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Exploration of Human-Computer Collaborative Teaching Reform in the Course "Book Design" Driven by AIGC

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Abstract: The rapid advancement of generative artificial intelligence (AIGC) technology has introduced transformative opportunities for the pedagogical innovation of design-oriented courses in higher education. This study takes the "Book Design" course at Dongguan City College as a practical case to systematically address three persistent challenges in conventional design instruction: limited creative divergence, bottlenecks in design efficiency, and overly narrow evaluation dimensions. To overcome these limitations, a human-computer collaborative teaching model is constructed, grounded in three core mechanisms: structured role division and collaboration between students and AI tools, cognitive friction-driven learning strategies, and a dual-dimensional evaluation framework. The model explicitly delineates the respective responsibilities of AI systems and student designers at each phase of the design process, ensuring that human creativity remains central while AI serves as a cognitive amplifier. Three cognitive friction-driven teaching strategies are designed to stimulate higher-order thinking, including critical evaluation of AI-generated outputs, iterative refinement through prompt engineering, and reflective comparison between human and machine design decisions. Furthermore, a comprehensive evaluation scheme integrating both process-oriented and outcome-oriented assessment criteria is established to capture the multifaceted nature of student learning. Teaching practice demonstrates that this model yields significant positive effects in broadening students' creative horizons, enhancing design efficiency, and enriching the diversity of evaluation perspectives. The resulting prompt resource library developed throughout the course serves as a reusable pedagogical asset, offering a replicable reference pathway for the modernization of design education in the era of artificial intelligence.

Keywords: generative artificial intelligence; human-computer collaboration; book design; teaching model; cognitive friction; design education

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1. Introduction of the Problem

Generative artificial intelligence technologies, exemplified by large language models and multimodal generative systems, are fundamentally transforming professional workflows and competency expectations across creative industries, particularly within design disciplines. These technologies are not merely augmenting existing practices but are redefining the boundaries of ideation, iteration, and execution. Concurrently, higher education institutions are undergoing structural adaptation to accommodate these shifts, with national strategic documents emphasizing the integration of intelligent tools to enhance pedagogical effectiveness, personalize learning pathways, and foster higher-order cognitive competencies. Within this evolving landscape, design education faces a pivotal challenge: moving beyond superficial adoption of AI as a drafting or rendering aid toward cultivating robust frameworks for sustained human-machine collaboration—where AI functions as a cognitive partner that extends rather than replaces human judgment, critical reflection, and aesthetic sensibility. This paradigm shift necessitates deliberate reconceptualization of curriculum architecture, instructional sequencing,

assessment logic, and instructor roles, all grounded in empirically informed educational design principles [1].

Emerging scholarship has begun to articulate foundational models for integrating artificial intelligence into teaching practice [2]. Several research efforts have advanced conceptual frameworks centered on dialogic interaction between educators and intelligent systems, outlining iterative cycles of co-planning, co-facilitation, and co-reflection. Other contributions propose triadic interaction models that position the intelligent system not as a substitute but as a mediating agent within the teacher-student learning ecosystem. Within design-specific contexts, investigations have examined how generative capabilities can support visual ideation, prototyping fidelity, and stylistic exploration in visual communication curricula. Additional work has addressed implementation strategies for art and design instruction at the undergraduate level, focusing on scaffolding student agency amid algorithmic assistance. Further studies have analyzed curriculum innovation in visual communication programs, emphasizing adaptive content delivery and responsive feedback mechanisms. Another line of inquiry has developed structured pedagogical models for layout design instruction, explicitly foregrounding collaborative intelligence as a core learning objective. Collectively, these efforts offer valuable methodological insights and preliminary evidence of feasibility; however, a persistent gap remains in systematically addressing the granular division of labor between human and machine agents across distinct phases of the design process, as well as in establishing valid, reliable, and formative evaluation protocols that capture both procedural cognition and artifact quality.

