



A Study on Pathways for Cultivating Aesthetic Expression Skills in the Course “Rendering Techniques for Product Design” in the Context of Digital and Intelligent Transformation

Hongling Jiang^{1*}, Zhijun Zhu¹, Dan Cai¹

¹ Guangzhou Huashang College, 510030, China

Corresponding Authors*: Hongling Jiang Email: jianghl@gdhsc.edu.cn

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ABSTRACT

The transition to digital and intelligent technologies is transforming the knowledge structure, teaching methods, and competency development goals of product design education. As a foundational course in product design, “Product Design Rendering Techniques” not only provides training in rendering techniques such as line work, perspective, color, materials, and lighting but also plays a crucial role in cultivating students’ abilities in aesthetic judgment, form expression, the translation of design logic, and comprehensive visual expression. From the perspective of cultivating aesthetic expression abilities, this paper identifies the main issues in traditional course design, analyzes the shift in teaching approaches within the context of digital and intelligent transformation, defines the components of aesthetic expression abilities, and proposes a path for curriculum reform covering course resource development, AI-assisted analysis, the integration of hand-drawn and digital illustration, project-based task organization, training in integrated text-and-image expression, and formative assessment mechanisms. The study argues that curriculum reform should not replace hand-drawing training with digital tools. Instead, it should leverage technological assistance, case studies, project-based practice, and process-oriented feedback to shift the curriculum from a focus on technical skills training to the cultivation of aesthetic expression capabilities, thereby enhancing students’ ability to comprehensively express product form, color, materials, function, and context.

1. Introduction

(I) Changes in Design Education in the Context of Digital and Intelligent Transformation

Artificial intelligence, big data, cloud computing, and intelligent design platforms are reshaping the curriculum content and organizational methods of design education. For product

design programs, technological transformation has not only altered product development processes but also changed the ways students present their proposals, access resources, and engage in design communication. The OECD (2021) notes that artificial intelligence, learning analytics, and intelligent technologies are influencing the organizational structure of educational systems and classroom teaching methods; Redecker and Punie (2017) propose that university faculty need to develop corresponding digital competencies in areas such as digital resource development, instructional implementation, and learning assessment. From this perspective, product design curriculum reform cannot be limited to merely updating tools but must respond to the new requirements for the competency structure of design professionals in a digital and intelligent environment.

With the introduction of generative AI into design education, curriculum development must also address the relationship between technological efficiency and the cultivation of professional competencies. Miao and Holmes (2023) emphasize that the application of generative AI should adhere to human-centered educational principles, avoiding situations where technology replaces learners' judgment and creativity. Zawacki-Richter et al. (2019) also point out that the application of artificial intelligence in higher education has already extended to areas such as learning support, assessment feedback, and instructional management; however, how educators organize AI-supported learning processes remains a key issue. Therefore, the digital and intelligent transformation of design education is not simply a matter of adding software training, but rather involves restructuring the relationship among "technology, curriculum, and competencies."

(2) The Importance of the Course on Rendering Techniques for Product Design

"Product Design Visualization Techniques" is a core foundational course for product design majors and serves as a crucial link between design conception and the expression of design proposals. The course not only trains students in the representation of lines, perspective, color, materials, and lighting and shadows but also guides them in translating product structure, functional logic, usage scenarios, and design concepts into a visual language. McLain (2022), in research on design and technology education, points out that design education requires the joint training of "mind, hand, and value judgment" to enable students to develop professional competencies through thinking, practice, and evaluation. The product visualization course serves as a vital vehicle for this comprehensive training.

From the perspective of design practice, product rendering serves both as a tool for refining design proposals and as a medium for design communication. Research by Zhang and Ranscombe (2021) on learning experiences with digital sketching indicates that the approach to learning design visualization tools influences students' future attitudes toward using these tools and their practical skills. In recent years, AI image-generation tools have gradually entered the product design process. Bartlett and Camba (2024) caution that design education must address issues of originality, copyright, bias, and ethics raised by generative AI. Consequently, the focus of this course reform should not be on having students mechanically use new tools, but rather on cultivating their ability to make rational choices and achieve integrated expression by balancing hand-drawing fundamentals, digital expression, and AI-assisted methods.

