculum, assessment, and governance issue.

This study addresses this gap by bringing posthuman pedagogy into dialogue with AI-supported architectural education and design education policy. Posthuman pedagogy is relevant to this discussion because it challenges human-centered assumptions about learning and design by emphasizing distributed agency, situated knowing, relational responsibility, and human-non-human entanglement. In architectural education, these concepts are particularly useful because studio learning has always been mediated by drawings, models, materials, sites, software, precedents, critiques, and representational systems. AI intensifies this condition by introducing algorithmic and data-driven agents into the pedagogical environment.

Building on this position, the study adopts a posthuman perspective to examine how architectural education is being reconfigured in the age of AI. Instead of treating AI as a tool to be integrated into existing pedagogies, the study explores how learning evolves when cognition and design intelligence are distributed across humans, machines, and material systems. Through a systematic literature review, the paper identifies three interrelated transformations: distributed agency, situated knowing, and ethical entanglement. The aim is not only to interpret these transformations theoretically, but also to translate them into a policy-oriented pedagogical framework that can inform curriculum development, studio pedagogy, assessment practices, educator training, and ethical governance.

Accordingly, this study asks: How can a posthuman pedagogical perspective inform a policy-oriented framework for AI integration across architectural curricula, studio pedagogy, assessment practices, educator training, and ethical governance?

The contribution of the paper is threefold. First, it clarifies the conceptual boundaries between posthuman pedagogy, distributed agency, situated knowing, ethical entanglement, and ecological intelligence in the context of AI-supported architectural education. Second, it strengthens the methodological basis of the argument by combining a conceptual framing review with a systematic synthesis of empirical and pedagogical studies. Third, it proposes a policy-oriented framework that links posthuman learning principles to actionable dimensions of architectural education, including curriculum design, studio governance, assessment criteria, educator roles, and ethical accountability. In this way, the study moves beyond a general philosophical reading of AI and offers a transferable framework for architectural schools seeking to integrate AI responsibly into design education.

2. Materials and Methods

This study adopts a two-stage literature review design to examine how architectural education is being transformed by artificial intelligence, computational design, and AI-supported creativity from a posthuman pedagogical perspective. The paper does not aim to measure the effectiveness of a specific educational intervention but rather to interpret emerging conceptual and pedagogical shifts. The review combines a conceptual framing review with a systematic literature review. The first stage establishes the theoretical and analytical vocabulary of posthuman learning, while the second stage systematically examines empirical and pedagogical studies on AI and computational design in architectural education. This distinction was made to avoid conflating conceptual and empirical literature. The conceptual review was used to construct sensitizing concepts, whereas the systematic review was used to identify evidence-based pedagogical implications. Therefore, the study does not treat conceptual and empirical sources as equivalent forms of evidence; rather, it connects them through an interpretive synthesis.

The methodological design was guided by three principles: transparency, conceptual relevance, and pedagogical applicability. Transparency refers to the explicit reporting of databases, search strings, inclusion and exclusion criteria, screening stages, and final selection numbers. Conceptual relevance refers to the use of posthuman pedagogy as an analytical lens for interpreting AI-supported architectural education. Pedagogical applicability refers to the translation of review findings into a policy-oriented pedagogical framework concerned with curriculum design, studio governance, assessment, educator training, and ethical accountability.

The review was limited to studies published between 2010 and 2025. This period was selected because it captures the expansion of digital design pedagogies, the increasing use of computational tools in architectural education, and the recent emergence of AI-supported design systems in studio-based learning. The selected time frame also enabled the study to connect earlier discussions on digital and algorithmic design education with more recent debates on artificial intelligence, human-machine collaboration, and posthuman pedagogy. Although the review covers the period between 2010 and 2025, priority was given to recent studies, particularly those published after 2020, in order to reflect the rapid development of generative AI, human-machine collaboration, and AI-mediated design education debates. Earlier studies were retained only when they provided foundational pedagogical or theoretical relevance to architectural education.

The first stage focused on conceptual literature related to posthuman pedagogy, distributed agency, relational learning, situated cognition, non-human agency, and human-machine interaction. Scopus was used for this stage because of its broad interdisciplinary coverage across education, humanities, social sciences, philosophy, and technology studies. The conceptual review was not intended to produce statistical generalization; rather, it was used to identify theoretical constructs capable of interpreting changes in learning, agency, and responsibility in AI-supported architectural education. The following search formula was used:

TITLE-ABS-KEY(("posthuman*" OR "posthumanism" OR "posthuman pedagogy" OR "more-than-human" OR "non-human agency" OR "distributed agency" OR "relational learning" OR "situated cognition") AND ("education" OR "learning" OR "pedagogy" OR "teaching") AND ("artificial intelligence" OR "digital technology" OR "computational" OR "human-machine interaction"))

The initial records obtained from Scopus were screened through document type, language, publication year, and relevance criteria. The search was conducted in February 2026. It initially returned 48 records. After title and abstract screening, 25 records remained for further assessment, while 23 records were excluded because they did not directly address education, pedagogy, learning, or knowledge production. These 25 full-text records were then assessed for eligibility. Studies were included if they contributed directly to posthuman pedagogy, relational learning, distributed agency, situated knowing, materiality, ethics, or human/non-human relations in education. Studies were excluded if they used posthumanism only as a general theoretical reference, focused solely on literary or cultural theory without educational relevance, or did not address pedagogy, learning, or knowledge production. During full-text assessment, 9 records were excluded because they did not sufficiently contribute to the analytical construction of posthuman pedagogy in relation to learning, agency, materiality, or human/non-human relations. Following full-text assessment, 16 conceptual studies were retained to construct the theoretical framework of the paper. The final conceptual corpus was used to define the analytical categories of distributed agency, situated knowing, ethical entanglement, and ecological intelligence.

