

Teaching Reform and Innovation of Color Design of Automobile Interior from the Perspective of CMF

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Abstract: Under the dual impetus of the transformation of new energy vehicle architecture and the upgrading of consumption, the interior of automobiles, as the core carrier of user perception, is undergoing multi-dimensional paradigm reconstruction. The color design of automotive interiors has gradually become the core battlefield of CMF innovation, directly influencing brand recognition and user driving experience. This paper, starting from the perspective of CMF color research, explores the innovative paths and methods of automotive interior color design. It analyzes the contemporary consumer aesthetic trends, breaking through the traditional static aesthetic research paradigm. By integrating color psychology, human-computer interaction, and sustainable development concepts, as well as the application of new materials and digital processing technologies, it constructs a three-dimensional trend of color, emotion, and function, and formulates innovative color design strategies.

Keywords: CMF Design; Color; Automotive Interior Design; Development Trend; Innovative Research

1. Introduction

As the automotive industry accelerates its evolution toward intelligentization, electrification and personalization, the automobile cockpit is transforming from a mere driving carrier into a "third living space". In this transformation, automotive interior design has become a key dimension for shaping brand differentiation and upgrading user experience.

CMF (Color, Material, Finishing) is an interdisciplinary field covering aesthetics, color science, engineering, materials science and other disciplines. As a visual language that directly touches users' emotions, color serves not only as the core expressive medium of interior design, but also profoundly influences occupants' emotional cognition and the efficiency of human-machine interaction.

To cultivate innovative design talents adaptable to industrial changes, this paper, based on the CMF triadic integration framework, explores the co-evolution of automotive interiors in aesthetic expression, emotional resonance, humanistic value, functional experience and ecological sustainability, which profoundly responds to the emotional needs of drivers and passengers.

Through systematic research and teaching practice, this study constructs a future-oriented systematic innovation paradigm for interior color design, develops a feasible teaching reform plan for design education, and realizes the integration of theoretical research and innovative talent cultivation.

2. The Correlation Between CMF Theory and Automotive Interior Color Design from the Perspective of Teaching Reform

2.1 The Correlation Between Color Emotional Communication and Brand Gene Coding in Teaching

In CMF design, color not only directly influences users' spatial cognition and emotional feedback through visual perception, but also serves as an important carrier of brand genes. As a space with which users directly interact and immerse themselves, automotive interior color schemes not only shape the atmospheric sense, spatial scale and riding mood inside the vehicle, but also

become a core element in forging unique brand recognition through systematic color strategies. To help students better master the ability to convey brand identity through color, case studies are integrated into teaching. This enables students to better understand that well-designed interior color language can effectively communicate brand value, help automakers establish distinctive brand recognition, and ultimately form a profound brand impression in users' minds.

Take Ferrari as an example. Among the brilliant stars of the automotive industry, Ferrari shines like an everlasting ruby, establishing an unshakable position in the hearts of car enthusiasts worldwide with its breathtaking speed aesthetics, sculptural aerodynamic design, and unquenchable racing passion. Originating from the racetrack, Ferrari's brand gene and soul were defined by founder Enzo Ferrari's declaration: "Racing is a mission flowing in my blood." Today, the Prancing Horse badge represents far more than the physical form of a sports car. It has evolved into the ultimate mechanical artwork of the internal combustion engine era, a symbol of the perfect fusion of technology and art.

In an era when the color system of the modern automotive industry is becoming increasingly commercialized, Ferrari still dominates its body and interior with blazing red. The high-saturation Italian Rosso Corsa serves as the visual expression of Ferrari's racing DNA, whose lineage can be traced back to the national representative color of the Alfa Romeo racing team in the 1920s. Since the first model 125 S established the canonical status of this color in 1947, this genetic symbol has endured for more than 70 years. See our example below.



Fig. 1 Interior Design Based on Ferrari's Red Racing DNA

2.2 A Training Method for Expression Combining Material Texture and Processing Technology in Color Design Teaching

Successful CMF design represents a perfect symphony of color, material, and finish. The material texture and processing technology of automotive interiors serve as the core carrier and amplifier of color expressiveness. Material defines the basic character of color, while technology acts as the rhetorical device of color — this is the key entry point for CMF design teaching practice and curriculum system reform.

Training emphasizes that color never exists in isolation; there is no "pure" color detached from material and technology. Only by relying on specific materials and processes can the ultimate design intention and emotional communication be realized. In the curriculum system, students are guided to explore the inherent characteristics of different materials, the ability of various processes to shape surface conditions, and the comprehensive sensory experience (visual, tactile, and even auditory) produced by their combination. The core training method lies in enabling students to master the ability to truly "breathe life into" color through carefully selected materials and appropriate processes, so as to create a unique and memorable interior space.

Take the Audi A8 interior design as an example (Figure 2). Genuine wood trim is applied to areas including the interior door pulls and the center console, with different wood species selected across various models and trim levels. When gently touching the wooden surfaces, one can feel that every grain carries the charm of nature and the vitality of life.

The seats are wrapped in genuine leather, whose delicate texture complements the exquisite stitching craftsmanship. The door panels and instrument panel are also covered in soft leather, offering a warm and supple touch. Some variants feature full-leather or mixed-velvet seats for enhanced comfort. Large areas of the center console and door interiors are padded with high-density soft materials, providing a refined and gentle tactile experience.