2. Issues with Traditional Courses

Within the product design curriculum, the course "Techniques for Product Design Visualization" has long served as the foundation for training basic expressive skills, with its

instructional focus primarily centered on technical aspects such as line work, perspective, color, and materials. While the course helps students develop basic hand-drawing skills, it remains inadequate in terms of aesthetic judgment, design expression, and the integration of digital and intelligent tools. Particularly against the backdrop of the design industry's shift toward digitalization and intelligentization, traditional teaching models are gradually revealing their inadequacy in areas such as competency structure, teaching methods, and evaluation systems, making the need for curriculum reform increasingly urgent (Bower, 2017).

First, the curriculum objectives place too much emphasis on technical training, while the cultivation of aesthetic expression is insufficient. Traditional curriculum objectives primarily focus on training students in the skills required to produce product renderings—such as line control, perspective representation, lighting and shadow rendering, and material depiction—emphasizing “accurate drawing” and “complete representation.” However, this technique-driven approach often overlooks the aesthetic judgment and expression of design logic inherent in product design itself. Although students are able to complete relatively standardized rendering assignments, they lack proficiency in the rationality of product form, the consistency of visual style, and the expression of design semantics, resulting in a disconnect between visual representation and design thinking.

Second, the curriculum lags behind in updating its content, making it difficult to adapt to the evolving demands of digital and intelligent design. Course content remains centered on traditional hand-drawing training, with teaching resources primarily relying on textbook examples and instructor demonstrations; there is limited integration of new technologies such as digital drawing tools, AI-assisted design, and multimodal visual expression. Holmes et al. (2019) argue that the application of artificial intelligence in education should not focus solely on improving efficiency but should also address the development of learners' competencies and the evolving role of teachers. If existing curricula fail to develop teaching modules that integrate traditional hand-drawing with digital and intelligent technologies, this will likely create a disconnect between classroom training and industry practice.

Furthermore, teaching methods are primarily based on demonstration and copying, resulting in insufficient independent expression skills among students. Classroom instruction typically follows a model of teacher demonstration, student copying, and group feedback, with students primarily learning by imitating existing examples. While this approach has some merit during the foundational training stage, long-term reliance on it can lead students to adopt fixed expression patterns and lack the ability to proactively analyze product form logic and design problems. The principles of human-computer interaction proposed by Amershi et al. (2019) emphasize that intelligent systems should help users develop understanding and control, rather than undermine user agency; this perspective also offers valuable insights for AI-assisted design education.

Finally, the evaluation system is overly result-oriented, and the mechanisms for formative assessment are inadequate. Current course evaluations primarily judge performance based on the quality of the final renderings, with assessment criteria focused on aspects such as visual neatness, technical execution, and visual effects, while paying insufficient attention to the processes of sketch development, design iteration, design analysis, and the use of digital and intelligent tools. Brookhart (2013) points out that clear assessment rubrics help learners understand objectives and improve their performance. For this course, if assessment focuses solely on the final outcome, it will be difficult to reflect the developmental process of students' aesthetic judgment and design expression abilities.

3. The Shift in Teaching the Course on Product Design Rendering Techniques in the Context of Digitalization

3.1 Shifting from Technical Training to Cultivating Aesthetic Expression

In the context of digital and intelligent technologies, the product design rendering course must first shift from technical training to the cultivation of aesthetic expression. Traditional teaching typically emphasizes individual rendering skills such as line control, perspective conventions, light-and-shadow relationships, and material rendering, with “technical accuracy” serving as the core evaluation criterion. However, in the context of contemporary product design education, relying solely on technical proficiency is no longer sufficient to meet the complex demands of design expression; students must instead achieve comprehensive visual expression based on an understanding of product functionality, user experience, and form logic. This shift implies that course objectives must move from “accurate drawing” to “effective expression.”