The second stage focused on empirical and pedagogical studies addressing artificial intelligence, computational design, and architectural education. ScienceDirect and Web of Science were used in this stage to identify peer-reviewed studies situated at the intersection of architecture, design pedagogy, digital technologies, and AI-supported learning. These databases were selected because they index peer-reviewed research in architecture, design, education, engineering, built environment studies, and technology-enhanced learning. While Scopus was used to build the interdisciplinary conceptual framework, ScienceDirect and Web of Science were used to locate field-specific empirical and pedagogical studies in architectural education. This division of databases reflects the two different purposes of the review stages rather than two unrelated search procedures. In ScienceDirect, the following search string was used:

"architectural education" AND ("artificial intelligence" OR "computational design" OR "parametric design") AND ("design studio" OR "learning" OR "creativity")

In Web of Science, the equivalent Topic Search formula was used:

TS=("architectural education" AND ("artificial intelligence" OR "computational design" OR "parametric design") AND ("design studio" OR "learning" OR "creativity"))

The screening process was carried out in three stages. The first stage involved document type and scope screening. The second stage involved title and abstract screening. The third stage involved full-text assessment. The search was conducted in February 2026. ScienceDirect returned 205 records and Web of Science returned 65 records, resulting in 270 initial records. After document type and relevance screening, 80 records remained for title and abstract screening, including 52 records from ScienceDirect and 28 records from Web of Science. At this stage, 190 records were excluded because they consisted of technical studies clearly unrelated to architectural education, conference papers, book chapters, editorials, or other non-relevant document types. Following title and abstract screening, 20 records remained, including 14 records from ScienceDirect and 6 records from Web of Science. At this stage, 60 records were excluded because they focused on engineering applications, building performance simulation, BIM, energy analysis, software development, or professional practice without a clear pedagogical focus. These 20 full-text records were then assessed for eligibility. Studies were included if they directly addressed architectural education, design studio pedagogy, AI-supported design learning, computational design pedagogy, algorithmic design education, or human-machine collaboration in design education. During full-text assessment, 12 records were excluded because they did not provide sufficient pedagogical relevance, methodological detail, or direct connection to architectural education. Following full-text assessment, 8 empirical and pedagogical studies were retained for analysis, including 6 studies from ScienceDirect and 2 studies from Web of Science. The methodological structure of the study is summarized in Figure 1.

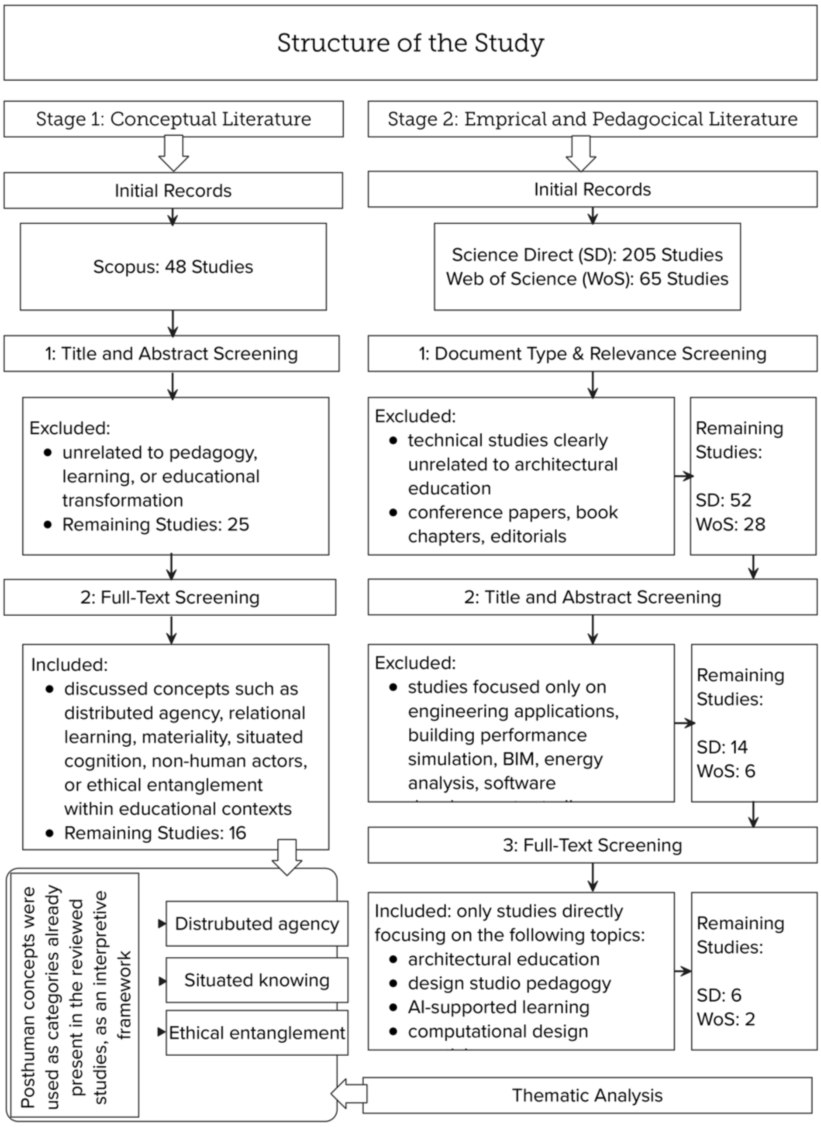

Figure 1. Two-stage review protocol and PRISMA-style screening process for conceptual and empirical literature.

To strengthen methodological transparency, the screening process is reported in a PRISMA-style flow diagram. The diagram does not claim formal PRISMA registration; rather, it adapts the PRISMA logic of identification, screening, eligibility, and inclusion to clarify how the final conceptual and empirical corpora were constructed. This visual record allows readers to evaluate the scope, selectivity, and reproducibility of the review process.

The selected studies were analyzed through thematic analysis informed by posthuman theory. In the first stage, the conceptual literature was read iteratively to identify recurring theoretical concepts, including distributed agency, relationality, materiality, situated knowing, human/non-human interaction, and ethical responsibility. In the second stage, the empirical and pedagogical studies were coded according to their educational context, technological focus, mode of AI or computational integration, pedagogical contribution, and ethical implications. The coding process was conducted independently by two researchers and then reviewed collectively to resolve interpretive differences and refine thematic consistency. The coding process followed three steps. First, descriptive codes were assigned to each empirical study, including educational setting, AI or computational technology, pedagogical aim, learning activity, reported benefit, reported limitation, and ethical concern. Second, these descriptive codes were compared with the sensitizing concepts derived from the conceptual review. Third, codes were clustered into analytical themes only when they were supported by both conceptual relevance and empirical or pedagogical evidence.

