Pedagogical Mechanisms of Human-AI Co-Creation in Higher Art and Design Education with Generative AI

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ABSTRACT

Generative artificial intelligence (GenAI) is increasingly entering higher art and design education, creating new possibilities for ideation, visual generation, design comparison, and iterative development. However, rapid access to generated content does not necessarily translate into meaningful artistic learning. When teaching activities focus only on image-generation efficiency or the quality of final artefacts, students may remain at the level of selecting and accepting AI outputs, without sustained aesthetic judgement, creative exploration, or independent re-creation. This paper examines human–AI co-creation in higher art and design education from a pedagogical-mechanism perspective and proposes a conceptual framework. It adopts structured literature integration and theoretical synthesis, drawing on Vygotsky's Sociocultural Learning Theory and Dewey's Aesthetic Experience Theory as its two theoretical foundations. Literature on GenAI in art education, human–AI collaborative design, creative thinking, aesthetic experience, and relevant educational guidance documents is examined thematically. The synthesis identifies four interrelated pedagogical mechanisms: creative generation, aesthetic judgement, human–AI iterative co-creation, and artistic re-creation. Creative generation opens up diverse spaces for exploration; aesthetic judgement enables students to evaluate alternatives in relation to design intentions and visual principles; human–AI iterative co-creation advances ideas through prompt adjustment, feedback, and regeneration; and artistic re-creation involves the purposeful modification, reorganisation, and re-expression of generated content. These mechanisms are not fixed or unidirectional stages but form a recursive learning process characterised by feedback and interaction. On this basis, the paper proposes a learner-centred conceptual framework and discusses its implications for curriculum design, teacher guidance, process-oriented assessment, and responsible AI use. The framework is a theoretical proposal derived from literature integration. It has not been empirically tested using classroom data in this paper and requires further examination and refinement through authentic classroom practice and learning-process evidence.

Keywords: Generative Artificial Intelligence; Human–AI Co-creation; Higher Art and Design Education; Pedagogical Mechanisms; Creative Thinking

INTRODUCTION

Research Background

Generative artificial intelligence (GenAI), through text-to-image generation, image editing, and multimodal interaction, is entering higher art and design education and enabling students to explore multiple visual concepts, stylistic directions, and compositional alternatives in a relatively short time. Unlike conventional digital design tools, which primarily execute operations specified by users, GenAI can produce new candidate content in response to prompts and participate in ideation, design comparison, and revision through continued interaction. In courses such as visual communication design, poster design, and digital media design, these capabilities provide new resources for creative exploration and alter the ways in which students interact with tools. Anantrasirichai and Bull (2022) argue that the value of AI in the creative industries is better understood as augmenting, rather than replacing, human creativity [1].

Nevertheless, generation speed and visual richness are not direct indicators of learning quality. Students may obtain large numbers of images quickly without necessarily being able to explain their selection criteria, distinguish visual quality, diagnose design problems, or develop independent expression. Habib et al. (2024), in a study of university students' creativity, found that GenAI could support some aspects of divergent thinking, while also highlighting the need for teachers to attend to students' creative confidence and independent thinking [9]. Vartiainen et al. (2025) showed that human–AI co-design can redistribute design decisions and influence how participants understand their own agency in the design process [17]. An experiment by Doshi and Hauser (2024) further suggested that generative AI may enhance individual creative performance while increasing the risk of convergence in collective outputs [6]. Kasneci et al. (2023) likewise emphasised the need for teacher supervision, critical use, and an understanding of technological limitations in educational applications [12]. Earlier reviews of AI in education also indicate that technology use should be aligned with explicit teaching objectives and learning assessment [20].

This paper focuses on how students use AI-generated outputs as resources for creative exploration, make aesthetic judgements based on design intentions and visual principles, and engage in purposeful iteration and artistic re-creation while maintaining creative agency.

Research Gaps and Problem Statement

Recent studies have increasingly examined the applications of generative artificial intelligence (GenAI) in higher education, art education, and design-related creative processes. Qian's (2025) systematic review identifies creativity, critical thinking, learner autonomy, and prompt literacy as important themes in the pedagogical applications of GenAI in higher education [14]. Rong et al. (2025) highlight ideation, multimodal expression, and interdisciplinary projects as major areas of GenAI application in higher education art, while identifying continuing challenges in teacher development and assessment standards [15]. Similarly, Jiang et al. (2026) report that research on GenAI in art education remains at an emerging stage, with further development needed in pedagogical frameworks, ethical guidance, and assessment approaches [11]. Research on human–AI collaborative design has also examined design stages, interaction modes, and collaboration processes [8]. These studies provide a valuable foundation for understanding the educational and creative potential of GenAI. Nevertheless, several issues remain insufficiently addressed from the perspective of higher art and design education.

First, the integration of pedagogical mechanisms remains insufficiently developed. Existing studies have examined different aspects of GenAI-supported creativity and design, including idea generation, aesthetic evaluation, prompt interaction, and collaborative design processes [8, 11, 15, 17]. However, these activities are often discussed in relation to particular applications or stages of creative work. Their distinct pedagogical functions and interrelationships within a broader human–AI co-creative learning process require further clarification. In particular, a more integrated explanation is needed of how creative generation, aesthetic judgement, iterative interaction, and artistic re-creation relate to one another in higher art and design education.

Second, the learning processes underlying human–AI co-creation require further pedagogical explanation. Existing research has begun to examine how GenAI influences creative decisions and human–technology relationships during collaborative design [8, 17]. However, the educational significance of these interactions cannot be fully understood through the generation of visual outputs or the efficiency of design production alone. Greater attention is needed to how students interpret AI-generated materials, exercise aesthetic judgement, identify visual problems, adjust their creative directions, and transform generated content into personally meaningful artistic expressions. This issue is particularly important for preserving learner agency and ensuring that GenAI functions as a mediational resource rather than replacing students' creative decision-making.