From the perspective of design cognition research, visual expression itself is a process of thought generation, rather than a presentation of results. Cross (2011) argues that the core of design thinking lies in the continuous generation and refinement of solutions through visualization; Goldschmidt (2014) further emphasizes that design sketches reveal the relationships, judgments, and reflections inherent in the conceptualization process. At the same time, multimodal learning theory posits that images, symbols, and text collectively contribute to the construction of meaning, thereby helping to enhance learners’ comprehensive expressive abilities (Kress, 2010; Mayer, 2021). Therefore, curriculum reform should embed technical training within a framework of aesthetic expression, enabling students to understand not only “how to draw” but also “why to express it in this way.”

3.2 Transitioning from Hand-Drawn Sketching Alone to the Synergy of Hand-Drawn and Digital Tools

Traditional product rendering courses center on hand-drawn sketches on paper as the core training method. Their advantage lies in strengthening students’ spatial judgment, line control, and form analysis skills, making them irreplaceable for foundational design training. However, in a digital and intelligent design environment, relying solely on hand-drawn sketches can no longer cover the entire design expression process; digital drawing, AI-assisted tools, and image-generation technologies are gradually integrating into the design practice system. A comparative study by Das, Huang, and Yang (2024) on paper and tablet sketching indicates that different tools influence sketch quality, fluidity, and communication effectiveness. This suggests that courses need to help students understand the characteristics of various tools rather than simply choosing one over another.

The synergy between hand-drawn and digital tools is not a relationship of substitution, but rather one of functional division of labor. At the foundational stage, hand-drawn sketches remain the primary method for training in form, structure, and perspective; at the intermediate stage, digital tools are introduced for color exploration, material simulation, and layer optimization; and at the comprehensive stage, AI-assisted analysis and digital layout are used to integrate the overall design expression. Verganti, Vendraminelli, and Iansiti (2020) point out that even after the integration of artificial intelligence into innovation and design, human judgment and problem-selection capabilities retain their core value. Curriculum reform should adhere to the principle that “tools serve the development of abilities,” enabling students to retain their skills in hand-drawn analysis, aesthetic judgment, and original expression while mastering digital tools.

3.3 Shifting from Outcome-Based Assessment to Process-Based Assessment

Traditional course evaluations for product rendering typically focus on the final piece as the primary criterion, emphasizing the completeness of the image, technical proficiency, and visual presentation. While this evaluation method is operationally straightforward, it fails to reflect the processes students undergo during the learning journey—such as data analysis, sketch development, proposal refinement, and cognitive development—thereby creating an evaluation bias that “prioritizes results over process.” Black and Wiliam (2018) point out that the core of formative assessment lies in promoting learning through feedback, rather than merely judging outcomes.

Process-based assessment should emphasize the continuous documentation of learning trajectories and dynamic feedback, including stages such as sketch development, design iteration, color experimentation, structural revisions, and expression optimization. The theory of constructive alignment proposed by Biggs and Tang (2011) emphasizes that instructional objectives, learning activities, and assessment tasks should be aligned. For this course, students are required to submit not only the final renderings but also the sketching process, reference analyses, AI usage notes, revision logs, and design descriptions, ensuring that assessment truly focuses on the development of aesthetic expression skills.

3.4 Shifting from Copy work to Project-Based Expression

Copy work exercises can help students quickly develop line control, an understanding of perspective, and basic form recognition in the early stages of the course. However, if used as the core teaching method over the long term, it can easily lead to students becoming overly reliant on established approaches, thereby weakening their ability to independently analyze product design problems and express original ideas. Therefore, the course should gradually shift from “imitating examples” to “project-driven expression.” Through real or simulated design tasks, students should be guided through the complete process—from 需求分析, sketching, and 方案比较 to the final rendering—enabling them to understand the logical relationships and visual strategies of product expression within specific design contexts. Guo et al. (2020) point out that project-based learning in higher education can promote students’ cognitive, affective, and behavioral development; Kokotsaki, Menzies, and Wiggins (2016) also argue that project-based learning emphasizes independent inquiry, goal-setting, collaboration, and reflection, making it suitable for teaching courses with a strong practical focus. Dorst’s (2015) research on framework innovation further illustrates that design problems need to be reorganized and understood within a contextual framework, which also provides theoretical support for shifting the product rendering course from imitation exercises toward project-based expression.