To reduce interpretive bias, two researchers independently coded the selected empirical studies using a shared coding matrix. Initial coding differences were compared and discussed in a consensus meeting. Disagreements were resolved through re-reading of the full texts and collective refinement of code definitions. A third researcher reviewed the final thematic structure for conceptual consistency. Since the study is an interpretive review rather than a quantitative meta-analysis, inter-rater reliability was addressed through independent coding, comparison, consensus validation, and audit of the thematic structure rather than through statistical agreement alone.
The empirical studies were also assessed for methodological relevance and pedagogical quality before synthesis. The assessment considered five criteria: (1) clarity of educational context, (2) relevance to architectural or design education, (3) explicit description of AI, computational, or digital design integration, (4) presence of pedagogical findings or implications, and (5) relevance to ethical, curricular, or policy-related questions. Studies that did not meet the architectural education and pedagogical relevance criteria were excluded. Studies with limited methodological detail were retained only when they offered direct relevance to AI-supported architectural pedagogy, and their limitations were considered during interpretation.
Through this process, three overarching analytical themes were identified: distributed agency, situated knowing, and ethical entanglement. These themes were not treated as isolated categories, but as interrelated dimensions through which AI-supported architectural education can be interpreted from a posthuman perspective. Instead of aiming for statistical generalization, the study seeks conceptual coherence and interpretive depth across interdisciplinary and pedagogical literature. The themes were therefore neither fully predetermined nor purely inductive. They emerged through an abductive process in which posthuman concepts from the conceptual review were tested, refined, and operationalized through the empirical and pedagogical review. This procedure allowed the study to move from theoretical interpretation toward a policy-oriented framework for responsible AI integration in architectural education. The generalizability of the findings is conceptual and transferable rather than statistical: the framework is intended to inform comparable architectural education contexts where AI-supported design learning, curriculum governance, and ethical responsibility are emerging concerns.

3. Results

The findings of the review are presented in two interconnected parts. The first part synthesizes the conceptual literature on posthuman pedagogy and identifies the theoretical categories through which AI-supported architectural education can be interpreted. The second part examines empirical and pedagogical studies on artificial intelligence, computational design, and architectural education. Rather than treating these two bodies of literature as separate domains, the results show how posthuman concepts such as distributed agency, situated knowing, relational pedagogy, and ethical entanglement provide an interpretive perspective for understanding recent changes in architectural learning environments.

3.1 Theoretical Framework: Posthuman Learning for AI-Supported Architectural Education

The transformation of architectural education in the age of artificial intelligence requires a reconsideration of the epistemological assumptions that shape learning and design. Conventional educational paradigms, largely grounded in humanist thought, position the human subject as the central agent of cognition, creativity, and knowledge production. However, posthumanist theory challenges this anthropocentric framework by reconceptualizing learning as a relational, distributed, and materially situated process that emerges through interactions between human and non-human actors (Ferrando & Rozzoni, 2024; Mustola, 2019; Leibowitz & Naidoo, 2017). In the context of AI-supported architectural education, this theoretical shift is particularly significant because design learning is increasingly mediated by algorithms, datasets, prompts, interfaces, digital models, material systems, and institutional rules. Therefore, posthuman learning is used in this study not as a broad philosophical label, but as an analytical framework for examining how agency, knowledge, and responsibility are redistributed in AI-supported architectural education.

From a posthuman perspective, the human subject is no longer understood as an autonomous and pre-defined entity but as continuously constituted through relationships with technologies, environments, and material systems. Learning is therefore not confined to individual cognition but emerges across networks of relations that include digital tools, bodies, ecological systems, and affective conditions. As Ferrando and Rozzoni (2024) argue, posthumanist education emphasizes the importance of materiality, relationality, and transformation in addressing contemporary educational challenges. This does not mean that human agency disappears. Rather, human agency is redefined as relational and situated: students and educators still make judgments, but these judgments are shaped through interaction with non-human actors such as software systems, AI-generated outputs, design media, studio norms, and material constraints.

A central concept in this framework is distributed agency, which challenges the notion that agency resides exclusively within human actors. Instead, agency emerges through interactions among heterogeneous elements, including technologies, objects, and environments. In pedagogical contexts, this means that tools and systems are not neutral instruments but actively shape learning processes. As Mustola (2019) demonstrates, anthropocentric pedagogies tend to exclude non-human actors, whereas posthuman approaches foreground the ethical and epistemological significance of these entities in shaping knowledge and educational practices. For this study, distributed agency refers specifically to the way design decisions, creative exploration, feedback loops, and evaluative judgments are co-produced by students, educators, AI systems, datasets, interfaces, prompts, representational media, and studio environments. This concept is distinct from simple human–computer interaction because it does not treat AI as an external tool used by a sovereign designer; instead, it examines how design agency is shared, negotiated, and sometimes contested across human and non-human participants.

Closely related to distributed agency is the concept of situated and relational knowing, which rejects universal and abstract understandings of knowledge. Knowledge is instead viewed as context-dependent, embodied, and materially grounded. Learning emerges through engagement with specific environments, tools, and practices, making it inseparable from the conditions in which it occurs. This perspective aligns with broader critiques of dominant epistemologies, particularly in higher education, where posthuman approaches intersect with concerns about inequality, context, and social justice (Leibowitz & Naidoo, 2017). In architectural education, situated knowing is especially relevant because studio learning depends on drawing, modelling, critique, site interpretation, material experimentation, and iterative representation. In AI-supported studios, prompts, datasets, generated images, parametric rules, and digital simulations also become part of the situation through which students learn. Situated knowing therefore refers to the capacity to connect AI-supported outputs to architectural context, spatial reasoning, material logic, environmental conditions, and social use.

In this context, relational pedagogy becomes a defining feature of posthuman learning. Rather than focusing only on human-to-human interactions, posthuman pedagogy expands the scope of educational relationships to include non-human actors such as technologies, environments, and material systems. Learning is thus understood as emerging from networks of relations that involve both human and non-human participants. This approach shifts the role of the educator from knowledge transmitter to facilitator of complex relational processes (Ferrando & Rozzoni, 2024). In AI-supported architectural education, this means that educators are not only responsible for teaching tool use, but also for framing the relationships among students, AI systems, design tasks, representational media, ethical questions, and assessment criteria. This point directly links posthuman pedagogy to design education policy because curriculum and studio governance must define how such relationships are organized, evaluated, and made accountable.

