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Integrating Artificial Intelligence Generated Content into Environmental Design Education: A Conceptual Analysis of a Sichuan Residential Space Course

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Abstract: *Artificial Intelligence Generated Content (AIGC) is increasingly positioned as a transformative influence in creative disciplines, yet its pedagogical functions in design education remain conceptually underexamined. This paper presents a conceptual analysis of AIGC integration in environmental design education, advancing a theoretically grounded framework informed by constructivist learning theory, design cognition, and spatial cognition research. Rather than framing AIGC as a technological innovation alone, the study reconceptualises it as a form of cognitive and representational support that mediates ideation, visualization, and reflective design processes. Through conceptual synthesis of interdisciplinary literature, three propositions are developed: (1) AIGC may facilitate spatial reasoning and creative exploration by expanding external visual representations; (2) its educational value is contingent upon pedagogical mediation, including instructional design, guided critique, and reflective engagement; and (3) cultural and disciplinary knowledge function as interpretive constraints shaping the appropriation and transformation of AI-generated outputs. The paper contributes a structured conceptual model clarifying how AIGC may influence learning processes, offering theoretical directions for curriculum design and future empirical inquiry in design education.*

Keywords: Artificial Intelligence Generated Content (AIGC); Environmental Design Education; Constructivism; Design Cognition; Spatial Cognition

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1. Introduction

1.1 Background and Educational Context

The rapid development of artificial intelligence (AI) technologies is reshaping creative industries and higher education, generating renewed debate about the nature of learning, creativity, and human–technology collaboration (Benvenuti et al., 2023; Wu et al., 2024). In art and design education, generative AI systems capable of producing text, images, and visual concepts, commonly referred to as Artificial Intelligence Generated Content (AIGC), are increasingly adopted as resources for ideation, visualization, and exploratory design processes (Lin et al., 2024; Zhang, 2025). Unlike conventional digital tools primarily designed to support technical execution, AIGC introduces algorithmically generated representations that may influence how learners construct, interpret, and refine design ideas.

Environmental design education is particularly sensitive to these developments due to its reliance on spatial cognition, visual reasoning, and iterative exploration. Design learning involves generating and manipulating representations, evaluating alternatives, and integrating contextual and cultural knowledge into coherent proposals (Cardoso et al., 2016; Lee & Ostwald, 2022). While digital modeling and visualization tools have long supported representational accuracy, AIGC extends this landscape by enabling rapid generation of variations and speculative visual scenarios. These affordances suggest potential cognitive and pedagogical implications that extend beyond efficiency or automation.

Simultaneously, higher education systems increasingly emphasise innovation, digital literacy, and pedagogical responsiveness, consistent with Sustainable Development Goal 4 (Quality Education). Within this context, integrating AIGC is not merely a technical decision but a theoretical and pedagogical concern requiring careful conceptualisation.

1.2 Problem Statement

Despite growing interest in AIGC across creative disciplines, its pedagogical functions within environmental design education remain insufficiently theorised. Existing literature has largely focused on technological capabilities, student acceptance, or empirical comparisons between AI-assisted and traditional design practices (Ji et al., 2024; Wu et al., 2024). Although these studies offer valuable insights, they often provide fragmented perspectives and limited conceptual clarification regarding how AIGC mediates learning processes, particularly those involving spatial reasoning and design cognition.

A persistent challenge in environmental design education concerns the development of spatial visualization and cognitive flexibility. Research in design cognition highlights that effective ideation depends on learners' capacity to externalise, reinterpret, and iteratively transform visual and spatial representations (Cardoso et al., 2016; Lee & Ostwald, 2022). Traditional instructional approaches, frequently centred on lectures, static drawings, and delayed critique, may constrain opportunities for dynamic exploration and immediate representational variation.

The integration of AIGC introduces additional tensions. While generative tools may expand visual possibilities, uncritical adoption risks superficial imitation, cognitive offloading, or aesthetic homogenisation. These concerns are particularly salient in culturally grounded courses, where disciplinary knowledge and regional design principles remain central. Consequently, a key conceptual gap persists: how can AIGC be understood pedagogically and cognitively within environmental design learning rather than merely technologically?

1.3 Aim of the Study

This paper presents a conceptual analysis aimed at developing a theoretically grounded framework for understanding the pedagogical integration of AIGC in environmental design education. Drawing on constructivist learning theory and research on design cognition and spatial cognition, the study reconceptualises AIGC as a form of cognitive and representational support. The objective is not to evaluate technological effectiveness empirically but to clarify theoretical relationships, pedagogical mechanisms, and design-learning implications.