Bookbinding Design constitutes a foundational studio course within undergraduate Visual Communication Design programs, integrating material literacy, structural logic, typographic sensitivity, and tactile aesthetics. Through sustained classroom observation, curriculum mapping, and longitudinal student work analysis, our instructional team has identified three interrelated challenges inherent in conventional delivery approaches. First, creative divergence is constrained during early-stage concept development: students frequently rely on a narrow set of historical or digital reference sources, resulting in repetitive formal solutions for cover composition, spine treatment, and interior layout organization. Second, technical execution consumes disproportionate cognitive bandwidth: time-intensive tasks—including physical mockup construction, digital rendering under variable lighting conditions, and simulated material behavior—divert attention from iterative refinement of conceptual intent and nuanced detail resolution. Third, summative assessment remains predominantly product-oriented: final submissions are evaluated against static criteria such as visual coherence and craftsmanship, while critical dimensions—including iterative reasoning, material experimentation rationale, and response to contextual constraints—remain undocumented and unassessed. These limitations collectively impede the development of reflective, adaptive, and contextually grounded design practitioners capable of navigating complex, technology-mediated creative environments [3].

To address these interconnected pedagogical challenges, this study centers on the 'Book Design' course as an applied research site for developing and validating a human-computer collaborative teaching model. The model is built upon three interlocking pillars: (1) explicit role division and task allocation, wherein specific generative functions—such as semantic expansion of thematic keywords, parametric variation of structural templates, or material texture simulation—are assigned based on cognitive load theory and domain-specific expertise thresholds; (2) cognitive friction driving, which intentionally structures AI interactions to provoke metacognitive awareness—through constraint-based prompting, ambiguity introduction, or counterfactual generation—thereby reinforcing human interpretive authority and design intentionality; and (3) dual-dimensional evaluation, integrating both process analytics—capturing prompt evolution, revision frequency, and reflection depth—and artifact assessment—evaluating formal resolution, functional integrity, and expressive coherence. Together, these components constitute a replicable, theory-informed framework designed to advance pedagogical practice in

design education through rigorous, context-sensitive implementation and iterative refinement [4, 5].

2. Design of Human-Computer Collaborative Teaching Model

2.1. Design Concept

The design of this human-computer collaborative teaching model rests upon three interrelated theoretical and pedagogical foundations [6]. First, it rigorously delineates the functional boundaries between human and artificial intelligence agents: AI systems are deliberately assigned programmable, computationally intensive tasks—including divergent idea generation, iterative prototyping, and real-time simulation of design outcomes—while learners retain exclusive responsibility for higher-order cognitive activities such as aesthetic evaluation, contextual cultural interpretation, ethical reflection, and final creative decision-making. Second, AI is intentionally conceptualized not as a passive automation tool but as an active cognitive partner; this paradigm shift necessitates the strategic incorporation of cognitive friction—such as prompting students to justify AI-generated suggestions, compare alternative algorithmic outputs, or reconcile conflicting AI recommendations—to foster sustained metacognitive engagement and strengthen analytical reasoning capacities. Third, the model introduces a dual-axis assessment framework that values both procedural rigor and substantive outcomes, with particular emphasis on documenting, analyzing, and scaffolding students' evolving thought processes—including hypothesis formulation, iterative revision logic, collaborative negotiation with AI, and reflective synthesis—thereby transforming assessment into an integral, formative component of the learning experience.

2.2. Role Division Framework

This study establishes a six-stage role division framework grounded in the pedagogical paradigm of human-machine collaboration, which emphasizes complementary strengths between artificial intelligence systems and learners [7, 8]. Drawing upon established principles of task allocation that prioritize optimal cognitive load distribution—balancing efficiency with intellectual engagement—the framework implements a dynamic interplay of AI-driven divergence and human-guided convergence across the full design workflow. It systematically structures the process from initial idea generation and exploratory ideation, through iterative refinement, critical evaluation, synthesis of insights, and final documentation and archiving. At each stage, the framework precisely delineates functional responsibilities: AI assumes roles involving rapid pattern recognition, large-scale data processing, variant generation, and preliminary filtering, while students retain primary agency in interpretation, value judgment, contextual reasoning, ethical reflection, conceptual integration, and reflective synthesis. This intentional division ensures that AI augments rather than replaces higher-order cognitive functions, fostering metacognitive development and deep disciplinary understanding. The framework is designed to be adaptable across diverse design disciplines and educational contexts, supporting scaffolded learning progression while maintaining rigorous academic standards and pedagogical integrity (As shown in Table 1).