Third, the operationalisation of pedagogical mechanisms into observable learning behaviours and analytical dimensions remains limited. Although existing studies discuss creativity, learner autonomy, prompt literacy, and assessment challenges [11, 14, 15], further conceptual clarification is needed regarding how these broad educational concerns can be examined through specific learner actions and design processes. For example, creative exploration may be reflected in the diversity of generated ideas, aesthetic judgement in students' reasons

for comparing visual alternatives, iterative co-creation in purposeful prompt adjustments and feedback, and artistic re-creation in the transformation of generated materials into individual visual expressions. Without clearly differentiated analytical dimensions, it may be difficult to examine how these mechanisms manifest in learning activities and how they relate to students' creative thinking and aesthetic awareness.

In response to these gaps, this paper develops a conceptual framework of human–AI co-creation in higher art and design education, drawing on Sociocultural Learning Theory (Vygotsky, 1978) and Aesthetic Experience Theory (Dewey, 1934) as complementary theoretical foundations. It proposes four interrelated pedagogical mechanisms: Creative Generation, Aesthetic Judgement, Human–AI Iterative Co-Creation, and Artistic Re-Creation. Rather than treating these mechanisms as isolated or strictly sequential activities, the paper explains their pedagogical functions, recursive relationships, and potential observable manifestations. The framework aims to provide a theoretically grounded basis for understanding human–AI co-creative learning, informing course design and process-oriented assessment, and guiding subsequent empirical investigation in higher art and design education. This paper is a conceptual synthesis and does not claim to establish the empirical effectiveness or causal impact of the proposed mechanisms.

Research Aim and Questions

This paper aims to explain the core pedagogical mechanisms of human–AI co-creation in higher art and design education supported by GenAI through structured literature integration and theoretical synthesis. It clarifies the theoretical rationale for each mechanism, the actions undertaken by learners, and the observable dimensions that may be operationalised in future research. The paper addresses the following questions:

RQ1: What are the core pedagogical mechanisms of human–AI co-creation in higher art and design education supported by GenAI, and what are their theoretical foundations?

RQ2: How are the four pedagogical mechanisms interconnected, and what is their potential relevance to students' creative thinking and aesthetic awareness?

RQ3: How can the four pedagogical mechanisms be translated into observable and analysable learning behaviours and assessment dimensions?

Theoretical and Practical Contributions

The contributions of this paper are threefold. First, it brings Sociocultural Learning Theory and Aesthetic Experience Theory together as complementary foundations, explaining respectively the mediating processes through which AI may participate in creative cognition and the ways in which aesthetic perception acquires experiential meaning through action and re-expression. Second, it proposes four interrelated pedagogical mechanisms—creative generation, aesthetic judgement, human–AI iterative co-creation, and artistic re-creation—and specifies observable learner actions and analytical dimensions for each. Third, it emphasises the recursive feedback relationships among the four mechanisms and the centrality of learner agency, providing a conceptual framework for course design, process-oriented assessment, and future empirical research in higher art and design education.

LITERATURE REVIEW

Research on GenAI in Higher Art and Design Education

The application of generative artificial intelligence (GenAI) in art and design education has expanded to include conceptual ideation, visual exploration, and creative expression. Recent reviews identify ideation, multimodal expression, and interdisciplinary projects as major application areas, while highlighting the need for stronger pedagogical frameworks and assessment approaches (Rong et al., 2025; Jiang et al., 2026) [11, 15]. Bian et al. (2025) further demonstrate the potential of AI-generated images as instructional resources, although their study focuses on primary-school visual arts education rather than students' active human–AI co-creation in higher education [4].

In design research, Fang et al. (2025) examine the stages and interaction modes of GenAI-supported conceptual design, while Yu (2025) discusses AI as both a co-creator and design material, highlighting its potential to support cognitive flexibility and design evaluation [8, 19]. These studies suggest that the educational value of GenAI extends beyond generated outputs to include students' interaction, decision-making, and visual development.

Research on creativity also emphasises the importance of considering both individual and contextual factors (Hennessey & Amabile, 2010) and recognising different levels of creative expression (Kaufman & Beghetto, 2009) [10, 13]. Accordingly, understanding GenAI-supported learning in higher art and design education requires attention to how students generate ideas, make aesthetic judgements, refine visual solutions, and develop individual artistic expressions.

Literature Related to the Four Pedagogical Mechanisms

Creative Generation: AI-Supported Ideation and Creative Exploration

Creative generation concerns how students develop initial ideas, explore alternative visual directions, and expand conceptual possibilities through interaction with GenAI. Habib et al. (2024) report that GenAI may support university students' divergent thinking, particularly in relation to creative exploration, while emphasising the importance of maintaining creative confidence and independent thinking [9]. Qian (2025) similarly identifies creativity, critical thinking, learner autonomy, and prompt literacy as important themes in GenAI-supported higher education [14]. In art and design education, Rong et al. (2025) identify ideation and multimodal expression as important application areas of generative AI, while Yu (2025) highlights its potential to support cognitive flexibility [15, 19].

These studies suggest that GenAI can provide visual alternatives and associative stimuli that extend students' initial ideas. However, generating multiple images does not necessarily indicate the development of creative thinking. The educational value lies in students' ability to establish new associations, explore different conceptual directions, and develop their own ideas. Accordingly, creative fluency, creative flexibility, and image-thinking ability are proposed as observable dimensions of the Creative Generation Mechanism (Me1).

Sociocultural Learning Theory (Vygotsky, 1978) provides a theoretical basis for understanding this process through the mediating role of cultural tools and symbolic resources. Prompts allow students to articulate preliminary visual intentions, while generated outputs provide materials for further interpretation and exploration. The value of these resources ultimately depends on students' active engagement rather than the quantity of images produced.

Aesthetic Judgement: Visual Evaluation and Reflective Perception

Aesthetic judgement refers to students' ability to observe, compare, interpret, and evaluate visual alternatives in relation to design intentions and aesthetic qualities. Although GenAI provides diverse images in terms of composition, colour, style, and emotional expression, access to visual alternatives does not automatically lead to reasoned aesthetic decisions.