1.4 Research Questions

This conceptual inquiry is guided by the following research questions:

RQ1: What theoretical and pedagogical challenges emerge in integrating AIGC into environmental design education?

RQ2: How may AIGC function as a cognitive and representational support within spatial and creative design learning?
RQ3: How can pedagogical mediation and cultural context shape meaningful AIGC-supported learning processes?

1.5 Significance of the Study

This study contributes to scholarship on design education and AI in education by advancing a theoretically integrated perspective on AIGC. First, it clarifies how generative AI may be interpreted through constructivist and cognitive lenses, extending discussions beyond technological affordances. Second, it proposes a structured conceptual framework linking AIGC, spatial cognition, and pedagogical mediation. Third, by foregrounding cultural and disciplinary context, the analysis addresses concerns regarding homogenisation and superficial AI adoption in heritage-oriented design courses.

More broadly, the paper informs curriculum design and future empirical research by identifying key conceptual variables and mechanisms relevant to AIGC-supported learning. In doing so, it supports ongoing efforts to integrate emerging technologies in ways aligned with educational quality, disciplinary integrity, and culturally responsive pedagogy.

2. Literature Review

2.1 AIGC in Art and Design Education

Artificial Intelligence Generated Content (AIGC) has rapidly entered discussions of art and design education, largely due to advances in generative AI systems capable of producing images, text, and design variations from multimodal inputs (Wu et al., 2024; Lin et al., 2024). Within creative disciplines, these tools are often described as catalysts for ideation, visualization, and experimentation, enabling students to externalise conceptual ideas and explore alternatives at unprecedented speed.

Empirical studies report that AIGC may support creative exploration by expanding visual repertoires and stimulating divergent thinking (Lin et al., 2024; Zhang, 2025). Generative outputs can function as prompts that provoke reinterpretation, comparison, and iterative refinement. However, findings remain mixed and context-dependent. While some research associates AIGC with enhanced ideation efficiency and perceived creativity, other studies caution against risks such as design fixation, aesthetic homogenisation, and overreliance on algorithmic suggestions (Wu et al., 2024).

Moreover, scholarship increasingly emphasises that the educational implications of AIGC cannot be reduced to technological capability. Ji et al. (2024) demonstrate that student acceptance and perceived usefulness depend strongly on instructional design and pedagogical alignment. Similarly, conceptual discussions of human–AI collaboration argue that generative tools reshape representational practices and decision-making processes rather than merely automating production (Benvenuti et al., 2023; Zhu et al., 2024).

Despite growing literature, two limitations are evident. First, many studies focus on general creativity outcomes rather than specific cognitive processes involved in design learning. Second, relatively few analyses address culturally grounded design contexts where disciplinary knowledge and heritage considerations mediate AI use.

2.2 Teaching Traditional Art and Architectural Culture in Design Education

Courses centred on traditional architectural culture occupy a distinctive position within environmental design education. Such courses require learners to interpret historical precedents, understand structural and spatial logic, and translate cultural knowledge into contemporary design applications. Learning is therefore simultaneously cognitive, visual, and interpretive.

Research indicates that teaching traditional architectural content presents persistent pedagogical challenges. Historical spatial forms and construction systems are often complex, demanding advanced visualization and representational interpretation (Bryant, 2021). Traditional instructional approaches, including lectures, static drawings, and case-based analysis, may limit learners' engagement with dynamic spatial reasoning and iterative exploration.

Digital visualization tools have been introduced to address these constraints by enhancing representational clarity and multimodal learning (Gruszczynska et al., 2013). Within this trajectory, AIGC offers additional possibilities by generating speculative reconstructions, visual variations, and contextualised imagery. These affordances may be particularly relevant for culturally grounded design learning, where students must bridge historical understanding and creative reinterpretation.

However, integrating generative AI into heritage-oriented courses raises conceptual tensions. Scholars warn that AI-generated outputs may privilege stylistic mimicry over structural reasoning or cultural interpretation if not pedagogically mediated (Wu et al., 2024; Zhu et al., 2024). The concern is not technological inadequacy but epistemic displacement: learners may accept visually persuasive outputs without engaging critically with disciplinary principles.

Consequently, understanding AIGC integration in traditional architectural education requires a framework that accounts for cognition, pedagogy, and cultural knowledge simultaneously.