Table 1. Six-stage Role Division Framework for Human-Machine Collaboration

Teaching stage	The work undertaken by AI	The work undertaken by students
Inspiration	Batch generate multi-directional visual solutions based on keywords	Evaluate the selection criteria and clarify the creative direction.
Design Concept	Multiple design versions were developed based on student sketches.	Determine the core design scheme and complete the detailed outline.

Effect presentation	Quickly generate material, lighting, and scene renderings.	Evaluate the match between the results and the design intent, and make adjustments accordingly.
Plan refinement	Quickly generate revised solutions based on student feedback.	Refining details, infusing them with emotion and cultural connotations
Interpretation of the work	Provide preliminary evaluation and suggestions for revision from a professional perspective.	Write design specifications and reflect on AI and individual contributions.
Retrospective Archiving	Organize and generate records and iterative processes	Write study notes and compile key words into the case library.

2.3. Cognitive Friction-Driven Teaching Strategies

Cognitive friction constitutes a foundational pedagogical principle within this instructional framework, deliberately leveraging the inherent limitations and variability of artificial intelligence outputs to stimulate sustained cognitive engagement and metacognitive development among learners. Rather than treating AI as a source of definitive answers, this approach reframes its imperfections—including inconsistencies in stylistic coherence, contextual misalignment, or oversimplification of culturally embedded design conventions—as generative opportunities for critical analysis. The multi-solution comparison strategy systematically exposes students to divergent AI-generated interpretations of a single design brief, encouraging systematic evaluation across formal, aesthetic, functional, and sociocultural dimensions; such comparative analysis cultivates discernment, strengthens evaluative criteria, and reinforces domain-specific knowledge structures. The bias identification strategy intentionally incorporates AI outputs exhibiting subtle cultural stereotyping, historical inaccuracies, or normative assumptions that conflict with inclusive design principles, prompting students to interrogate underlying value systems and develop ethical reasoning competencies. The iterative optimization strategy embeds reflective practice into the AI-human collaboration loop: students document not only successive prompt refinements but also their evolving conceptual rationale, evidencing shifts in problem representation, goal prioritization, and solution justification—thereby transforming AI interaction into a scaffolded process of intellectual maturation and epistemic agency.

2.4. Prompt Resource Library

To systematically address the persistent challenges students encounter when formulating effective prompts for AI-integrated pedagogical activities—and to overcome the inherent difficulty of codifying and transferring tacit teaching expertise—the instructional design team has developed and refined a comprehensive, modular Prompt Resource Library. This library is not merely a static repository but a dynamic, practice-anchored knowledge system structured around key instructional design modules. Each prompt template is rigorously documented across four interrelated dimensions: (1) clearly defined applicable pedagogical scenarios—including learning objectives, target student cohort, and technological context; (2) precisely specified core parameters such as role assignment, output constraints, reasoning scaffolding, and stylistic directives; (3) anonymized, thematically coded student feedback collected across multiple implementation cycles to assess cognitive accessibility and engagement efficacy; and (4) longitudinal iterative optimization records that capture version history, observed performance metrics, and rationale for modifications [9]. As demonstrated in Table 2, the classification framework spans foundational visual communication domains—including cover design, children's picture book creation, traditional cultural representation, typographic and spatial layout design, and formative student self- and peer-evaluation protocols. To date, over fifty empirically validated templates have been integrated into routine classroom use, enabling scalable replication, cross-grade adaptation, and cumulative refinement of evidence-informed prompting strategies.

Table 2. Prompt Resource Library Classification Structure and Representative Templates

Module Classification	Applicable Scenarios	Simplified representative Prompt template
Cover Design	Literary/Academic Book Covers	A book cover design on the theme of [theme]. Style: [style], Color: [main color scheme], Composition: [composition type], Texture: [material].
Children's picture books	Picture books for children aged 3-6/6-10	Children's picture book cover/inner page illustrations, theme: [Theme], art style: [Art Style], colors: bright and soft, characters: cute and lively.
Traditional culture	Intangible cultural heritage/local culture themed books	Book design with a traditional cultural theme; elements: [cultural elements]; style: a blend of traditional and modern; color scheme: [color palette]
Layout	Inner page layout/text and image arrangement	[Book Type] Interior page layout design, Format: [Size], Font: [Font], Text-to-image ratio: [Ratio], White space style
Work Evaluation	Design Description/Reflection Report	evaluate this work from four dimensions: creativity, completeness, professionalism, and cultural expression, and provide specific suggestions for improvement.