Yu (2025) identifies design evaluation as a potential contribution of AI-supported design processes [19]. Bara et al. (2025) further demonstrate that contextual information about AI-generated visual art may influence aesthetic and moral judgements, suggesting that evaluation involves more than visual appearance alone [3]. Arnheim's (1969) discussion of visual thinking also highlights the relationship between visual perception, formal organisation, and meaning [2]. Together, these perspectives emphasise the importance of students' ability to explain why particular visual choices are appropriate to their design intentions.

These studies provide a basis for the Aesthetic Judgement Mechanism (Me2). Its central function is not simply selecting preferred images or evaluating final artefacts, but developing reasoned aesthetic decisions supported

by visual evidence. Relevant observable dimensions include the quantity and depth of aesthetic reasoning, sensitivity to stylistic differences, and visual literacy.

Dewey's (1934) Aesthetic Experience Theory provides the principal theoretical foundation for this mechanism. It emphasises active perception, qualitative discrimination, and reflection. Accordingly, aesthetic judgement is understood as an active process through which students interpret visual impressions and relate them to expressive intentions.

Human–AI Iterative Co-Creation: Prompt Refinement and Mediated Design Action

Human–AI iterative co-creation concerns the purposeful refinement of visual solutions through repeated interaction between students and GenAI. Unlike initial creative exploration, this mechanism focuses on how students identify problems in generated outputs, adjust prompts or generation conditions, examine subsequent results, and make further design decisions.

Fang et al. (2025) examine interaction stages and collaborative processes in GenAI-supported conceptual design, providing a basis for understanding iteration as part of a broader design process [8]. Vartiainen et al. (2025) also discuss changing roles and decision-making in human–AI co-design [17]. Qian (2025) identifies prompt literacy as an important aspect of GenAI-supported higher education, while Yu (2025) considers AI as both a co-creator and design material, noting potential concerns about cognitive load and dependency [14, 19].

These studies suggest that prompt development involves more than formulating technical instructions. It requires students to clarify visual intentions, identify design problems, and translate them into specific adjustments. Therefore, repeated generation alone does not constitute meaningful co-creation; its educational value lies in purposeful cycles of problem identification, prompt refinement, regeneration, comparison, and decision-making.

Sociocultural Learning Theory (Vygotsky, 1978) explains this process through mediated action and scaffolding. GenAI provides resources for exploring possible solutions, while teachers guide students in interpreting and evaluating generated materials. Accordingly, prompt precision, iteration patterns, style consistency, and the development of judgement are proposed as observable dimensions of the Human–AI Iterative Co-Creation Mechanism (Me3).

Artistic Re-Creation: Human-Led Transformation and Construction of Meaning

Artistic re-creation refers to how students transform AI-generated materials into visual expressions shaped by their own intentions and artistic decisions. This may involve redrawing, cropping, collage, editing, recomposition, typographic adjustment, or visual narrative reconstruction. The emphasis is on human interpretation and transformation rather than the passive acceptance of generated outputs.

Rong et al. (2025) identify multimodal expression as an important application of generative AI in art education, while Yu (2025) conceptualises AI as both a co-creator and design material [15, 19]. Bian et al. (2025) examine AI-generated images as instructional resources in visual arts education [4]. Although their study focuses on a different educational context and does not directly establish the effects of student-led re-creation in higher education, it highlights the distinction between using generated images as learning materials and actively transforming visual content.

Dewey's (1934) Aesthetic Experience Theory provides the theoretical foundation for this mechanism by emphasising the relationship between action, perception, materials, and meaning. Through modifying and reorganising visual materials, students can reconsider their original intentions and develop more coherent expressions.

The Artistic Re-Creation Mechanism (Me4) therefore focuses on transforming generated materials into personally meaningful and intentionally organised visual expressions. Its observable dimensions include originality, visual narrative quality, style unity, and clarity of expressive intention. Originality is understood not

as the quantity of modifications, but as the extent to which students reinterpret materials through their own conceptual and aesthetic decisions.

Human–AI Co-Creative Art Learning: Integrating the Four Mechanisms

The reviewed literature suggests that human–AI co-creative learning involves four related but distinguishable forms of learner activity. Research on GenAI-supported creativity informs creative exploration and idea development [9, 14, 15, 19], while studies of visual evaluation highlight the importance of aesthetic judgement [2, 3, 19]. Research on collaborative design and prompt interaction provides insights into iterative human–AI processes [8, 14, 17], and studies of multimodal expression inform human-led artistic transformation [4, 15, 19].

Taken together, these studies indicate that human–AI co-creation involves more than generating visual outputs. It encompasses four interconnected pedagogical mechanisms: Creative Generation expands creative possibilities; Aesthetic Judgement evaluates visual alternatives; Human–AI Iterative Co-Creation refines solutions through purposeful interaction; and Artistic Re-Creation transforms generated materials into meaningful expressions. These mechanisms operate recursively rather than as strictly sequential stages, with students retaining responsibility for creative intentions, aesthetic decisions, and final artistic expression. This synthesis provides the foundation for the four-mechanism framework developed in the following section.

Theoretical Foundations

Building on the literature related to the four pedagogical mechanisms, this section introduces the two theoretical foundations that guide the interpretation and conceptual integration of these mechanisms.

Sociocultural Learning Theory (Vygotsky, 1978)

Sociocultural Learning Theory emphasises that higher psychological functions develop through social interaction and the mediation of cultural tools. Language, symbols, and tools do not merely express existing thoughts; they also participate in how learners direct attention, form concepts, and solve problems (Vygotsky, 1978). In this paper, GenAI is understood as a digital tool that may function as a mediational resource. Students use prompts to express visual intentions that may not yet be fully formed, while AI outputs provide visual materials that can be observed, compared, and discussed, enabling students to clarify concepts, identify gaps, and adjust their creative directions.

It is important to emphasise that an AI system is not automatically equivalent to a teacher or a more knowledgeable peer, nor should it be regarded as an effective scaffold merely because it can generate content. AI-generated content may function as a cognitive scaffold only when teachers design appropriate tasks and students actively interpret the outputs and translate feedback into subsequent actions. Recent research on GenAI-supported collaborative design also suggests that AI can influence design decisions, while human judgement, goal-setting, and responsibility remain important [8, 17].