4. Components of Aesthetic Expression in the Course on Product Design

Rendering Techniques

(1) Aesthetic Judgment of Product Form

The ability to make aesthetic judgments regarding product form is one of the most fundamental and core competencies in the course on product design rendering techniques. It primarily refers to students’ ability to comprehensively assess a product’s proportions, volumetric relationships, structural order, and formal semantics before engaging in its visual representation. This ability goes beyond the technical aspect of “drawing realistically” and places greater emphasis on students’ understanding of the functional relationships, usage characteristics, and visual style

underlying the product's form. In teaching practice, students often tend to focus on local details and coloring effects while neglecting the overall harmony and logic of the form, leading to problems such as disproportionate scaling, ambiguous structure, or an unstable visual center of gravity in their renderings.

From a design cognition perspective, aesthetic judgment of form is essentially a process of visual reasoning. Research by Tovey, Porter, and Newman (2003) on automotive design sketches indicates that the form lines, shading, and visual proportions in sketches support concept development and design evaluation. Goldschmidt (2014) also emphasizes that the sketching process reveals the construction of relationships within design thinking. Course instruction should guide students in developing the ability to identify the stylistic characteristics of different product types through case comparisons, form decomposition, and angle selection exercises. In the context of digital and intelligent technologies, AI-generated design reference images and screenshots of digital models may be appropriately introduced for comparative analysis, enabling students to refine their evaluation criteria through diverse visual materials. However, their auxiliary nature must be clearly defined to prevent image generation from replacing design thinking.

(2) Color and Material Representation Skills

Color and material representation skills primarily refer to students' ability to accurately convey a product's material properties, user experience, and visual style through visual language in product renderings; this serves as a vital bridge connecting a product's functional attributes with its aesthetic expression. Color serves not only a decorative purpose but also conveys a product's character, target audience, and emotional appeal; material representation, in turn, directly influences a product's realism, tactile perception, and sense of spatial volume. If students cannot distinguish the gloss, reflectivity, transparency, and textural characteristics of materials such as metal, plastic, glass, rubber, and wood, their product renderings are likely to remain superficial.

Multimodal learning theory posits that color, images, text, and spatial relationships all contribute to the construction of meaning (Kress, 2010). In this course, color and materials are not isolated technical skills but should serve product positioning, usage contexts, and user experience. Instructors can guide students in understanding the visual expression patterns of different product categories through the observation of material samples, analysis of exemplary renderings, and comparison of digital color schemes. For example, electronic products emphasize precision and cool colors; home furnishings emphasize warmth and a sense of daily life; and age-friendly products must balance recognizability, a sense of security, and approachability. Zhang and Ranscombe (2021) point out that the learning experience with digital sketching tools influences designers' attitudes toward visualization tools and their practical choices; therefore, the course may incorporate training in digital color matching, layer overlay, and material simulation, but the core remains students' understanding of color logic and material properties.

(3) Ability to Express Structure and Function

The ability to express structure and function refers to students' capacity to clearly convey a product's structural logic, functional relationships, and usage through renderings; this is a key characteristic that distinguishes product design expression from general artistic expression. Excellent product renderings should not only present the product's appearance but also illustrate how it is used, how its components relate to one another, and how its design highlights are realized. In traditional classrooms, students tend to view renderings as mere representations of appearance, focusing excessively on visual aesthetics while neglecting the role of structural analysis diagrams,

detailed close-ups, and functional explanation diagrams. This results in works that lack design clarity and professional depth of expression.

Cross (2011) points out that design thinking emphasizes constant back-and-forth reasoning between problems and solutions. Product renderings serve as a crucial medium for this process. Course instruction should strengthen training in structural breakdown diagrams, exploded views, cross-sections, usage flowcharts, and functional annotation diagrams, enabling students to shift from “drawing the exterior” to “clearly explaining the design.” With the support of digital and intelligent tools, instructors can incorporate 3D modeling screenshots, AI structural references, and dynamic usage scenario analyses to help students understand the relationship between internal structure and external form. However, these tools can only assist students in observing and verifying structure; they cannot replace students in performing functional reasoning. Amershi et al. (2019) proposed that human-computer interaction design should help users understand the system’s state and maintain control; this principle also applies to AI-assisted design expression instruction: technology should enhance students’ ability to judge structure and function, rather than obscure problems.