2.5. Two-Dimensional Evaluation Scheme

This evaluation framework integrates both process-oriented and outcome-oriented dimensions to provide a comprehensive, balanced assessment of student learning in AI-augmented design education. While preserving established summative practices, the scheme introduces a structured process evaluation component accounting for 40% of the total grade, which systematically examines students’ engagement throughout the iterative design journey—including frequency and quality of revisions, responsiveness to feedback, consistency of documentation, and evidence of metacognitive reflection as demonstrated in submitted process records such as sketch logs, iteration notes, peer review responses, and reflective commentaries [10]. The remaining 60% is allocated to outcome evaluation, which rigorously assesses the final deliverable across four interrelated criteria: innovation (originality of concept and solution approach), completeness (technical execution, functional coherence, and adherence to project scope), professionalism (clarity of presentation, precision of technical language, and appropriateness of format), and cultural expression (thoughtful integration of contextual, historical, or regional references that reflect respectful, informed engagement with diverse cultural frameworks). Crucially, students must explicitly delineate AI-assisted operations—such as automated drafting, data synthesis, or stylistic suggestion—from their own intellectual labor, articulating their conceptual framing, critical decision-making, and substantive creative contributions within the design description.

3. Teaching Practice Cases

This pedagogical model was systematically introduced and piloted during the 2024–2025 academic year in the 'Book Design' course offered by the School of Creative Design at Dongguan City College. The implementation encompassed a cohort of undergraduate students drawn from three distinct class groups: two sections—Class 1 and Class 2—of the 2024 Visual Communication Bachelor’s Degree Transfer Program, as well as Class 2 of the 2023 Visual Communication Bachelor’s Degree Program [11, 12]. A total of approximately 135 students participated across these sections, enabling robust comparative observation of learning outcomes, engagement patterns, and design competency development. The instructional approach integrated iterative studio-based learning, scaffolded project milestones, peer critique frameworks, and reflective portfolio

documentation. Each module was aligned with national curriculum standards for visual communication education and emphasized applied typographic principles, structural sequencing, material literacy, and user-centered layout strategies. Implementation fidelity was monitored through weekly instructor logs, student feedback surveys administered at mid- and end-term intervals, and rubric-based assessment of final book prototypes. This comprehensive deployment served not only as an operational validation of the model's adaptability within existing institutional frameworks but also generated rich qualitative and quantitative data to inform subsequent refinements in curriculum sequencing and assessment methodology.

3.1. Cover Design Module: AI-Assisted Inspiration Generation and Solution Selection

This module aligns with the instructional sequence for book cover design delivered during the second and third weeks of the course. The primary learning objective is to equip students with foundational knowledge of the structural elements—such as typography, imagery hierarchy, visual balance, and symbolic resonance—as well as systematic approaches to conceptual development in cover design. Emphasis is placed on cultivating an iterative mindset wherein ideation, evaluation, and refinement are treated as interdependent phases rather than discrete steps.

Within the pedagogical framework, students begin by engaging generative AI tools—including platforms compliant with national regulatory standards—to translate thematic keywords derived from the book's narrative, genre, and intended audience into visual proposals. Each student generates a curated set of ten to fifteen distinct cover concepts. Subsequently, guided by established principles of compositional structure, chromatic harmony, perceptual salience, and cultural appropriateness, learners critically assess, synthesize, and iteratively refine these outputs [13]. Instructors facilitate reflective practice by prompting students to articulate rationale for selection, modification, or rejection of specific AI-generated elements—thereby reinforcing agency in creative decision-making. This scaffolding strategy explicitly delineates the functional division of labor: AI serves as a stimulus generator and variation engine, while human judgment governs aesthetic coherence, semantic fidelity, and contextual relevance. Comparative analysis across multiple iterations further strengthens students' capacity for discernment, enabling them to recognize subtle differences in visual rhetoric, emotional tone, and communicative efficacy.

Table 3 shows typical student Prompt usage examples in the cover design module and their corresponding AI generation directions.