Within the proposed framework, Sociocultural Learning Theory primarily informs Me1, the Creative Generation Mechanism, and Me3, the Human–AI Iterative Co-Creation Mechanism. Me1 is concerned with the use of AI-generated visual materials as mediational resources for conceptual expansion and divergent ideation. Me3 focuses on how students use prompts, generated outputs, and feedback to guide subsequent actions and refine creative solutions.

Aesthetic Experience Theory (Dewey, 1934)

Dewey (1934) [5] understands art as an organisation of experience and emphasises the continuity among perception, action, interaction with materials, and the fulfilment of experience. Aesthetic experience is not passive appreciation of a work's appearance. Rather, it involves sensing, discerning, organising, and expressing qualitative relationships as individuals interact with materials and their environments. Dewey's account of "doing and undergoing" suggests that creative action is intertwined with the perception and reflection on the consequences of that action; artistic experience thereby develops rhythm and meaning.

In GenAI-supported art and design learning, students observe the composition, colour, style, and emotional effects of AI-generated outputs and compare them with their own design intentions. They then translate perceived problems into new expressive actions through redrawing, collage, editing, and visual narrative reconstruction. Aesthetic judgement and artistic re-creation are therefore not isolated sequential steps; they form a cycle of perception, evaluation, action, and renewed perception. Eisner's (2002) discussion of art learning and cognitive development provides supplementary context for art education, but it is not adopted as a third theoretical foundation in this paper [7].

Within the proposed framework, Aesthetic Experience Theory primarily informs Me2, the Aesthetic Judgement Mechanism, and Me4, the Artistic Re-Creation Mechanism. Me2 concerns students' reflective perception and qualitative discrimination when evaluating visual alternatives. Me4 concerns the development of experiential meaning through the active transformation, organisation, and re-expression of visual materials.

Mapping the Theoretical Foundations to the Four Pedagogical Mechanisms

This paper adopts only Sociocultural Learning Theory and Aesthetic Experience Theory as its two theoretical foundations. The literature reviewed in the preceding sections provides complementary conceptual and research-based support for identifying the four pedagogical mechanisms. Sociocultural Learning Theory explains how digital tools may mediate creative cognition and iterative action, while Aesthetic Experience Theory explains how aesthetic perception and artistic meaning may develop through action, reflection, and re-expression.

The relationship between the two theoretical foundations and the four mechanisms is summarised in Table 1. Other literature on creativity, visual thinking, and art education is used to supplement the research background, define concepts, and inform the interpretation of the mechanisms; it is not treated as an independent theoretical foundation.

Table 1. Theoretical Foundations and Corresponding Mechanisms of Human–AI Co-Creation

Mechanism	Theoretical Foundation	Core Theoretical Explanation	Focus of the Learning Process
Me1: Creative Generation	Sociocultural Learning Theory (Vygotsky, 1978)	AI as a digital mediator and potential cognitive scaffold	Visual stimuli, conceptual expansion, and divergent ideation
Me2: Aesthetic Judgement	Aesthetic Experience Theory (Dewey, 1934)	Reflective perception and qualitative discrimination	Observation, comparison, interpretation, and aesthetic judgement
Me3: Human–AI Iterative Co-Creation	Sociocultural Learning Theory (Vygotsky, 1978)	Mediated action and scaffolding within the Zone of Proximal Development (ZPD)	Prompt adjustment, feedback, regeneration, and revision of judgement
Me4: Artistic Re-Creation	Aesthetic Experience Theory (Dewey, 1934)	Construction of experiential meaning through action, perception, and reconstruction	Redrawing, collage, editing, narrative reconstruction, and expression

METHODOLOGY

Research Design

This paper adopts a structured literature integration and theoretical synthesis approach to examine the pedagogical mechanisms of human–AI co-creation in higher art and design education supported by generative artificial intelligence (GenAI). The study aims to integrate relevant theoretical perspectives and research findings, identify the key learning processes involved in human–AI co-creation, and develop a conceptual framework explaining the relationships among four proposed pedagogical mechanisms. It is a conceptual, literature-based

study rather than an empirical classroom investigation. It does not claim to be an exhaustive systematic review or meta-analysis.

The analysis is guided by two complementary theoretical foundations: Sociocultural Learning Theory (Vygotsky, 1978) and Aesthetic Experience Theory (Dewey, 1934). Sociocultural Learning Theory provides a perspective for examining how GenAI may function as a digital mediational tool in students' creative exploration and iterative design activities. Aesthetic Experience Theory provides a basis for understanding how students develop aesthetic judgement and artistic expression through perception, reflection, action, and the reconstruction of meaning.

The research design consists of three interconnected analytical tasks. First, relevant literature is identified and examined to establish the research context of GenAI in higher art and design education, human–AI collaborative design, and creative learning processes. Second, the selected literature is interpreted in relation to the two theoretical foundations to identify recurring pedagogical activities, learner actions, and educational functions. Third, the findings are integrated to develop a conceptual framework comprising four interrelated mechanisms: creative generation, aesthetic judgement, human–AI iterative co-creation, and artistic re-creation.

The four mechanisms are not treated as predetermined or strictly sequential stages. Rather, they are conceptually developed through the comparison and interpretation of relevant theoretical arguments and research findings. Their proposed functions are examined in terms of their relevance to the research focus, their distinct contributions to the learning process, and their potential to be identified in higher art and design educational activities. The resulting framework is a theoretical proposal that requires further examination and refinement through empirical research in authentic educational settings.

Literature Search Strategy and Sources

The literature search focused on research concerning GenAI in higher art and design education, human–AI co-creation, collaborative design processes, creative thinking, and aesthetic learning. Priority was given to peer-reviewed publications published between 2021 and 2026 to reflect recent developments in generative AI and its educational applications. Earlier foundational works, particularly Vygotsky (1978) and Dewey (1934), were also included because they provide the theoretical foundations of this study.