2.3 Creativity and Spatial Cognition in Environmental Design Learning

Creativity in environmental design education is closely associated with ideation, problem framing, and iterative representation. Design cognition research conceptualises creativity not as spontaneous originality but as a dynamic process involving the generation, evaluation, and transformation of ideas through external representations (Cardoso et al., 2016; Lee & Ostwald, 2022).

Visual stimuli and representational variation play a central role in these processes. Exposure to diverse representations can facilitate divergent thinking, reinterpretation, and conceptual reframing. From this perspective, generative technologies may function as cognitive amplifiers by increasing the availability and variability of visual prompts.

Yet creativity research also highlights potential constraints. Excessive reliance on externally generated representations may induce fixation, reduce cognitive effort, or narrow exploratory pathways. Studies of AI-assisted ideation therefore emphasise the importance of reflective engagement and metacognitive regulation (Lin et al., 2024; Zhu et al., 2024).

Importantly, creativity is shaped by constraints rather than inhibited by them. Cultural, disciplinary, and contextual boundaries provide interpretive structures that guide meaningful innovation (Lee & Ostwald, 2022). This insight is particularly relevant for culturally grounded design courses, where creative reinterpretation must remain anchored in architectural logic and heritage understanding.

2.4 The Role of Digital Tools in Supporting Design Learning Processes

Spatial cognition constitutes a foundational competence in environmental design education. It encompasses the ability to perceive, interpret, and mentally manipulate spatial relationships and three-dimensional structures (Stieff et al., 2005). Visualization research demonstrates that external representations, such as diagrams, models, and simulations, support spatial reasoning by reducing cognitive load and enabling iterative reinterpretation.

Traditional design pedagogy has long relied on sketches, drawings, and physical models as mediational tools. Digital technologies further expanded these representational resources through three-dimensional modeling and immersive visualization. AIGC introduces a qualitatively different representational dynamic: instead of manually constructing representations, learners interact with algorithmically generated visual scenarios.

Conceptual discussions suggest that AIGC-generated imagery may function as cognitive scaffolds, representational provocations, and iterative comparison resources.

However, scholars caution that visual abundance alone does not guarantee improved spatial reasoning. Without pedagogical structuring, learners may engage superficially with generated outputs rather than developing internal visualization skills (Wu et al., 2024). Thus, the cognitive implications of AIGC must be interpreted through learning theory rather than technological determinism

2.5 Pedagogical Mediation and Digital Learning

Constructivist perspectives conceptualise learning as an active process of meaning construction mediated by interaction, representation, and reflection. Within this framework, digital tools are not neutral instruments but mediational artefacts shaping cognitive engagement.

Research on technology-supported learning consistently shows that educational value depends on pedagogical mediation, including task design, instructor guidance, reflective critique, and metacognitive scaffolding (Khosravi et al., 2022; Ji et al., 2024). Explainable AI research further emphasises transparency and interpretability, suggesting that learners benefit when AI outputs are positioned as resources for reasoning rather than authoritative solutions (Khosravi et al., 2022).

In design education, pedagogical mediation is particularly critical because creativity and spatial reasoning involve iterative judgment, ambiguity tolerance, and reflective evaluation. Generative AI tools may either enhance or disrupt these processes depending on instructional framing.

2.6 Identified Conceptual Gap

The reviewed literature reveals several unresolved issues as follows:

i. *Technological emphasis over pedagogical theory*
   Many studies prioritise tool functionality or adoption metrics.
ii. *Limited focus on cognitive mechanisms*
   Few analyses connect AIGC to design cognition or spatial cognition explicitly.
iii. *Underrepresentation of culturally grounded contexts*
   Heritage-oriented design courses remain largely unexplored.
iv. *Fragmented conceptual models*
   Lack of integrated frameworks linking AIGC, cognition, pedagogy, and culture.

2.7 Positioning of the Present Study

Addressing these gaps, this paper advances a conceptual analysis that:

i. Interprets AIGC through constructivist and cognitive lenses
ii. Links generative AI with spatial and design cognition
iii. Emphasises pedagogical mediation
iv. Incorporates cultural–disciplinary context

Rather than evaluating empirical effectiveness, the study clarifies theoretical relationships and pedagogical propositions to guide curriculum design and future research.

3. Conceptual Framework and Propositions

3.1 Theoretical Orientation

This study adopts a conceptual synthesis approach to theorise how Artificial Intelligence Generated Content (AIGC) may be pedagogically integrated into environmental design education. Rather than evaluating learning outcomes empirically, the framework seeks to clarify how and under what conditions AIGC may function as a mediational resource within design learning processes.