Another critical dimension of posthuman theory is the reconfiguration of ethics through the notion of ethical entanglement. In contrast to traditional frameworks that locate responsibility within individual subjects, posthuman ethics emphasizes distributed responsibility across networks of relations. This shift is particularly relevant in technologically mediated learning environments, where issues such as bias, authorship, and accountability emerge through interactions between humans and AI systems. As Mustola (2019) suggests, posthuman pedagogy invites educators and students to confront uncomfortable ethical questions that destabilize assumptions of human superiority and control. In this study, ethical entanglement refers to the pedagogical condition in which responsibility for design outcomes cannot be assigned only to the individual student or only to the AI system. Instead, responsibility is distributed across prompt formulation, dataset assumptions, software defaults, institutional policies, educator guidance, assessment culture, and the social and environmental consequences of design decisions.

Posthuman approaches also intersect with decolonial and socially just pedagogies, challenging dominant knowledge systems and advocating for epistemic diversity. By questioning hierarchical distinctions between humans and non-humans, as well as between different forms of knowledge, posthumanism opens up possibilities for rethinking education as a site of transformation. This suggests that posthuman perspectives contribute to socially just pedagogies by foregrounding relational responsibility, inclusivity, and the need to address structural inequalities in education (Leibowitz & Naidoo, 2017). This concern is relevant to AI-supported architectural education because algorithmic systems may reproduce dominant spatial, cultural, aesthetic, and environmental assumptions. A posthuman framework therefore requires AI integration to be accompanied by critical awareness of bias, exclusion, representational dominance, and contextual injustice.

The concept of ecological intelligence is introduced in this study to connect posthuman learning with design education policy. It refers to the capacity to think, design, evaluate, and act responsibly within interconnected systems of humans, AI technologies, materials, environments, institutions, and social consequences. This concept differs from systems thinking because it is not limited to understanding interdependencies at an abstract level; it also concerns situated design judgment, ethical accountability, and pedagogical action. It differs from ecological literacy because it does not refer only to environmental awareness, but to the broader ability to work critically within human–machine–material–environment relations. It also differs from design intelligence because it expands design competence beyond creativity, problem-solving, or formal innovation toward responsibility within more-than-human systems. In this paper, ecological intelligence functions as the bridge between posthuman theory and responsible AI integration in architectural education.

When considered together, distributed agency, situated knowing, relational pedagogy, ethical entanglement, and ecological intelligence offer a useful framework for interpreting current transformations in architectural education. Instead of treating artificial intelligence as another tool to be added to existing pedagogical models, this framework shows how learning is being reshaped through interactions between humans, machines, and material systems. The framework also clarifies why AI integration should be addressed as a curriculum and governance issue rather than merely a technical training problem. Distributed agency requires policies for authorship and responsibility; situated knowing requires studio tasks that connect AI outputs to context and material reasoning; ethical entanglement requires assessment criteria that include bias, accountability, and environmental implications; and ecological intelligence requires curricula that cultivate responsible design judgment across human and non-human systems.

The relevance of this framework for architectural education lies in the already relational nature of design studio learning. Architectural knowledge is rarely produced through individual cognition alone; it is developed through drawings, models, software, materials, sites, critiques, precedents, and representational media. Therefore, the posthuman concepts discussed above are not external theoretical additions to architectural education. Rather, they make visible the distributed and situated conditions that have long shaped studio-based learning and that are now intensified by AI-supported design systems. This theoretical framework provides the basis for the subsequent analysis of empirical and pedagogical studies and for the policy-oriented synthesis developed in the discussion section.

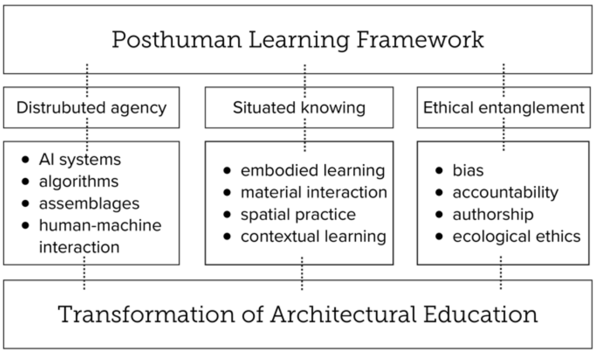

Figure 2. Posthuman learning framework for AI-supported architectural education. Developed by the authors from the conceptual review literature.

The framework presented in Figure 2 synthesizes the conceptual findings of the posthuman pedagogy literature. To clarify how each reviewed source contributes to this framework, Table 1 summarizes the pedagogical focus, key findings, and analytical contribution of the conceptual studies included in the review.

Table 1: Conceptual synthesis of posthuman pedagogy literature and its analytical contribution to the framework.

Source	**Pedagogical Focus**	**Key Findings / Conclusions**	**Analytical Contribution to the Framework**
Chiew (2018)	posthuman pedagogy, subjectivity, ecology of learning	human-centered and individualized models of learning are insufficient; pedagogy should be understood through relational, ecological, and inter/intra-subjective processes.	Supports the shift from individual cognition to relational and ecological learning; informs the concepts of situated knowing and ecological intelligence.
O'Halloran (2020)	digital text analysis and posthuman subjectivity	digital tools can extend critical thinking by enabling students to think with machine-generated data, producing posthuman forms of subjectivity and interpretation.	Demonstrates how human cognition can be extended through digital systems; supports the interpretation of AI as a pedagogical mediator rather than a neutral tool.
Myles and Havsteen-Franklin (2025)	arts-based posthuman research pedagogy	knowledge is co-produced through human, non-human, digital, affective, and material assemblages; research pedagogy should move beyond purely human-centered data interpretation.	Contributes to the idea of knowledge co-production across human, digital, affective, and material agents; informs distributed agency and ethical entanglement.
Mansoor and Malik (2022)	decolonial-posthuman pedagogy	posthuman pedagogy can support situated identity reconstruction, but it should be combined with decolonial awareness to avoid universalizing Western assumptions.	Adds a critical lens for addressing bias, exclusion, and epistemic dominance in AI-supported architectural education.
Barritt et al. (2021)	art education, abstraction, and lifeworld	learning emerges through embodied perception, abstraction, and student–environment relations; art-based methods can make these relations visible.	Supports the role of embodied, affective, and material engagement in learning; informs situated knowing in design studio contexts.
Gravett et al. (2024)	relational pedagogy and mattering	relational pedagogy should include not only human relationships but also spaces, objects, technologies, bodies, and material conditions as active participants in learning.	Provides a foundation for understanding studio pedagogy as a network of human and non-human relations; informs relational pedagogy and educator roles.
Mills et al. (2025)	GenAI, diffraction, scholarship of teaching and learning	generative AI requires pedagogical research to be reframed through entanglement, diffraction, uncertainty, and human–non-human co-constitution.	Directly links GenAI to posthuman educational research; supports the interpretation of AI-supported learning as entangled and co-constituted.