(4) Comprehensive Expression Skills for Scenarios and Layouts

The ability to integrate scenarios and layout primarily refers to students’ capacity to holistically organize product renderings, usage scenarios, structural descriptions, functional annotations, and textual information. It is a crucial dimension in the evolution of product design expression from single images to systematic presentations. This ability emphasizes not only the quality of individual renderings but also the hierarchical organization of diverse information, visual flow, and expressive logic. In course assignments, students often encounter issues such as a confusing relationship between the main image and detail views, an overabundance of explanatory text, and unclear layout hierarchy. As a result, although their design proposals may have a certain visual impact, they struggle to accurately convey the product’s value.

Mayer’s (2021) theory of multimedia learning posits that the effective integration of text and images helps learners form clearer cognitive structures. In the context of product design communication, the main rendering is used to present the overall form, detail views are used to explain structure and function, scenario images are used to illustrate usage contexts, and textual descriptions are used to supplement design intent and innovative features. Course instruction should guide students in establishing an expression framework of “main visual—supplementary illustrations—textual explanations—layout hierarchy.” In the context of digital transformation, digital typesetting tools and AI-assisted layout analysis can be used to identify issues with visual hierarchy and information organization; however, the core of layout proficiency lies in understanding design logic, rather than proficiency in tool operation. Therefore, the course should emphasize the principle that “structural expression takes precedence over visual ornamentation,” enabling students to develop a systematic approach to design expression.

Table 1: Components of Aesthetic Expression Skills in the Course on Rendering Techniques for Product Design Visualizations

Competency Dimension	Main Content	Course Training Focus
Aesthetic Judgment of Product Form	Assessing product proportions, forms, structural order, and visual style	Decomposition of forms, selection of angles, and comparison of forms
Ability to Express Color and	Expressing a product’s color	Color scheme comparison,

Texture	character, material properties, and tactile associations	material observation, and digital simulation
Ability to Express Structure and Function	Illustrating the relationships between product components, functional logic, and usage methods	Exploded views, cross-sections, flowcharts, and functional annotations
Ability to Integrate Scenarios and Layout	Integrating main illustrations, detail views, scenario illustrations, and textual descriptions	Hierarchy of text and graphics, layout organization, and visual flow

5. Pathways for Cultivating Aesthetic Expression in the Context of Digital Intelligence

(1) Building a Digital Course Resource Library to Expand Aesthetic Experience with Products

Reforming the course on product design visualization techniques must first address students' lack of aesthetic experience. Many students exhibit issues such as monotonous forms, inconsistent material choices, and haphazard color schemes in their work; these problems do not stem entirely from weak hand-drawing skills, but rather from a lack of systematic observation of different product types, design styles, and visual languages. Based on this, the course should establish a digital resource repository tailored to the teaching process, categorizing and organizing product form case studies, exemplary renderings, material representation examples, color scheme examples, outstanding student assignments, and common error cases. The resource library should not merely be a collection of images; rather, it should be organized with clear tags based on product categories, presentation angles, material types, color styles, compositional approaches, and common issues. Cope and Kalantzis (2009) argue that learning in the digital age requires students to understand and apply multiple modes of expression, which provides theoretical support for the development of this course resource library.

In course implementation, instructors can utilize the resource library for pre-class preparation, in-class analysis, and post-class revisions. Before class, students review case studies related to designated product types and complete observation logs; during class, instructors select typical case studies to analyze form, color, materials, and layout; after class, students revise their own assignments by comparing them with problematic examples. Through this approach, digital resources become more than just materials for instructors to present; they serve as vital learning scaffolds for students to establish aesthetic judgment criteria.