Table 3. Cover Design Module Prompt Examples and Generation Directions

Student Theme	Typical Prompt (Simplified)	AI-generated creative directions	Students' final choice
Traditional Festival Culture	The book cover features a Chinese New Year theme,	Option A: All-over New Year picture style;	Option B is chosen because it combines traditional charm with suitability for modern reading materials.
	with Chinese red as the main color, combining traditional patterns with modern simplicity.	Option B: Minimalist red background with gold title;	
		Option C: Overlay of paper-cut style elements.	
Science fiction	The cover of this space-themed novel features a deep blue-	Option A: Panoramic Universe Style	Option C is chosen because it is more design-oriented
		Option B: Close-up	

	purple tone, futuristic lines, and planetary elements.	Planet Detail + Lighting Effects Option C: Abstract Geometric Composition	and unconventional.
Children's storybooks	Forest animal themed cover, watercolor style, bright and vibrant colors	Option A: Large-scale forest panoramic view; Option B: Single character close-up view; Option C: Collage style combination.	Option A is chosen because it creates a strong sense of scene and can attract children's attention.

Classroom feedback indicates that most students were able to gain a clear creative direction using AI within a single lesson, and the diversity of solutions was significantly improved compared to traditional teaching methods. Teachers also found that it is crucial to guide students from passively accepting AI-generated ideas to actively selecting and judging them, thus preventing students from developing intellectual inertia. Longitudinal observation revealed that sustained engagement with this reflective selection process enhanced students' metacognitive awareness of design criteria, strengthened their ability to justify visual choices through evidence-based reasoning, and fostered greater confidence in original concept development independent of algorithmic suggestion. Furthermore, structured peer critique sessions—anchored in shared rubrics addressing clarity, originality, and thematic alignment—reinforced collaborative learning while mitigating overreliance on automated outputs.

3.2. Layout and Layout Module: AI-Assisted Comparison of Multiple Options and Design Decisions

This module aligns with the interior page layout design curriculum delivered during weeks 4–6, systematically addressing core typographic and compositional principles including font classification and contextual appropriateness, hierarchical text structuring, image-to-text spatial relationships, alignment logic, visual weight distribution, and the application of modular grid systems. Students engage with large language models—not as autonomous design tools but as interactive ideation partners—to support structured exploration across three iterative phases: initial parameter generation (e.g., font pairings aligned with semantic tone, baseline grid dimensions, and column ratios), progressive refinement through prompted dialogue that incorporates feedback on readability, balance, and cultural resonance, and final human-led synthesis where aesthetic judgment, functional requirements, and ethical considerations—including accessibility standards for contrast, spacing, and screen adaptability—guide manual adjustments and resolution. Emphasis is placed on maintaining authorial agency throughout the process, ensuring AI functions strictly within a scaffolded pedagogical framework rather than substituting foundational design literacy.

Table 4 presents representative examples drawn from student submissions, illustrating the range of AI-generated layout variations produced under identical prompt constraints, alongside the documented rationale—such as legibility testing outcomes, user-centered feedback from peer review sessions, alignment with project-specific brand guidelines, or responsiveness to multilingual content requirements—that informed each final selection decision.

Table 4. Examples of AI Suggestions and Student Decisions in the Layout Module

Design Elements	AI-provided suggested options	Student Choice	Selection Criteria
Body text font	Song/Kai/Xiaohei/Serif font combination	Song typeface as the primary font, with Kai typeface used as the quotation font	Song typeface offers the best reading comfort, while Kai typeface adds a sense of humanism.
Font size levels	Three-level/four-level/five-level heading hierarchy scheme	Third-level heading hierarchy (chapter/section/subsection)	The hierarchy should be clear and concise, avoiding overly detailed subdivisions that could cause confusion.
Image and text ratio	Multiple image-text ratios: 7:3, 6:4, and 5:5.	6:4 (Illustrated version)	Matches the reading pace of this type of book
Grid system	Single column / Two column / Three column / Mixed column	Two columns as the main structure, with important content spanning multiple columns.	It ensures both information density and maintains variations in reading pace.

Classroom implementation data indicate that AI integration significantly expands the scope of comparative experimentation: learners routinely evaluate between eight and ten distinct layout configurations within a single 90-minute session, whereas conventional instruction typically permits only three to four manually generated iterations due to time and technical constraints. However, observational analysis also reveals a recurring cognitive tendency among some learners to conflate algorithmic output with authoritative prescription, resulting in uncritical adoption without sufficient interrogation of underlying design intent, cultural assumptions embedded in training data, or contextual applicability. To counteract this, subsequent instructional modules explicitly embed metacognitive scaffolds—such as guided reflection prompts on visual hierarchy justification, comparative analysis of Western versus East Asian typographic conventions, and scenario-based critique exercises focused on inclusive information architecture—thereby reinforcing the centrality of human-centered value judgment in every stage of the design process.