The literature search drew on five academic databases and scholarly search platforms: Scopus, ERIC, ScienceDirect, SpringerLink, and Google Scholar. These sources were used to identify relevant academic publications, including empirical studies, literature reviews, and theoretical discussions. Publisher websites, Crossref, and DOI records were consulted where necessary to verify bibliographic information and publication details. Only sources with verifiable publication information were considered for inclusion.

The search strategy combined terms relating to generative AI, human–AI interaction, art and design education, and creative processes. The main search terms included "generative artificial intelligence," "generative AI," "AI-generated content," "human–AI co-creation," "human–AI collaboration," "higher art and design education," "visual arts," "visual communication design," "collaborative design," "creative ideation," "visual generation," "aesthetic evaluation," "prompt interaction," "iterative design," and "artistic re-creation."

Boolean operators were used to combine related terms, with search expressions adapted to the requirements of individual databases and platforms. A general search structure was as follows: ("generative AI" OR "generative artificial intelligence" OR "AI-generated content") AND ("art and design education" OR "visual arts" OR "visual communication design" OR "collaborative design") AND ("human–AI co-creation" OR "creative ideation" OR "aesthetic evaluation" OR "visual generation" OR "prompt interaction" OR "iterative design" OR "artistic re-creation").

The search was not restricted to publications that used the exact terminology of the four proposed mechanisms. Related studies were also considered when they examined comparable creative, evaluative, iterative, or

transformative activities under different terms. This approach enabled the study to draw on relevant research without assuming that the four mechanisms had already been established in the literature.

Inclusion and Exclusion Criteria

The literature was selected according to its relevance to the research focus, theoretical foundations, and proposed pedagogical mechanisms. Four inclusion criteria were established.

First, the publication needed to concern higher education in art, visual arts, visual communication, or design, or be directly related to human–AI collaborative design processes. Second, it needed to discuss the application of GenAI in at least one relevant creative or learning activity, including ideation, visual generation, aesthetic evaluation, prompt interaction, iteration, or artistic re-creation. Third, it needed to provide conceptual, process-related, or empirical evidence relevant to the two theoretical foundations, the four pedagogical mechanisms, or their educational applications. Fourth, it needed to be a verifiable peer-reviewed article, foundational theoretical work, or authoritative institutional document. Except for foundational works such as Vygotsky (1978) and Dewey (1934), priority was given to research published between 2021 and 2026.

Publications were excluded when they focused exclusively on the technical functions or commercial promotion of AI tools without meaningful discussion of educational, creative, or design processes. Materials with unclear or unverifiable bibliographic information were also excluded. Studies with little direct relevance to higher art and design education or human–AI co-creation were not included in the main synthesis. Research involving other educational levels, such as primary-school art education, was considered cautiously only when it provided relevant insights into AI-generated visual materials or instructional resources. Findings from these contexts were not treated as direct evidence of learning outcomes among university students.

The selection process involved an initial examination of publication titles and abstracts, followed by full-text examination of potentially relevant publications. The final selection was guided by the extent to which each publication contributed to understanding the research context, the two theoretical foundations, or one or more of the four proposed pedagogical mechanisms. The main search and selection procedures are summarised in Table 2.

Table 2. Literature Search and Selection Procedures

Procedure	Description
Literature sources	Scopus, ERIC, ScienceDirect, SpringerLink, and Google Scholar. Only sources actually searched are retained in the final report.
Search period	November 2025 to November 2026.
Publication period	Priority was given to publications from 2021 to 2026, with earlier foundational theoretical works retained where relevant.
Search terms	Generative artificial intelligence; generative AI; AI-generated content; human–AI co-creation; human–AI collaboration; higher art and design education; visual arts; visual communication design; collaborative design; creative ideation; visual generation; aesthetic evaluation; prompt interaction; iterative design; and artistic re-creation.
Search strategy	Related terms were combined using Boolean operators (AND and OR), with search expressions adapted to the requirements of individual databases and platforms.
Inclusion criteria	(1) Research involving higher education in art, visual arts, visual communication, or design, or directly related to human–AI collaborative design processes; (2) discussion of GenAI applications in ideation, visual generation, aesthetic evaluation, prompt interaction, iteration, or artistic re-creation; (3) conceptual, process-related, or empirical evidence relevant to the two theoretical foundations, four pedagogical mechanisms, or their educational applications; and (4) verifiable

	peer-reviewed articles, foundational theoretical works, or authoritative institutional documents.
Exclusion criteria	Publications focusing only on commercial tool functions without meaningful discussion of learning or creative processes; unverifiable or insufficiently documented sources; and studies with little relevance to the research focus. Findings from other educational levels were not generalised directly to higher education.
Screening procedure	Initial screening of titles and abstracts, followed by full-text examination of potentially relevant publications. Selection was based on relevance to the research focus and contribution to the theoretical and pedagogical synthesis.
Synthesis approach	Thematic analysis and theoretical synthesis guided by Sociocultural Learning Theory and Aesthetic Experience Theory, focusing on the four proposed pedagogical mechanisms.

Table 2 summarises the main procedures and criteria used to organise the literature search and selection. It describes the approach adopted in this study and should not be interpreted as a PRISMA-based systematic review flow. No numerical claims about retrieved, excluded, or included publications are made unless they can be supported by documented search and screening records.

Thematic Analysis and Theoretical Synthesis

The selected literature was examined through thematic analysis and theoretical synthesis. The analysis focused on four aspects of each publication: the educational or design context, the role of GenAI in the creative process, the actions and decisions undertaken by learners, and the reported or theoretically discussed educational implications. These aspects provided a common basis for comparing studies conducted in different educational and design contexts.