The framework is grounded in three complementary theoretical perspectives:

i. *Constructivist learning theory*, which conceptualises learning as an active process of meaning construction mediated by interaction, representation, and reflection. From this perspective, knowledge in design education is not transmitted but constructed through engagement with visual artefacts, iterative exploration, and critique.
ii. *Design cognition*, which emphasises ideation, problem framing, and iterative representation as central mechanisms of creative design thinking. Design cognition research highlights the role of external representations in enabling reinterpretation, comparison, and conceptual transformation.
iii. *Spatial cognition*, which focuses on learners' ability to perceive, manipulate, and reason about spatial relationships. Visualization and representational tools are understood as cognitive supports that externalise spatial information and reduce processing demands during complex design tasks.

Integrating these perspectives, the framework conceptualises AIGC not as an autonomous creative agent, but as a representational and cognitive mediator embedded within pedagogical and cultural contexts.

3.2 Core Assumptions of the Framework

The proposed framework rests on four core assumptions:

i. *Learning in environmental design is representationally mediated*
Design learning depends on interaction with external visual and spatial representations that support ideation and reasoning.
ii. *AIGC produces representational abundance rather than knowledge*
AI-generated outputs do not constitute understanding; their educational value depends on how learners interpret, evaluate, and transform them.
iii. *Pedagogical mediation determines cognitive engagement*
Without instructional structuring and reflective guidance, AIGC risks encouraging superficial imitation rather than deep learning.

iv. *Cultural and disciplinary knowledge act as interpretive constraints*
In environmentally and culturally grounded design education, disciplinary principles and cultural logic guide meaningful appropriation of AI-generated content.

These assumptions position AIGC as conditionally educational, rather than inherently beneficial.

3.3 Structure of the Conceptual Framework

The conceptual framework comprises three interrelated components that collectively shape AIGC-supported learning in environmental design education.

3.3.1 AIGC as Cognitive and Representational Support

Within the framework, AIGC is conceptualised as a cognitive and representational support system that generates visual artefacts, design variations, and speculative spatial scenarios. These outputs function as external representations that learners can observe, compare, reinterpret, and critique.

From a cognitive perspective, AIGC may expand the range of visual stimuli available during ideation, facilitate iterative comparison of spatial alternatives and support externalisation of abstract design concepts.

However, the framework does not assume that such representational abundance automatically enhances learning. Instead, AIGC-generated representations are understood as potential cognitive affordances whose educational impact depends on learner engagement and pedagogical structuring

3.3.2 Pedagogical Mediation and Instructional Design

Pedagogical mediation occupies a central position in the framework. It refers to the instructional strategies through which AIGC is embedded into learning activities, including task design and sequencing, instructor guidance and critique, and reflective and evaluative learning activities.

Pedagogical mediation determines whether learners engage with AI-generated content analytically or adopt it uncritically. In the absence of mediation, learners may prioritise visual plausibility over conceptual reasoning or cultural coherence.

Within this framework, instructors function as epistemic guides, helping students interrogate AI-generated outputs, articulate design rationales, and align representations with disciplinary principles. Pedagogical mediation thus transforms AIGC from a generative tool into a learning resource.

3.3.3 Cultural and Disciplinary Context

Environmental design education is inherently situated within cultural, historical, and disciplinary contexts. The framework recognises cultural and disciplinary knowledge as interpretive structures that shape how AIGC outputs are evaluated and transformed.

In culturally grounded design courses, such as those involving traditional architectural principles, cultural context functions in two ways, that are, as a constraint, limiting uncritical adoption of stylistic features, and as a generative resource, guiding meaningful reinterpretation and innovation

Rather than viewing cultural constraints as barriers to creativity, the framework aligns with design cognition research that conceptualises constraints as productive conditions for innovation. Cultural and disciplinary knowledge therefore mediates how learners appropriate AI-generated representations and integrate them into coherent design thinking.

3.4 Dynamic Interactions within the Framework

The framework emphasises the dynamic interaction among its three components:

- AIGC provides representational inputs
- Pedagogical mediation structures cognitive engagement
- Cultural context guides interpretation and judgment

Learning emerges not from any single component but from their interaction. For example, AI-generated imagery may stimulate ideation, but meaningful learning occurs only when learners critically evaluate these representations through pedagogically guided and culturally informed reflection.

3.5 Conceptual Propositions

Based on the framework, the study advances three conceptual propositions:

P1: AIGC may support spatial cognition and creative ideation by expanding external visual representations and enabling iterative exploration, provided learners actively engage with generated outputs.