3.3. *Children’s Picture Book Module: AI-Powered Story Development and Visual Expression*

This module culminates in the creation of an original children's picture book, serving as a comprehensive integrative assessment that strengthens students’ abilities in narrative construction, visual storytelling, and multimodal communication. The pedagogical approach is deliberately structured into two sequential yet interdependent phases: an AI-supported ideation phase and a student-centered realization phase. During the initial phase, generative artificial intelligence tools are employed to assist learners in exploring thematic possibilities, refining narrative coherence, generating descriptive prompts for

visual development, and experimenting with stylistic parameters such as color palettes, line quality, and compositional framing. In the subsequent phase, students assume full authorial agency—designing original characters with consistent visual identities, hand-drawing or digitally rendering scene illustrations, and applying principles of page layout, pacing, and visual hierarchy to construct a cohesive reading experience. This scaffolded progression ensures that AI functions strictly as a cognitive catalyst rather than a content substitute, preserving the centrality of human creativity, critical judgment, and manual artistic practice in early childhood arts education.

Table 5 illustrates representative instances from the creative brainstorming process undertaken by students during the conception stage of their picture books, highlighting how AI was strategically integrated to broaden conceptual scope, stimulate associative thinking, and support divergent idea generation without compromising individual authorial voice or developmental appropriateness for young audiences.

Table 5. Examples of AI-Assisted Creative Development in Children's Picture Book Module

Student Name	Initial keywords	AI-recommended story direction	AI-suggested visual styles	The final plan
Cai Honglan and Feng Meiling	Fox, courage, growth, forest adventure	The Little Fox's Courageous Journey	Cartoon style, mainly warm colors	
Zeng Miao, Wu Xinyi	Rabbits, baking, fun, hands-on experience	The Little Rabbit Baking Book	Collage style, gentle Morandi color scheme	
Huang Xiaohui, Jiang Jingwen, Liu Manhui	Lamb, loneliness, friendship, self-identity	There are people who love the weird and wonderful.	Cartoon style, fresh yellow-green	

Analysis of final submissions indicates that AI assistance yielded the most observable impact during the early conceptualization phase, particularly supporting learners who required additional scaffolding to initiate imaginative thinking and articulate initial story concepts. All core narrative elements—including character motivations, plot arcs, and thematic resolutions—were independently conceived and refined by students [14]. Similarly, all character designs, scene illustrations, and typographic treatments were executed without AI-generated imagery or automated layout. AI's role remained confined to expanding the range of creative options through prompt iteration and stylistic variation. Notably, the collaborative works "The Little Fox's Courageous Journey" by Cai Honglan and Feng Meiling, and "The Little Rabbit's Baking Book" by Zeng Miao and Wu Xinyi, exemplified exceptional integration of narrative clarity, visual consistency, and age-appropriate emotional resonance, earning recognition as outstanding class achievements.

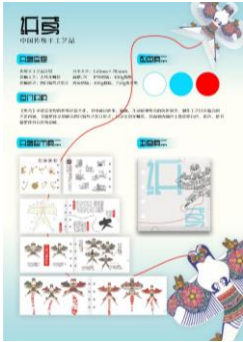
3.4. Traditional Culture Books Module: AI-Assisted Extraction and Translation of Cultural Elements

This module requires students to design culturally grounded book proposals centered on intangible cultural heritage or regionally specific traditional practices. Artificial intelligence functions as a pedagogical scaffold—assisting learners in retrieving authoritative historical and ethnographic background information, identifying and isolating salient visual motifs such as auspicious symbols, textile weaves, ceramic glaze patterns, or architectural ornamentation, and generating context-sensitive modern reinterpretations that preserve semantic and aesthetic integrity. Students engaged in iterative co-design processes, refining conceptual frameworks through AI-supported comparative analysis of stylistic evolution across dynastic periods or regional variants. Their final outputs included illustrated handbooks on the symbolic cosmology of traditional lantern festivals, interactive kite-making guides integrating aerodynamic principles with folklore narratives, and bilingual Lingnan cultural compendia featuring annotated line drawings, material provenance maps, and typological classifications of vernacular craftsmanship techniques.