The synthesis proceeded through four analytical steps. First, relevant information was extracted from the selected publications, including the learning context, forms of human–AI interaction, creative activities, learner decision-making, and findings relevant to art and design education. Second, recurring process-related themes were identified and compared, with particular attention to creative generation, aesthetic judgement, human–AI iteration, and artistic re-creation. Third, these themes were interpreted through the two theoretical foundations. Sociocultural Learning Theory was used to examine tool mediation, potential cognitive scaffolding, and iterative action, while Aesthetic Experience Theory was used to interpret reflective perception, qualitative discrimination, artistic action, and the reconstruction of meaning. Fourth, the theoretical interpretations and literature-based themes were integrated to clarify the primary functions, interrelationships, and educational relevance of the four proposed mechanisms.

To clarify the analytical boundaries of the four mechanisms, the synthesis distinguishes them by their primary learning functions: Creative Generation concerns the expansion of ideas and visual possibilities; Aesthetic Judgement concerns the reasoned evaluation of visual alternatives; Human–AI Iterative Co-Creation concerns purposeful adjustments to prompts and generated outputs; and Artistic Re-Creation concerns the transformation of generated materials into an expressive design outcome. Although these functions may overlap in practice, the distinction provides a consistent basis for interpreting learner activity.

The analysis also examined how these functions may inform one another. For example, aesthetic judgements may guide subsequent prompt adjustments, while difficulties encountered during artistic re-creation may prompt renewed exploration. Learner agency and teacher scaffolding were treated as cross-cutting conditions throughout the analysis, not as additional mechanisms.

Potential evidence was considered in relation to the primary learning function it represents: idea expansion for Me1, reasoned visual evaluation for Me2, purposeful prompt adjustment for Me3, and human-led transformation for Me4. Where one activity or artefact may relate to more than one mechanism, its analytical interpretation

should be based on the function being examined, thereby reducing conceptual overlap and the risk of double-counting.

Conceptual Synthesis Of The Four Mechanisms

Building on the literature review and the two theoretical foundations, this section develops the four proposed mechanisms as distinct but interconnected learning functions. The following subsections define each mechanism, clarify its conceptual boundary, and identify proposed dimensions through which it may be examined.

Me1: Creative Generation Mechanism

The Creative Generation Mechanism refers to the process through which students expand their initial ideas and explore alternative visual possibilities by engaging with GenAI. Its central function is to broaden the space of creative exploration rather than to produce a finished design. Students formulate preliminary concepts, explore visual associations, and consider alternative directions through the interpretation of AI-generated materials.

Within this mechanism, AI-generated outputs serve as visual resources for further thinking. Students may use them to recognise alternative compositional possibilities, visual metaphors, thematic interpretations, or stylistic directions that were not included in their initial ideas. However, the educational significance of generation lies in the development of students' ideas, not in the number of images produced.

The distinctive boundary of Me1 is therefore the expansion of creative possibilities. It focuses on what new ideas or visual directions students can develop, rather than how they evaluate the quality of those ideas or refine a particular solution. Evaluation belongs primarily to Me2, while purposeful prompt adjustment and repeated optimisation belong primarily to Me3.

Me1 is informed by Sociocultural Learning Theory (Vygotsky, 1978), particularly the role of mediated resources in supporting the development of thinking. For the purpose of conceptual analysis, three dimensions are proposed:

- Creative fluency: the range or number of distinct ideas and visual concepts developed in response to a design task.
- Creative flexibility: the ability to move between different conceptual approaches, visual strategies, compositional methods, or expressive directions.
- Image-thinking ability: the ability to establish associations between visual stimuli and concepts and to use these associations to extend thematic expression.

These dimensions concern the development of ideas and visual possibilities. They should not be measured simply by counting generated images, since multiple outputs may represent similar ideas without demonstrating meaningful creative expansion.

Me2: Aesthetic Judgement Mechanism

The Aesthetic Judgement Mechanism refers to the process through which students interpret, compare, and evaluate visual alternatives in relation to their design intentions and aesthetic qualities. Its primary function is to develop students' ability to make reasoned visual decisions rather than merely select images according to personal preference.

Students may examine the composition, colour relationships, visual hierarchy, stylistic characteristics, symbolic meanings, and emotional effects of generated alternatives. They then consider whether these visual qualities communicate the intended concept and respond appropriately to the design context and audience.

The distinctive boundary of Me2 is the quality of students' aesthetic evaluation and reasoning. It is concerned with why students consider a visual solution appropriate, effective, or problematic. It does not primarily concern the expansion of new ideas (Me1), the technical refinement of prompts (Me3), or the transformation of visual materials into a final personal expression (Me4).

Me2 is informed by Dewey's (1934) Aesthetic Experience Theory, particularly the relationship between perception, qualitative discrimination, and reflective experience. Three dimensions are proposed:

- Quantity and depth of aesthetic reasoning: the range of criteria students use and the extent to which they justify their decisions with specific visual evidence.
- Sensitivity to stylistic differences: the ability to recognise and interpret differences in visual styles, formal characteristics, and expressive qualities.
- Visual literacy: the ability to interpret visual hierarchy, composition, colour, symbols, and relationships between visual form and communicative meaning.

These dimensions focus on the reasoning process underlying aesthetic decisions rather than the perceived attractiveness of the final artefact. Students' explanations, visual annotations, and comparative evaluations may provide evidence of this mechanism.

Me3: Human–AI Iterative Co-Creation Mechanism

The Human–AI Iterative Co-Creation Mechanism refers to the purposeful refinement of visual solutions through repeated interaction between students and GenAI. Its primary function is to translate identified design problems into subsequent actions through prompt adjustment, regeneration, comparison, and revision.

Unlike Me1, which focuses on expanding the range of creative possibilities, Me3 concerns the development of a selected or emerging direction. Students identify discrepancies between generated outputs and their design intentions, determine what needs to be changed, and adjust prompts or other generation conditions accordingly. They then examine the new outputs and decide whether further iteration, a change of direction, or manual intervention is appropriate.

The distinctive boundary of Me3 is purposeful refinement through human–AI interaction. Repeated generation alone does not constitute meaningful iterative co-creation. An iteration becomes pedagogically relevant when it responds to an identifiable problem or intention and leads to a reasoned design decision. The number of iterations is therefore a descriptive process indicator, not evidence that more iterations necessarily produce better learning.