P2: The pedagogical value of AIGC is contingent upon instructional mediation, including task design, instructor guidance, and reflective critique, which shape learners' cognitive and metacognitive engagement.

P3: Cultural and disciplinary knowledge function as interpretive constraints that shape how AI-generated content is appropriated, evaluated, and transformed within environmental design learning.

These propositions articulate theoretical relationships rather than testable hypotheses, consistent with the conceptual orientation of the study.

3.6 Positioning of the Framework

The proposed framework contributes to scholarship by moving beyond tool-centred discussions of AIGC, linking generative AI to cognitive and pedagogical theory, and integrating cultural context into AI-supported design learning

It provides a conceptual foundation for future empirical research and curriculum design, offering a structured way to theorise AIGC integration without reducing learning to technological determinism.

4. Discussion

4.1 Theoretical Implications

This conceptual analysis advances current discussions on Artificial Intelligence Generated Content (AIGC) by situating generative AI within learning theory and design cognition, rather than treating it solely as a technological innovation. While much of the existing literature emphasises tool capabilities, adoption patterns, or creativity outcomes, the present framework foregrounds the cognitive-pedagogical mechanisms through which AIGC may mediate environmental design learning.

From a constructivist perspective, learning in design education is fundamentally representational and interpretive. Students construct knowledge by engaging with visual artefacts, iteratively generating alternatives, and refining ideas through critique. Within this epistemic structure, AIGC-generated outputs may be conceptualised as mediational representations that expand the landscape of visual stimuli and speculative possibilities. This interpretation aligns with research in design cognition, which highlights the importance of external representations in supporting ideation, reframing, and conceptual transformation (Cardoso et al., 2016; Lee & Ostwald, 2022).

However, the framework challenges technologically deterministic assumptions by emphasising that representational abundance alone does not constitute learning. AIGC outputs acquire pedagogical significance only when learners engage in processes of interpretation, evaluation, and transformation. Without reflective engagement, generative representations risk functioning as substitutes for reasoning rather than supports for cognition. This tension echoes broader debates in creativity research concerning cognitive offloading, fixation, and dependency in AI-assisted ideation (Wu et al., 2024; Zhu et al., 2024).

The framework further contributes to theoretical discussions by integrating spatial cognition into analyses of AIGC-supported learning. Environmental design relies heavily on spatial reasoning, visualization, and representational manipulation. AIGC tools introduce novel representational dynamics by enabling rapid generation of spatial scenarios and design variations. Yet, consistent with visualization research, cognitive benefits are mediated by learners' active processing rather than passive exposure (Stieff et al., 2005).

Importantly, the study extends human-AI collaboration discourse by highlighting the centrality of pedagogical mediation. Rather than framing AIGC as an autonomous co-designer, the framework positions instructors and instructional design as critical regulators of cognitive engagement. This perspective aligns with scholarship arguing that AI technologies function within educational ecosystems shaped by pedagogy, epistemology, and disciplinary norms (Benvenuti et al., 2023; Khosravi et al., 2022).

4.2 Pedagogical and Curricular Implications

The conceptual propositions developed in this study offer several implications for environmental design pedagogy. First, AIGC integration should be understood as a pedagogical design challenge rather than a tool adoption decision. The educational value of generative AI depends on how it is embedded within tasks, critique structures, and reflective activities.

Structured task design is particularly crucial. When AIGC is incorporated into clearly defined design briefs and inquiry-oriented activities, learners are more likely to treat generated outputs as prompts for exploration rather than final solutions. This pedagogical framing encourages comparison, reinterpretation, and justification as processes which are central to design cognition.

Second, the framework underscores the enduring importance of instructor mediation and critique. Generative AI may accelerate visual production, but it does not replace disciplinary judgment, contextual interpretation, or evaluative reasoning. Instructor-guided critique helps students interrogate AI-generated artefacts, identify conceptual inconsistencies, and align visual outputs with spatial, structural, and cultural logic.

Third, reflective and metacognitive activities become increasingly important in AI-supported learning environments. Students must develop the capacity to evaluate the credibility, relevance, and limitations of AI-generated representations. Pedagogical strategies that prompt explanation, comparison, and design rationale articulation can mitigate risks of superficial imitation or overreliance.

4.3 Cultural and Disciplinary Considerations

A distinctive contribution of this conceptual analysis lies in its emphasis on cultural and disciplinary context. Environmental design education is not only a technical or cognitive endeavour but also an interpretive practice embedded within cultural traditions, historical knowledge, and regional design logics.