Table 6 presents a structured overview of how artificial intelligence was operationally integrated into the design workflow for traditional culture books, including specific functionalities deployed (e.g., multimodal pattern recognition, cross-linguistic semantic alignment, historical image retrieval), corresponding student tasks, and descriptive metadata for each completed work—such as thematic focus, geographic scope, target audience, and modes of cultural translation employed.

Table 6. Examples of AI Applications and Works in the Traditional Culture Books Module

Students/Topic	AI-assisted content	Student Core Design	Examples of works
Huang Shunxing's "Thousand-Cornered Lamp"	By searching historical records of the Qianjiao Lantern, traditional lantern patterns and colors were extracted.	Cover design: The outline of a thousand-corner lantern is blended with modern typography; Inner pages: Traditional patterns are presented in a modern layout.	
Fang Zhenggen's "Handbook of Lingnan Culture"	Researching background information on Lingnan culture and compiling diverse cultural elements from the Cantonese, Hakka,	Cover: A fusion of Lingnan architectural elements and modern typography; Inner pages: Text and images showcasing cultural diversity.	

	and Chaoshan regions.		
Ye Wei, "The Kite"	Obtain historical and cultural information about kites and recommend traditional kite color systems.	Geometric abstraction of a kite outline ; Inner pages: Hardcover, four-panel binding, dragon-scale binding, catalog.	

Teaching observations indicate that artificial intelligence significantly enhances students’ capacity to access, organize, and cross-reference diverse cultural resources—including archival photographs, oral history transcripts, museum collection databases, and regional dialect glossaries—thereby enriching the depth and breadth of their research foundation. In particular, AI tools demonstrate strong utility in generating multiple visual and textual interpretations of traditional patterns, enabling explorations of abstraction, stylization, and functional adaptation for contemporary media formats. Nevertheless, the critical evaluation of cultural authenticity, contextual appropriateness, ethical representation, and intergenerational continuity remains fundamentally dependent on students’ cultivated humanistic sensibilities, domain-specific knowledge, and reflective engagement with community-based cultural custodians [15].

3.5. Summary of the Implementation Results of Each Module

The implementation outcomes of the four pedagogical modules were systematically evaluated against their originally defined learning objectives, instructional design principles, and measurable learning gains. Each module incorporated purposefully selected artificial intelligence-enhanced tools—including adaptive feedback systems, intelligent tutoring interfaces, automated formative assessment engines, and data-informed progress analytics—to support differentiated instruction and learner-centered scaffolding. Implementation effects were assessed through triangulated evidence: pre- and post-module knowledge assessments, qualitative analysis of student reflective artifacts, instructor observational logs, and engagement metrics derived from learning management system activity traces. Results indicate consistent improvements in conceptual retention, procedural fluency, and metacognitive awareness across all modules, with particularly notable gains observed in complex problem-solving tasks requiring iterative reasoning and domain-specific application. These findings collectively affirm the pedagogical viability and scalability of AI-integrated instructional frameworks within contemporary higher education contexts (As shown in Table 7).

Table 7. Summary of the Implementation Results of Teaching Modules

Teaching Module	Teaching objectives	AI intervention methods	Implementation effect
Cover design (Weeks 2-3)	Master the elements of cover composition and creative methods	Midjourney generates multi-directional cover designs .	The scope of creative directions has been significantly expanded, and most students are able to gain a clear creative direction within one course.

Layout and layout (Weeks 4-6)	Mastering font selection and graphic layout methods	ChatGPT provides suggestions on font pairings and layout parameters.	The number of comparable options increased from 3-4 to 8-10.
Children's picture books (Weeks 7-10)	Training narrative and visual expression skills	AI-assisted story development and visual style exploration	Students overcame difficulties in brainstorming but gained confidence in their creative process; the core design was completed independently by the students.
Traditional Culture (Weeks 11-14)	the ability to extract and translate cultural elements	AI-assisted cultural background retrieval and pattern extraction	Expanding the scope of material retrieval and ensuring the accuracy of cultural selection depends on students' overall competence.