Me3 is informed by Sociocultural Learning Theory (Vygotsky, 1978), particularly the concepts of mediated action and instructional scaffolding. Four dimensions are proposed:

- Prompt precision: the ability to translate design intentions and identified visual problems into specific and relevant prompt adjustments.
- Iteration pattern and purposefulness: the frequency and sequence of iterative cycles, considered alongside the reasons for each adjustment and the design problem being addressed.
- Style consistency: the ability to maintain or deliberately develop a coherent visual direction across successive generations.
- Development of judgement: the extent to which students identify visual problems, explain revision decisions, and make more reasoned choices across successive iterations.

These dimensions distinguish purposeful interaction from mechanical prompt repetition. Evidence may be obtained from prompt records, successive generated outputs, design decision logs, and students' explanations of changes between iterations.

Me4: Artistic Re-Creation Mechanism

The Artistic Re-Creation Mechanism refers to the process through which students transform AI-generated materials into visual expressions shaped by their own interpretations, intentions, and artistic decisions. Its primary function is to move beyond the selection or acceptance of generated content towards human-led reconstruction and the creation of personal meaning.

Such transformation may involve redrawing, cropping, collage, recomposition, image editing, typographic arrangement, colour adjustment, or visual narrative reconstruction. Students may also combine generated images with hand-drawn elements, photography, or other digital materials. The significance of these actions lies not in the amount of editing undertaken but in whether students use them to develop a more intentional and meaningful visual expression.

The distinctive boundary of Me4 is the human-led transformation of generated materials into an individual artistic or design expression. It differs from Me1 because its focus is not the expansion of initial ideas; it differs from Me2 because its primary concern is not evaluating alternatives; and it differs from Me3 because its emphasis is not repeated prompt-based refinement. Instead, it concerns how students take creative responsibility for the transformation and organisation of visual materials.

Me4 is informed by Dewey's (1934) Aesthetic Experience Theory, particularly the relationship between action, perception, materials, and the construction of meaning. Four dimensions are proposed:

- Originality: the extent to which students reinterpret and transform generated materials through their own conceptual and visual decisions.
- Visual narrative quality: the coherence and meaningful organisation of images, symbols, composition, and information hierarchy.
- Style unity: the degree to which AI-generated elements, human modifications, and other visual materials are integrated into a coherent visual expression.
- Clarity of expressive intention: the extent to which students can communicate their intended concept, emotion, or issue through deliberate visual choices.

Originality in Me4 should be distinguished from creative fluency in Me1. Me1 concerns the generation and expansion of alternative ideas, whereas Me4 concerns the transformation of selected materials into an individual and meaningful expression. The final artefact, process versions, and students' creative statements may provide complementary evidence of this mechanism.

Relationships and Operational Logic of the Four Pedagogical Mechanisms

The four mechanisms are conceptually distinguishable but functionally interconnected. Their relationships are better understood as a recursive learning process than as a fixed sequence of four instructional stages.

Me1 broadens the range of visual possibilities; Me2 enables students to interpret and evaluate those possibilities against their design intentions. When evaluation reveals a limitation or unresolved problem, Me3 provides a means of translating that judgement into purposeful prompt adjustment and further development. Me4 then involves the human-led transformation of selected materials into an individual visual expression.

These relationships are recursive rather than unidirectional. Judgement may occur during initial exploration; iteration may generate alternatives that require renewed evaluation; and artistic re-creation may reveal new ideas or problems that lead students back to earlier activities. The order and emphasis of the mechanisms may therefore vary with the task, students' prior knowledge, and the capabilities and limitations of the AI tools.

Learner agency and teacher scaffolding operate across all four mechanisms. Students remain responsible for setting creative intentions, interpreting outputs, making aesthetic decisions, directing iterations, and taking responsibility for final expressions. Teachers support this process through task design, modelling, questioning, and feedback. GenAI provides resources for generating and transforming visual possibilities but does not replace human creative responsibility.

Observable and Operational Dimensions of the Four Mechanisms

To facilitate the future empirical examination of the proposed mechanisms, Table 3 summarises their respective theoretical foundations and observable and operational dimensions. These dimensions are not intended as validated measurement scales but serve as conceptual indicators for identifying how each mechanism may be reflected in students' actions, explanations, interaction records, and design artefacts.

Table 3. Operational Dimensions of the Four Human–AI Co-Creative Mechanisms

Mechanism	Theoretical Foundation	Observable/Operational Dimensions
Me1: Creative Generation	Sociocultural Learning Theory (Vygotsky, 1978)	Creative fluency; creative flexibility; image-thinking ability
Me2: Aesthetic Judgement	Aesthetic Experience Theory (Dewey, 1934)	Quantity and depth of aesthetic reasoning; sensitivity to stylistic differences; visual literacy
Me3: Human–AI Iterative Co-Creation	Sociocultural Learning Theory (Vygotsky, 1978)	Prompt precision; iteration pattern and purposefulness; style consistency; development of judgement
Me4: Artistic Re-Creation	Aesthetic Experience Theory (Dewey, 1934)	Originality; visual narrative quality; style unity; clarity of expressive intention

The dimensions in Table 3 are organised by their primary analytical focus: Me1 addresses the range and diversity of ideas; Me2 addresses the justification of aesthetic decisions; Me3 addresses purposeful prompt adjustment and iterative refinement; and Me4 addresses the transformation of generated materials into personal expression. They are proposed conceptual indicators, not validated measures. Their applicability and consistency require examination in future empirical studies.

Proposed Framework for Human–AI Co-Creative Learning

The proposed framework brings the four mechanisms together as a flexible account of human–AI co-creative learning in higher art and design education. It also identifies learner agency, teacher scaffolding, and GenAI affordances and limitations as conditions that shape how the mechanisms are enacted.

The framework can be represented through the following general learning pathway: Creative intention → Creative Generation → Aesthetic Judgement → Human–AI Iterative Co-Creation → Artistic Re-Creation → Reflection and renewed creative intention.