Bozalek (2021)	slow scholarship and relational ontology	posthuman and feminist new materialist approaches can resist neoliberal acceleration by foregrounding process, attentiveness, trust, and collective responsiveness.	Helps critique productivity-driven AI adoption; supports the need for reflective, responsible, and process-oriented AI integration in education.
Niccolini et al. (2018)	affective-material feminist pedagogy	learning is produced through affective, embodied, and material relations; objects and classroom atmospheres actively shape pedagogical experience.	Strengthens the material and affective dimensions of situated knowing; supports attention to studio atmosphere, media, and material conditions.
Carabelli (2025)	more-than-human and plant-based pedagogy	non-human entities such as plants can become pedagogical participants, expanding students' ecological, political, and sociological imagination.	Extends the framework beyond digital actors to ecological and more-than-human participants; informs ecological intelligence.
Zembylas (2018)	decolonial and posthuman tensions	posthuman and decolonial perspectives share critiques of human exceptionalism, but their tensions should be carefully addressed in curriculum and pedagogy.	Supports the ethical and political dimension of the framework; helps position AI integration as a curriculum and governance issue.
Leibowitz and Naidoo (2017)	socially just posthuman pedagogy	posthuman insights can support socially just pedagogies by challenging fixed identities, deficit models, and linear developmental assumptions.	Connects posthuman pedagogy with educational justice; informs ethical entanglement and policy attention to inclusion.
Strom and Martin (2022)	teacher development, assemblage, and distributive agency	teaching practice develops through assemblages of teachers, students, institutions, materials, policies, and histories rather than through individual teacher agency alone.	Provides a basis for understanding educator roles as distributed across institutional, material, and pedagogical assemblages; informs studio governance.
Noble (2025)	architectural education, critical citizenship, and social justice	architectural education can use posthuman and decolonial approaches to promote critical citizenship, spatial justice, and socially responsive design practice.	Connects posthuman pedagogy directly to architectural education; supports the framework's relevance to design responsibility and policy-oriented pedagogy.
Ferrando and Rozzoni (2024)	posthumanist education as praxis	posthuman education should not remain theoretical; it should be enacted through embodied, experiential, critical, and transformative pedagogical practices.	Supports the translation of posthuman theory into pedagogical action; informs the policy-oriented aim of the study.
Mustola (2019)	non-human ethics, animals, and anthropocentrism	posthuman pedagogy requires confronting anthropocentrism, speciesism, and ethical discomfort in educational practice.	Provides the ethical basis for questioning human superiority and control; informs ethical entanglement and responsibility in AI-supported learning

3.2 Findings: AI, Computational Design, and Architectural Education

The systematic review of empirical and pedagogical studies shows that AI and computational technologies are not only technical additions to architectural education, but also agents that reshape design learning at operational, pedagogical, epistemological, and policy levels. Across the reviewed studies, AI-supported architectural education appears as an emerging field in which students, educators, algorithms, interfaces, datasets, prompts, design media, and studio cultures interact in the production of architectural knowledge. The findings are therefore organized around three analytical themes derived from the abductive synthesis: distributed agency, situated knowing, and ethical entanglement. These themes also provide the basis for the policy-oriented framework developed in the discussion section.

The first finding concerns distributed agency. The reviewed studies indicate that AI and computational tools increasingly participate in design exploration, programming, representation, evaluation, and decision-making. Jin et al. (2024) show that AI-assisted architectural programming and design can improve students' innovation capacity and work efficiency; however, their study also shows that students experience difficulties in controlling AI-generated outcomes. Wang et al. (2025) similarly demonstrate that AI-supported studio education requires both technical skill development and ethical reflection, because design decisions are increasingly shaped by interactions among students, AI tools, instructors, and studio tasks. Zhang et al. (2025) extend this argument by repositioning architects not only as users of computational tools but also as developers of generative systems and organizers of computational workflows. Zeng et al. (2025) further support this view by proposing a human-machine collaborative design education model in which student production, machine-generated outputs, and expert references interact within a comparative learning process. Together, these studies suggest that design agency in AI-supported architectural education is no longer located solely in the student-designer. Instead, it is distributed across human judgment, computational processes, pedagogical settings, and representational systems.

The second finding concerns situated knowing. The reviewed literature shows that AI-supported learning becomes pedagogically meaningful only when embedded within studio-based inquiry, critique, iteration, and architectural reasoning. Earlier studies on digital and algorithmic design education provide the historical basis for this finding. Azizinezhad and Amini (2011) show that technological tools influence creativity, decision-making, and the teacher-student relationship in architectural education. Yavuz and Yıldırım (2012) demonstrate that algorithmic design tools can help students generate alternatives and understand compositional relations in basic design education. Ciravoğlu (2014) shows that experimental studio pedagogy can challenge conventional one-to-one master-apprentice relations by promoting collective critique and multiple forms of pedagogical interaction. These studies indicate that digital and computational tools acquire educational value when they are situated within reflective studio processes rather than treated as isolated technical instruments. In the context of AI, this means that prompts, datasets, generated images, parametric rules, and digital simulations should be understood as pedagogical artefacts that require interpretation, critique, and contextualization.

The third finding concerns ethical entanglement. Several reviewed studies show that AI-supported architectural education introduces new ethical and pedagogical concerns related to authorship, bias, accountability, originality, dependency, fragmented tool use, and control over generated outputs. Dullinja and Jashanica (2025) identify a clear gap between students' widespread informal use of AI tools and their limited formal training in architectural education. This finding is significant because it shows that AI has already entered students' design practices before curricula, assessment systems, and ethical guidelines have been sufficiently developed. Jin et al. (2024) similarly report fragmented AI use and limited control over outputs, while Wang et al. (2025) explicitly argue that AI education in architecture should combine technical training with ethical reflection on authorship, algorithmic bias, accountability, and human-AI collaboration. These findings suggest that AI integration should not be understood only as a matter of digital literacy; it also requires governance structures that clarify responsible use, critical evaluation, and pedagogical accountability.