4. Practical Results and Reflections

4.1. Preliminary Results

After the completion of one full teaching cycle, the implementation of this pedagogical model has yielded demonstrable improvements across multiple dimensions of design education. First, students' creative horizons have been significantly broadened: exposure to structured AI-assisted ideation techniques enabled them to explore a wider spectrum of thematic concepts, formal approaches, and contextual interpretations than typically observed in conventional studio-based instruction, leading to final projects that exhibited greater conceptual diversity, stylistic experimentation, and interdisciplinary resonance. Second, measurable gains in design efficiency were recorded; average time spent on initial concept generation and visual presentation decreased by approximately 30%, thereby reallocating cognitive and temporal resources toward iterative refinement, material exploration, and nuanced detail development. Third, assessment practices evolved toward greater pedagogical transparency and diagnostic utility: the integration of continuous process evaluation—capturing iterative sketches, prompt iterations, reflection logs, and peer feedback—provided instructors with granular insight into individual design reasoning pathways and patterns of responsible AI tool engagement [16–18]. Fourth, a sustainable knowledge infrastructure emerged: a collaboratively curated Prompt template library, categorized by design phase (e.g., research framing, concept expansion, critique simulation), was systematically documented and validated, facilitating seamless adaptation across different course sections, instructor teams, and academic years while preserving pedagogical continuity and cumulative improvement.

4.2. Problems and Prospects

Empirical implementation of the pedagogical model has identified several key areas requiring refinement and further investigation [18]. First, student engagement with artificial intelligence tools exhibits considerable individual variation; while some learners leverage AI as a supplementary cognitive aid, others exhibit overreliance by adopting generated outputs without sufficient critical analysis, reflection, or iterative revision. Addressing this necessitates the development of pedagogically grounded scaffolding—such as structured reflection prompts, mandatory revision logs, and guided comparison

exercises—that foster metacognitive awareness and deepen conceptual understanding. Second, the current process evaluation framework depends heavily on self-reported documentation by students, raising concerns regarding consistency, thoroughness, and verifiability of learning artifacts. Future iterations will integrate multimodal verification strategies, including timestamped digital submissions, peer-validated checkpoints, and instructor spot-check protocols to enhance evidentiary rigor. Third, the model's application remains confined to a single foundational course within the visual communication design curriculum; its transferability, adaptability, and scalability across diverse course levels—from introductory studios to advanced capstone projects—require systematic validation through comparative case studies and longitudinal tracking. Subsequent research will prioritize refining cognitive friction techniques to better align with domain-specific design thinking processes, prototyping low-friction digital tools for seamless process documentation, and conducting cross-course pilot implementations to assess institutional feasibility and curricular integration pathways.

5. Conclusion

This study develops and implements a human-computer collaborative teaching model grounded in the undergraduate course 'Book Design', serving as a concrete pedagogical case study. The model integrates three interdependent pillars: (1) a stage-specific role division framework that explicitly delineates responsibilities between students and AI tools across ideation, research, prototyping, and refinement phases; (2) a cognitive friction-driven learning strategy that intentionally leverages AI's limitations—such as ambiguity in output interpretation, contextual gaps, or generative unpredictability—not as obstacles but as structured catalysts for critical analysis, iterative hypothesis testing, and metacognitive reflection; and (3) a two-dimensional evaluation system that simultaneously assesses both process-oriented competencies (e.g., prompt engineering rigor, revision logic, source triangulation) and product-oriented outcomes (e.g., typographic coherence, narrative flow, material appropriateness). Central to scalability is the Prompt resource library: a living, version-controlled repository organized by design task type, cognitive objective, and fidelity level, enabling instructors to scaffold prompts progressively and students to adapt, annotate, and contribute validated variants. Six comprehensive tables detail the operational architecture—including role allocation matrices per phase, taxonomy of prompt categories with usage guidelines, module-by-module implementation timelines, comparative pre- and post-intervention metrics on student engagement and conceptual fluency, rubric specifications for dual-axis assessment, and longitudinal tracking of resource reuse rates across semesters. Preliminary application demonstrates measurable gains in students' capacity to articulate design intent, navigate open-ended problem spaces, and critically appraise algorithmic outputs—thereby supporting more adaptive, reflective, and resource-efficient instructional practices in design education amid evolving AI capabilities.

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