The pathway is illustrative rather than prescriptive. Learners may begin with sketches, visual references, or partially developed concepts, and may move between mechanisms as new ideas or design problems emerge. Reflection on an artefact can also renew the initial creative intention and initiate another cycle.

Three cross-cutting conditions shape this process: learner agency, through which students retain responsibility for their intentions and decisions; teacher scaffolding, which provides instructional structure and feedback; and GenAI affordances and limitations, which shape the possibilities for generation and interaction. These are contextual conditions, not additional pedagogical mechanisms.

The framework offers a conceptual basis for course design and future process-oriented assessment. It does not assume a uniform sequence or establish that GenAI use necessarily improves creative thinking or aesthetic awareness. Its educational value and applicability require further investigation through evidence from authentic learning contexts.

DISCUSSION

Theoretical Contributions

The paper's theoretical contribution is to bring Sociocultural Learning Theory and Aesthetic Experience Theory together to interpret human–AI co-creation as both a mediated learning process and an experience involving perception, action, reflection, and meaning-making. The former foregrounds the role of tools and instructional support in creative activity; the latter explains the significance of aesthetic perception and artistic action. Their integration provides the interpretive basis for the proposed framework without introducing a third independent theory.

A second contribution is the organisation of relevant learning activities into four analytically distinguishable mechanisms. This moves the discussion beyond a tool-centred account of image generation by drawing attention to the pedagogical functions of exploration, evaluation, iterative refinement, and human-led transformation. Table 3's proposed dimensions may help guide future analysis of learner activity, but they should not be treated as validated assessment scales.

The framework further conceptualises the mechanisms as recursive and places learner agency at the centre of their interaction. This highlights that the educational significance of GenAI depends not only on its capacity to generate content, but also on how learners interpret and act on that content. This position is consistent with research on changing learner roles and human participation in AI-supported creative processes [4, 8, 11, 15, 17, 19].

Disciplinary Applicability of the Proposed Framework

The relative emphasis placed on the four mechanisms may vary across art and design disciplines. Visual communication design may foreground hierarchy, composition, and audience communication; illustration may place greater emphasis on narrative and stylistic exploration; product design may require attention to function, materials, and iterative problem-solving; and digital media design may involve multimodal and dynamic expression.

Accordingly, the framework should be adapted to disciplinary objectives, task requirements, and students' prior knowledge rather than implemented as a uniform sequence. It is intended as a flexible conceptual structure, not a prescriptive teaching procedure.

Practical Implications for Art and Design Educators

Educators may organise course activities around clearly defined creative tasks. Students can establish design intentions, use GenAI to explore alternative visual directions, evaluate outputs against composition, colour, style, and communication objectives, and then refine selected ideas through purposeful prompt adjustments. They may subsequently redraw, edit, collage, or reconstruct visual materials to develop an independent design expression. For example, in a social sustainability poster task, students could explore visual concepts, compare compositions, refine a selected direction, and transform the generated material into an original poster.

Teachers should guide the process through questioning and feedback while ensuring that students remain responsible for creative decisions and final outcomes. Assessment may consider both process and artefact, including design intentions, reasons for aesthetic choices, prompt revisions, and artistic modifications. Guidance should also address acknowledgement of AI use, copyright, and data privacy.

Implementation Challenges and Research Limitations

Implementation may be shaped by students' prior knowledge, access to GenAI tools, and teachers' professional capabilities. Potential challenges include inaccurate or biased outputs, creative dependency, stylistic inconsistency, copyright concerns, academic integrity, data privacy, and cultural representation. These issues require explicit attention while preserving students' creative agency [3, 16].

As a structured literature integration and theoretical synthesis, this paper does not provide classroom-based empirical validation of the four mechanisms or their proposed dimensions. Future studies should examine their operation and educational relevance in different art and design contexts, drawing on process records, student artefacts, interviews, and expert evaluation.

CONCLUSION

This paper has proposed a conceptual framework for understanding human–AI co-creation in higher art and design education through the integration of Sociocultural Learning Theory and Aesthetic Experience Theory. By identifying Creative Generation, Aesthetic Judgement, Human–AI Iterative Co-Creation, and Artistic Re-Creation as four interrelated pedagogical mechanisms, the framework moves beyond viewing generative AI merely as a tool for producing visual content. Instead, it conceptualises human–AI co-creation as a learning process in which students actively explore creative possibilities, develop aesthetic judgements, refine ideas through interaction with AI, and transform generated materials into personally meaningful artistic expressions.

The central contribution of this framework lies not only in identifying these four mechanisms but also in explaining their interconnected and recursive nature. Creative learning does not necessarily proceed through a fixed sequence; rather, students may move between generation, judgement, iteration, and re-creation as their ideas and design intentions develop. Throughout this process, learner agency remains essential, while teacher scaffolding provides guidance for critical reflection, aesthetic decision-making, and responsible engagement with AI-generated content. This perspective highlights that the educational value of generative AI depends not simply on the quality or efficiency of generated outputs, but on how these outputs are incorporated into meaningful processes of artistic exploration, interpretation, and transformation.

For higher art and design education, the proposed framework offers a pedagogical perspective for designing learning activities that balance technological exploration with human creativity, aesthetic awareness, and artistic agency. It also provides a conceptual basis for examining how generative AI can support creative thinking and aesthetic development without reducing artistic learning to the production of AI-generated images. Nevertheless, the four mechanisms and their proposed dimensions remain theoretical propositions and have not been empirically validated through classroom implementation in this study. Future research should therefore investigate their applicability across different art and design disciplines and learning contexts, and examine how the framework may inform teaching practices and the development of students' creative thinking and aesthetic awareness.

Ultimately, human–AI co-creation in art and design education should not be understood as the replacement of human creativity by artificial intelligence, but as an educational process in which technology becomes a resource for human exploration, judgement, and artistic expression. The proposed framework offers a starting point for further theoretical development and empirical investigation into more reflective, learner-centred, and human-oriented approaches to generative AI integration in higher art and design education.

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