In culturally grounded courses, AIGC integration presents a paradox. On one hand, generative AI may expand exploratory possibilities and enable visual reconstructions of traditional forms. On the other, algorithmically generated outputs may privilege stylistic plausibility over structural reasoning or cultural coherence if adopted uncritically.

The framework therefore conceptualises cultural and disciplinary knowledge as interpretive constraints that shape meaningful AI use. Consistent with creativity theory, constraints are not inherently restrictive but may function as productive conditions guiding innovation. Cultural logic, architectural principles, and historical understanding mediate how learners evaluate, appropriate, and transform AI-generated representations.

This perspective challenges narratives that position AI as a homogenising force by emphasising the agency of pedagogical design and disciplinary framing. When culturally responsive mediation is present, AIGC may support reinterpretation rather than imitation, fostering reflective engagement with heritage rather than aesthetic replication.

4.4 Implications for Future Research

As a conceptual study, this paper does not claim empirical validation but instead proposes a theoretical framework to guide subsequent inquiry. Future research may examine the propositions articulated here through the following:

- Experimental or quasi-experimental designs
- Mixed-method investigations of cognitive engagement
- Studies of representational interaction in design tasks
- Cross-cultural analyses of AI-supported design pedagogy

Particularly valuable would be empirical exploration of how AIGC-generated representations influence spatial reasoning, ideation processes, and metacognitive regulation. Additionally, research examining instructor mediation strategies may clarify how pedagogical structuring shapes learner outcomes and perceptions.

5. Conclusion

This paper presented a conceptual analysis of integrating Artificial Intelligence Generated Content (AIGC) into environmental design education, advancing a theoretically grounded framework that repositions generative AI within learning theory and design cognition. Rather than evaluating technological effectiveness empirically, the study sought to clarify how AIGC may be understood pedagogically as a form of cognitive and representational mediation.

The primary contribution of this study lies in the development of a structured conceptual framework integrating constructivist learning theory, design cognition, and spatial cognition perspectives. By conceptualising AIGC as a mediational resource rather than an autonomous creative agent, the analysis challenges technologically deterministic interpretations that equate AI adoption with educational enhancement. Instead, the framework emphasises that the pedagogical significance of AIGC emerges through processes of interpretation, evaluation, and transformation, shaped by instructional design and learner engagement.

A second contribution concerns the articulation of pedagogical mediation as a central mechanism governing AIGC-supported learning. Generative AI tools do not inherently produce meaningful educational outcomes; their value depends on task structuring, instructor guidance, and reflective critique. This perspective advances ongoing debates in AI-assisted creativity research by foregrounding epistemic and cognitive considerations over efficiency-oriented narratives.

Third, the framework extends existing discussions by incorporating cultural and disciplinary context as integral components of AI integration. In culturally grounded design education, disciplinary principles and cultural knowledge function as interpretive constraints that shape how AI-generated outputs are appropriated and evaluated. This conceptualisation reframes cultural constraints not as limitations but as productive conditions guiding reflective and contextually coherent creativity.

Collectively, these contributions position AIGC integration as a pedagogical and epistemological design challenge, offering a conceptual vocabulary that may inform curriculum development and future empirical investigations.

Beyond its theoretical contributions, this study also speaks to broader educational priorities associated with Sustainable Development Goal 4 (Quality Education). By emphasising pedagogically mediated and culturally responsive uses of AIGC, the framework highlights how emerging technologies may support richer visualization, exploratory learning, and reflective engagement without displacing disciplinary understanding. In this sense, AIGC is conceptualised not merely as a digital innovation but as a potential resource for enhancing learning quality, fostering creative confidence, and promoting inclusive forms of design thinking aligned with contemporary educational transformation.

As a conceptual study, this paper does not claim empirical validation. Instead, it proposes a theoretically informed model intended to guide subsequent research. Future studies may examine the propositions advanced here through experimental, quasi-experimental, or mixed-method approaches, particularly focusing on learners' cognitive engagement with AI-generated representations and the role of pedagogical mediation.

In conclusion, the educational implications of AIGC extend beyond technological adoption. Meaningful integration requires conceptual clarity regarding the cognitive, pedagogical, and cultural dynamics that mediate human-AI interaction in design learning. By situating AIGC within established theories of learning and cognition, this study contributes to a more nuanced understanding of how generative AI may support innovation while preserving disciplinary integrity and cultural responsiveness in environmental design education.

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Conflict of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

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