(2) Introducing AI-Assisted Analysis to Enhance Form and Style Judgment Skills

AI tools can serve as aids for preliminary analysis and inspiration generation, but they must be embedded within clear instructional tasks. Instructors can ask students to use AI tools to generate different design directions, color schemes, or usage scenarios for the same product brief, and then compare their merits and demerits through classroom discussions. For example, when designing small home products, students can generate visual references in styles such as minimalist, approachable, or tech-inspired, and then analyze the differences in proportions, curves, colors, and materials across these styles. Miao and Holmes (2023) emphasize that as generative AI enters the

educational field, a human-centered approach must be upheld to prevent the use of technology from undermining learners' agency.

The key to AI-assisted analysis lies in “analysis,” not “replacement.” After using AI, students should submit a brief explanation outlining the purpose of the reference image, its useful aspects, its shortcomings, and how they plan to translate it into their own hand-drawn expression. Instructors can focus on guiding students to identify common issues in AI-generated images, such as structural inconsistencies, uncontrollable details, and missing functional logic. Bartlett and Camba (2024) point out that generative AI raises issues of originality, ethics, and copyright in product design education, reminding instructors that they must incorporate guidelines for AI use into course requirements.

(3) Promoting the Integration of Hand-Drawn and Digital Sketching to Form a Phased Training Chain

Curricula must not neglect the fundamentals of hand-drawing simply because digital tools have become widespread. On the contrary, the more we operate in a digital and intelligent context, the more we need to clarify the fundamental value of hand-drawing training. Courses can adopt a phased training sequence: the first phase focuses primarily on hand-drawing on paper, emphasizing lines, perspective, geometric shapes, product forms, and simple materials; the second phase introduces digital drawing tools, focusing on color adjustment, material layering, lighting and shadow correction, and local refinement; Stage three involves comprehensive expression training, integrating main renderings, detail drawings, usage scenario illustrations, and textual descriptions into a complete layout. Research by Das et al. (2024) indicates that digital drawing tools can influence the quality of sketches and communication methods; therefore, instructors should help students understand the appropriate boundaries for using different tools.

This phased integration helps avoid two extremes: first, an overemphasis on traditional hand-drawing at the expense of contemporary expression tools; and second, an overreliance on digital tools that neglects the fundamentals of form. In the foundational stage, teachers should emphasize “accuracy”; in the advanced stage, “clarity”; and in the comprehensive stage, “complete expression.” Students develop spatial and structural awareness through hand-drawn sketches on paper, improve revision efficiency and visual completeness through digital drawing, and cultivate the ability to express design proposals through comprehensive layout. The relationship between hand-drawn sketches and digital tools is not one of substitution, but of complementarity.

(4) Design Project-Based Course Assignments to Strengthen the Applied Focus of Design Expression

Curriculum reform must shift from isolated technical exercises to project-based task organization. The ultimate goal of courses on product rendering techniques is not for students to produce an isolated practice drawing, but to enable them to create visual expressions for specific product proposals. Instructors can design project tasks at different levels based on the course schedule, such as “rendering of portable small appliances,” “rendering of age-friendly daily necessities,” “rendering of campus cultural and creative products,” and “rendering of smart wearable devices.” Guo et al. (2020) point out that project-based learning can improve student learning outcomes in higher education; Kokotsaki et al. (2016) also regard independent inquiry, collaboration, reflection, and real-world practice as key characteristics of project-based learning.

The advantage of project-based assignments lies in their ability to link technical training with

design application. When illustrating age-friendly products, students need to consider safety, ease of recognition, and approachable colors; when illustrating electronic products, they need to convey a sense of precision, technological sophistication, and material luster; and when illustrating cultural and creative products, they must focus on the adaptation of cultural elements and the control of decorative language. Different projects correspond to different aesthetic expression requirements, which helps students understand that product rendering is not a one-size-fits-all template but rather requires adjustments based on product attributes and design objectives.