Read comparatively, the reviewed studies suggest that AI-supported architectural education operates across four interconnected levels. At the operational level, AI and computational tools support efficiency, visualization, alternative generation, programming, and workflow organization. At the pedagogical level, they reshape how students learn, iterate, critique, communicate, and evaluate design ideas within studio settings. At the epistemological level, they challenge human-centered assumptions about authorship, creativity, agency, and design intelligence. At the policy level, they create the need for curricular guidelines, assessment criteria, educator training, and ethical governance mechanisms. This layered interpretation explains why AI cannot be evaluated only as a technical tool in architectural education; it must also be understood as part of a broader transformation in design education policy and pedagogical governance.

The synthesis of the empirical and pedagogical studies therefore supports the three analytical dimensions identified in the conceptual review. Distributed agency is supported by studies showing that design decisions are increasingly shaped through human-machine collaboration and computational workflows. Situated knowing is supported by studies showing that digital and AI tools become educationally meaningful when embedded in studio-based critique, iteration, and architectural reasoning. Ethical entanglement is supported by studies showing that AI integration raises unresolved questions of authorship, bias, accountability, dependency, and responsible use. These findings provide the evidential basis for the discussion section, where the three dimensions are translated into a policy-oriented pedagogical framework.

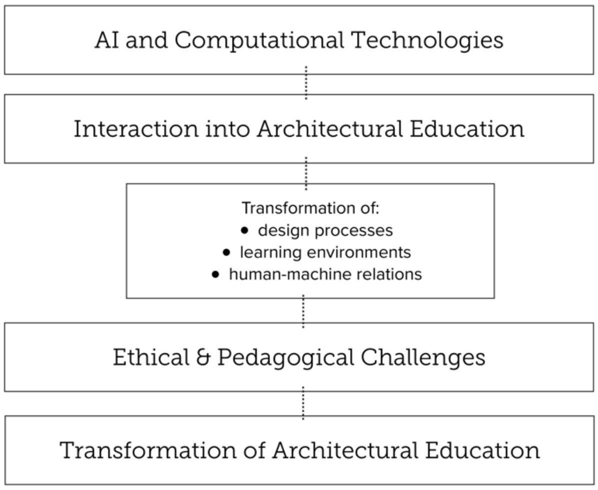

Figure 3. Evidence-based synthesis of AI-supported architectural education across operational, pedagogical, epistemological, and policy levels. Developed by the authors.

Building upon this synthesis, Table 2 presents the reviewed empirical and pedagogical studies together with their pedagogical focus, principal findings, analytical theme, and policy implications.

Table 2: Synthesis of empirical and pedagogical studies on AI, computational design, and architectural education

Source	**Pedagogical Focus**	**Key Findings / Conclusions**	**Analytical Theme Supported**	**Implication for Design Education Policy**
Azizinezhad and Amini (2011)	instrument technology in architectural education	technological tools affect creativity, decision-making, and the relationship between teacher, student, and design process.	Situated knowing; relational pedagogy	Digital and AI tools should be integrated into studio learning as pedagogical mediators, not as isolated technical instruments.
Yavuz and Yıldırım (2012)	digital-algorithmic tools in basic design education	algorithmic tools can help students generate alternatives, visualize design principles, and understand compositional relations.	Situated knowing	Curriculum should connect computational tools to design reasoning, composition, spatial logic, and reflective iteration.
Ciravoğlu (2014)	experimental design studio pedagogy	collective critique and multiple tutor engagement can challenge conventional one-to-one master-apprentice studio relations.	Relational pedagogy; distributed agency	Studio governance should support collective critique, multiple feedback channels, and distributed forms of pedagogical interaction.
Jin et al. (2024)	AI-assisted architectural programming and design course	AI-supported teaching can improve innovation and efficiency, but student use of AI remains fragmented and design-output control remains problematic.	Distributed agency; ethical entanglement	AI curricula should include guidance on output control, critical evaluation, authorship, and responsible use.
Dullinja and Jashanica (2025)	architecture students' AI knowledge and opinions	students show high awareness and frequent informal AI use, but formal AI education in architecture remains very limited.	Ethical entanglement; curriculum gap	Schools need explicit AI policies, structured training, and assessment criteria for AI-supported design work.

Zhang et al. (2025)	human-computer collaboration and generative design systems	architects should be repositioned as tool-makers, algorithm developers, and workflow organizers rather than merely tool users.	Distributed agency	Curriculum should move beyond tool operation toward computational authorship, workflow design, and human-machine collaboration.
Zeng et al. (2025)	human-machine collaborative design education through GAN learning logic	GAN-based learning can support design education by combining bottom-up student production with top-down comparative analysis.	Distributed agency; situated knowing	Studio pedagogy should treat AI outputs as comparative learning artefacts that require critique, revision, and contextual interpretation.
Wang et al. (2025)	AI skills and ethical reflection in design studio	AI education should integrate technical training with ethical reflection on authorship, bias, accountability, and human–AI collaboration.	Ethical entanglement; distributed agency	Design education policy should embed ethical reflection, bias awareness, accountability, and assessment criteria into AI-supported studio teaching.

4. Discussion

The findings of this review indicate that AI integration in architectural education should not be understood merely as the adoption of new digital tools. Rather, it requires a reconsideration of how agency, knowledge, responsibility, assessment, and curriculum governance are organized within design education. The reviewed studies show that AI-supported architectural education operates across several interconnected levels. At the operational level, AI supports visualization, programming, alternative generation, and workflow organization. At the pedagogical level, it reshapes critique, iteration, feedback, and studio-based learning processes. At the epistemological level, it challenges human-centered assumptions about creativity, authorship, and design intelligence. At the policy level, it requires architectural schools to develop explicit principles for curriculum design, studio governance, assessment, educator training, and ethical accountability.

The first major implication concerns distributed agency. In conventional architectural education, creativity and authorship are often attributed primarily to the student-designer, while tools are treated as passive instruments that support human intention. AI complicates this model because it participates in generating alternatives, organizing information, producing representations, suggesting patterns, and influencing design decisions. Jin et al. (2024) show that AI-assisted architectural programming and design can improve students' innovation capacity and work efficiency, while also revealing problems related to fragmented tool use and limited control over AI-generated outcomes. Zhang et al. (2025) argue that architects should be repositioned as developers, organizers, and interpreters of computational workflows rather than merely as users of software. Zeng et al. (2025) similarly suggest that human-machine collaboration can support design education when students learn through comparison, critique, and revision of machine-generated outputs. These findings suggest that architectural curricula should not limit AI education to operational skills such as prompt writing, image generation, or software use. Instead, curricula should help students understand how design agency is shared among human intention, algorithmic processes, datasets, interfaces, representational media, and institutional expectations.

From this perspective, AI should be treated as a form of design literacy rather than as a separate technical skill. Such literacy should include understanding how AI systems generate outputs, how datasets shape representational possibilities, how prompts influence design direction, and how students can critically evaluate the relationship between AI outputs and architectural reasoning. This does not mean that students should become dependent on AI systems. On the contrary, the aim should be to strengthen students' capacity to negotiate agency within AI-supported design processes. Students need to learn when AI expands design exploration, when it narrows conceptual thinking, when it introduces bias, and when it produces visually convincing but architecturally weak results. Distributed agency should therefore be treated as a curriculum design issue because it changes what students need to know, how they learn, and how their design decisions are evaluated.

The second implication concerns situated knowing. The review shows that AI-supported learning becomes educationally meaningful only when it is embedded within reflective design inquiry. Earlier studies on digital and algorithmic design education already demonstrate that digital tools contribute to learning when they help students understand compositional relations, generate alternatives, and make design processes explicit (Azizinezhad & Amini, 2011; Yavuz & Yıldırım, 2012). Ciravoğlu (2014) also shows that experimental studio pedagogy can challenge conventional master-apprentice relations through collective critique and multiple forms of pedagogical interaction. These studies provide an important basis for understanding AI not as an isolated technical addition, but as part of the situated culture of studio learning.

In AI-supported studios, prompts, datasets, generated images, parametric rules, simulations, and algorithmic outputs become pedagogical artefacts. They are not neutral results to be accepted or rejected quickly; they need to be discussed, interpreted, modified, compared, and situated within architectural questions. For example, an AI-generated image may appear visually convincing, but students must still evaluate its spatial logic, material feasibility, contextual relevance, social meaning, environmental implications, and relationship to the design brief. Therefore, studio pedagogy should move from output production toward output interpretation. Educators should ask students not only what they produced with AI, but how they produced it, why they selected particular outputs, what alternatives were rejected, what assumptions were embedded in the process, and how the AI-supported material was transformed through architectural reasoning.

This shift also has implications for studio governance. AI-supported work should be accompanied by process documentation, prompt histories, iteration maps, critical annotations, and reflective statements. These materials can help make the design process visible and assessable. Architectural schools may therefore need studio guidelines that clarify how AI may be used at different stages of the design process, such as precedent exploration, scenario generation, conceptual variation, representational testing, or environmental simulation. Each use should be linked to a specific pedagogical purpose. Without this situated framing, AI may accelerate representation while weakening students' ability to explain design decisions. With appropriate framing, however, AI can become a medium for reflective inquiry, comparative analysis, and situated design reasoning.

The third implication concerns ethical entanglement. The reviewed studies indicate that AI integration introduces ethical questions that cannot be addressed only through individual student responsibility. These questions include authorship, originality, algorithmic bias, accountability, dependency, environmental cost, and the reliability of AI-generated outputs. Dullinja and Jashanica (2025) show that many architecture students already use AI informally, while formal AI training remains limited. This gap is important because students may become fluent in producing AI-supported outputs without developing the critical capacity to evaluate how those outputs are produced or what assumptions they contain. Wang et al. (2025) directly address this issue by arguing that AI education in architecture should combine technical skill development with ethical reflection. Jin et al. (2024) also show that fragmented AI use can limit students' control over design outcomes.

These findings suggest that assessment systems must change. If AI becomes part of the design process, assessment cannot focus only on final visual outputs. It must also evaluate process transparency, critical decision-making, contextual interpretation, ethical awareness, and the student's ability to transform AI-generated material into architecturally meaningful proposals. A policy-oriented assessment framework for AI-supported architectural education should therefore include several criteria. Students should disclose where and how AI was used in the design process. They should demonstrate their own design reasoning by explaining how AI-generated outputs were selected, rejected, modified, or integrated. They should critically evaluate potential biases, limitations, and assumptions in generated outputs. They should also connect AI-supported representations to architectural criteria such as spatial organization, scale, materiality, context, user experience, environmental impact, and social responsibility.

This approach shifts the assessment question from whether the student used AI to how the student used AI critically, responsibly, and architecturally. Such a shift is necessary because prohibitive and purely permissive approaches are both insufficient. A prohibition-based approach ignores the reality that AI is already part of students' design practices. A purely permissive approach risks normalizing uncritical dependence on AI-generated outputs. What is needed instead is a transparent governance model that defines acceptable use, required disclosure, process documentation, ethical evaluation, and assessment standards.

This position is consistent with recent higher education research on generative AI and assessment. Luo (2024) argues that GenAI policies require a reconsideration of originality in student work rather than a simple return to pre-AI assessment assumptions. Xia et al. (2024) similarly show that generative AI transforms assessment in higher education by requiring curriculum and policy redesign. Weng et al. (2024) identify the need for innovative, refocused, and GenAI-incorporated assessment approaches that align assessment practices with emerging learning outcomes. Perkins et al. (2024) further propose a structured AI Assessment Scale that clarifies different levels of acceptable AI use in educational assessment. For architectural education, these arguments suggest that AI-supported studio assessment should define not only whether AI may be used, but also how its use should be disclosed, justified, evaluated, and connected to architectural learning outcomes.

The findings also suggest that AI-supported architectural education requires a broader educational capacity, which this study defines as ecological intelligence. In this paper, ecological intelligence does not refer only to environmental awareness. It refers to the capacity to think, design, evaluate, and act responsibly within interconnected systems of humans, AI technologies, materials, environments, institutions, and social consequences. This concept is central because AI-supported design decisions are never purely technical. They are also spatial, cultural, ethical, environmental, and institutional.

Ecological intelligence extends beyond conventional digital literacy. Digital literacy may enable students to operate tools, manage software, and produce outputs. Ecological intelligence requires students to understand how tools, datasets, design intentions, material consequences, social contexts, and environmental responsibilities are interconnected. It also extends beyond creativity because it asks whether creative outputs are contextually meaningful, ethically defensible, and environmentally responsible. In this sense, ecological intelligence provides a bridge between posthuman pedagogy and design education policy.

In practical terms, ecological intelligence can be cultivated through studio tasks that require students to connect AI-supported design processes with site conditions, material systems, user needs, environmental consequences, and social responsibilities. It can also be supported through reflective exercises in which students compare AI-generated outputs with site analysis, precedent research, spatial performance, and ethical criteria. Rather than treating AI as a shortcut for image production, educators can use AI as a trigger for questioning relationships among representation, context, materiality, and responsibility. Architectural education should not aim only to produce students who can use AI efficiently. It should aim to educate designers who can work critically within human-machine-material-environment relations.