(5) Strengthening Integrated Text-and-Image Expression to Enhance the Completeness of Proposal Presentations

Product design rendering courses should prioritize the integration of text and visuals as a key training component. Student submissions should not consist solely of a single main rendering but should include the main rendering, structural analysis diagrams, close-up detail views, material and color specifications, usage scenario illustrations, and a brief design description. The main rendering addresses the product's overall form; detail drawings address structural and functional explanations; scenario images address the context of use; and textual descriptions serve to supplement the design intent and innovative features. Mayer (2021) points out that the effective integration of text and images can help learners form clearer cognitive structures—a perspective that offers direct insights for teaching product design communication.

In the classroom, instructors can incorporate layout design exercises to guide students in analyzing the hierarchy of elements, the balance between text and images, visual flow, and information hierarchy. Some students possess adequate visual composition skills, yet their layouts are cluttered, explanations are disorganized, and key points are not highlighted, which undermines the effectiveness of their design communication. Through integrated text-and-image training, students can transition from presenting a single rendering to systematic communication, laying the foundation for future competition display boards, course projects, and graduation projects.

(6) Refining the Formative Assessment Mechanism to Promote Continuous Skill Improvement

The cultivation of aesthetic expression must be supported by formative assessment. Course evaluation can be structured around five dimensions: foundational techniques, aesthetic expression, design logic, application of digital and intelligent tools, and the learning process. Foundational techniques primarily assess the accuracy of lines, perspective, proportions, and form; aesthetic expression evaluates the quality of color, materials, lighting and shadow, and composition; design logic evaluates functional expression, structural explanations, and scene presentation; the application of digital and intelligent tools assesses the appropriateness of AI references, digital drawing, and resource organization; and the learning process evaluates sketch development, revision records, classroom participation, and reflective summaries. Biggs and Tang's (2011) theory of constructive alignment suggests that course assessment should align with learning objectives and classroom activities.

In practice, instructors can establish periodic assessment milestones, such as line art reviews, color scheme reviews, material reviews, comprehensive layout reviews, and final presentation evaluations. Each milestone has clear feedback priorities to help students address issues promptly. Peer assessment can also serve as a supplementary method, guiding students to evaluate works from perspectives such as form, color, materials, function, and layout, rather than simply judging them as “attractive” or “unattractive.” Black and Wiliam (2018) emphasize that the value of formative

assessment lies in promoting learning improvement. Through continuous feedback, students are able to develop stable aesthetic judgment and expressive abilities through repeated revisions



Figure 1: Pathway for Cultivating Aesthetic Expression Skills in the Context of Digital Intelligence

6. Conclusion

In the context of digitalization and intelligent technology, the focus of reforming the “Product Design Rendering Techniques” course lies not in simply adding AI tools or digital software, but in redefining the course’s competency development objectives. The core value of product hand-drawing courses remains the cultivation of students’ understanding of product form, structure, color, materials, and visual language through hand-drawing training. In today’s era of rapid development in digital technology and intelligent tools, traditional hand-drawing has not lost its significance; rather, it needs to realize a renewal of its value within new teaching environments.

This paper argues that the “Product Design Rendering Techniques” course should center on cultivating aesthetic expression skills, driving the curriculum’s transformation from single-technique training to comprehensive design expression. Aesthetic expression capabilities encompass aesthetic judgment of product form, the representation of color and materials, the expression of structure and function, and the integrated expression of scenes and layouts. Centered on these competency dimensions, the curriculum can be reformed through approaches such as building digital resource libraries, AI-assisted analysis, the integration of hand-drawing and digital drawing, project-based task organization, training in integrated text-and-image expression, and process-based assessment mechanisms.

Practice in curriculum reform has shown that when students are able to understand aesthetic judgments through hand-drawing exercises, expand their visual experience using digital resources, conduct comparative analyses with AI assistance, and achieve comprehensive expression through

project-based tasks, their ability to create product rendering visuals is enhanced in a more systematic manner. Future curriculum reform will still require further refinement of teaching resources, standardization of AI usage, refinement of evaluation metrics, and strengthened integration with the professional curriculum system. Only by adhering to the principle of “maintaining the foundation of hand-drawing, not allowing digital tools to replace it, prioritizing aesthetic ability, and aiming for design expression” can the course on product design visualization techniques continue to fulfill its vital role as a foundational professional course in the context of digital and intelligent transformation.

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