The review findings can be translated into several implications for design education policy. First, curricula should treat AI as a design literacy rather than a purely technical skill. Second, studio pedagogy should require process transparency through documentation of prompts, iterations, selected outputs, rejected alternatives, and modifications. Third, assessment criteria should be revised to include responsible AI use, contextual reasoning, bias awareness, material logic, environmental implications, and ethical accountability. Fourth, educator training is necessary because instructors need support to understand AI tools, evaluate AI-supported work, guide students' critical use of AI, and address questions of authorship and academic integrity. Fifth, institutional guidelines should be developed for disclosure, acceptable use, data ethics, authorship, plagiarism, environmental responsibility, and assessment standards for AI-supported design work. These policies should not be static; they should be revised regularly as AI technologies, pedagogical practices, and professional expectations evolve.

The framework proposed in this study is not intended as a universal model that can be applied identically across all architectural schools. Architectural education differs across institutional cultures, accreditation systems, technological access, studio traditions, and regional contexts. Therefore, the framework should be understood as conceptually transferable rather than statistically generalizable. It provides principles that can be adapted to different educational settings where AI-supported design learning is becoming relevant. This distinction is important because the study does not claim to measure the effectiveness of AI-supported pedagogy. Rather, it provides a conceptual and interpretive synthesis based on available literature.

The study also has limitations. The empirical dataset is relatively small, consisting of eight studies that directly address AI, computational design, and architectural education. This limitation reflects the emerging nature of research at this intersection, but it also means that the findings should be interpreted with caution. Future studies should test and refine this framework through empirical research in design studios, curriculum experiments, longitudinal studies, and cross-institutional comparisons. Despite these limitations, the framework offers a useful starting point for architectural schools seeking to integrate AI responsibly into design education. It clarifies that the central issue is not whether AI should be included in architectural education, but how its inclusion should be pedagogically framed, ethically governed, and critically assessed.

5. Conclusion

This paper examined how architectural education is being reshaped by artificial intelligence, computational design, and AI-supported creativity through a posthuman pedagogical perspective. The study argued that AI should not be approached as a neutral technical tool added to existing studio practices, but as a condition that changes how design agency, knowledge production, authorship, assessment, and responsibility are organized in architectural education.

Based on a two-stage review design combining conceptual posthuman pedagogy literature with empirical and pedagogical studies on AI and computational design in architectural education, the paper identified three interrelated transformations. First, design agency is increasingly distributed across students, educators, AI systems, datasets, prompts, interfaces, materials, and studio environments. Second, AI-supported learning becomes pedagogically meaningful when it is situated within reflective studio processes, critique, material reasoning, spatial inquiry, and contextual interpretation. Third, AI introduces ethical entanglements that require architectural education to address authorship, originality, bias, accountability, dependency, environmental responsibility, and the critical evaluation of AI-generated outputs.

These findings support the main argument of the study: AI-supported architectural education requires a policy-oriented pedagogical framework rather than only technical training or informal experimentation. The contribution of this paper is therefore threefold. First, it clarifies how posthuman pedagogy can be used to interpret AI-supported architectural education through the concepts of distributed agency, situated knowing, and ethical entanglement. Second, it defines ecological intelligence as an educational capacity that connects technical AI fluency with contextual reasoning, ethical accountability, material awareness, environmental responsibility, and human–machine–material relations. Third, it translates these theoretical insights into practical implications for curriculum development, studio pedagogy, assessment criteria, educator training, and institutional governance.

The study contributes to the literature by moving beyond discussions that frame AI primarily in terms of productivity, creativity, visualization, or tool use. Instead, it positions AI integration as a pedagogical and policy question concerning how architectural schools should organize learning, authorship, critique, evaluation, and responsibility in increasingly AI-mediated design environments. In this sense, the proposed framework offers a transferable conceptual basis for architectural schools seeking to integrate AI responsibly into design education.

The practical implications of the study are also significant. Architectural curricula should treat AI as a design literacy that includes prompt literacy, dataset awareness, human-machine collaboration, critical interpretation, and ethical reflection. Studio pedagogy should require process transparency through documentation of prompts, iterations, rejected alternatives, modifications, and reflective decisions. Assessment should evaluate not only final visual outputs, but also students' ability to justify, contextualize, transform, and critically assess AI-supported design materials. Educator training and institutional guidelines are also necessary to support responsible AI use, academic integrity, authorship disclosure, bias awareness, and environmental accountability.

The study has limitations. The final empirical dataset is relatively small, consisting of eight studies directly addressing AI, computational design, and architectural education. This limitation reflects the emerging nature of the field, but it also restricts the empirical generalizability of the findings. Therefore, the framework should be understood as conceptually transferable rather than statistically generalizable. It can inform comparable architectural education contexts where AI-supported design learning, curriculum governance, and ethical responsibility are becoming relevant, but it should be adapted according to institutional culture, technological access, accreditation requirements, and studio traditions.

Future research should test and refine this framework through empirical studies in actual design studio settings. Longitudinal research is needed to examine how AI-supported pedagogy affects students' spatial reasoning, design judgment, ethical awareness, authorship practices, and ecological intelligence over time. Comparative studies across different institutions and cultural contexts would also help clarify how AI integration varies according to curriculum models, technological resources, educator expertise, and policy environments. Further research may also develop assessment rubrics and curriculum prototypes for responsible AI-supported architectural education.

In conclusion, architectural education carries a deep-rooted pedagogical tradition built on studio culture, embodied making, material experimentation, and critical dialogue. As it enters the age of AI, the task is not to replace this tradition, but to rethink how it evolves under new conditions of human–machine collaboration. The central question is no longer whether AI should be included in architectural education, but how architectural education can prepare students to design critically, responsibly, and imaginatively within more-than-human systems of intelligence.

Acknowledgements

None.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The author(s) report no conflicts of interest.

Data availability statement

The data that support the findings of this study are available from the corresponding author, A.K., upon reasonable request.

Institutional Review Board Statement

Not applicable.

CRediT author statement:

Conceptualisation: H.T., A.K., S.A.; Methodology: H.T., A.K., S.A.; Writing - original draft: H.T., A.K.; Writing - review & editing: S.A.; Visualisation: H.T., A.K.; Supervision: S.A. All authors have read and approved the final version of the manuscript.

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