Certain models integrate carbon fiber elements into the cabin; their crisp texture and matte luster add a strong sense of technology and dynamism to the interior. The combination of metallic chrome trim and wood inlays creates a striking contrast between resolute cool tones and warm textures, outlining a distinctly layered sense of luxury. Every detail reflects Audi's uncompromising pursuit of interior quality, infusing the warmth of luxury into every single touch.



Fig. 2 Audi A8 Interior Design

2.3 Teaching Implementation Strategies for Color Constraints in Automotive Interior Design

In automotive interior design, students are required to skillfully balance multi-dimensional constraints within the teaching and training framework. The curriculum aims to cultivate students' ability to achieve visual aesthetic expression while taking into account functional requirements, engineering feasibility, and user experience.

Students are guided to understand that color schemes must meet the basic requirements of driving safety. Through training, they learn to use appropriate lightness and saturation designs to improve the comfort of human-machine interaction. In terms of aesthetic teaching methods, students are instructed to accurately grasp the dual mission of color in conveying brand positioning and users' psychological feelings. They must consider differences in color presentation caused by material properties, and create appropriate spatial and atmospheric effects through delicate color matching.

For example, cool colors may enhance a sense of technology, yet excessively dark tones should be avoided to prevent a depressing atmosphere. Warm colors convey vitality but need to be controlled to avoid visual fatigue. Luxury models often use dark or metallic finishes to strengthen a premium feel, while economy vehicles tend to adopt neutral colors to enhance spatial perception.

From an engineering perspective, practice integrates color selection into real-world constraints such as production technology, material durability, and cost control. Students simulate color difference control and fade resistance of different materials, and conduct adaptive analyses of market preferences.

Essentially, an excellent automotive interior color design scheme is a sophisticated art of balance. Teaching must enable students to integrate brand DNA, users' emotional demands, functional requirements, and production processes. In simulated or real project practice, students are guided to use color as a medium within a rigorous framework to create a spatial experience that combines emotional warmth and practical value, conveying the unique positioning and personality of the vehicle model.

3. The Influence Mechanism of Color in the Automotive Interior CMF System and Its Teaching Transformation

3.1 Teaching Module Design for Exploring the Psychological Effect Mechanism of Color in Automotive Interiors

Color design is a design process that purposefully selects, combines and applies colors through scientific, aesthetic and psychological methods to achieve functional, emotional, brand or artistic expression. Teaching enables students to understand that color matching directly affects the driver's emotions, perception and experience. Through practice, students develop the ability to precisely control color so that automotive interiors can enhance user experience from both physical comfort and psychological suggestion, ultimately translating into brand loyalty and sales conversion.

In the practical teaching section, the case analysis method is used to dissect classic examples. For instance, dark colors (such as black and dark gray) are applied to convey a sense of luxury and sportiness; warm and light colors (such as beige and light brown) create a warm and comfortable atmosphere; and cool colors (such as blue and light gray) deliver a sense of technology and calmness.

In response to the growing trend among consumers pursuing green, environmentally friendly and sustainable consumption, thematic training is designed to guide students in integrating green tones that symbolize health, environmental protection and freshness into interior design (such as low-saturation olive green and fresh mint green). Students are required to demonstrate that such colors not only reflect the sustainable vision of new energy vehicles but also create a relaxed and pleasant driving atmosphere.

Students are instructed to avoid the monotony caused by single-color schemes. Through color composition training, they master the skills of adding accent or secondary colors to enhance layering and vitality. Meanwhile, the teaching concept of "innovation under constraints" runs through the whole process, requiring students to balance functional requirements and accurately match vehicle positioning in their training.

The ultimate teaching goal is to cultivate students' ability to shape a unique brand image and strengthen users' recognition of healthy travel on the premise of ensuring safety and aesthetics.

Take the white interior of the Tesla Model 3 as an example (see Figure 3). The pure white futuristic cockpit uses pearl white as the main color to unify the visual order of the space and improve interior brightness. Combined with black and gray contrasting colors, it integrates minimalist design, a sense of technology and practicality, creating a clean and high-end cabin atmosphere.

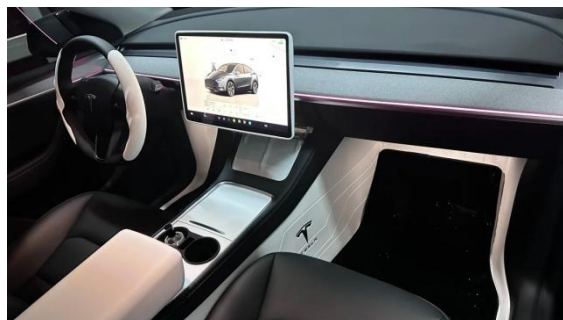


Fig. 3 Pure White Futuristic Cockpit of Tesla Model 3

The interior design of the Volvo XC90 centers on a minimalist Nordic style and embodies Scandinavian design principles (see Figure 4). With cardamom brown as the dominant warm visual tone, paired with warm ambient lighting, it creates a cozy and premium cabin atmosphere. The seats are made of natural leather, whose eco-friendly characteristics, combined with light gray linen texture, deliver both delicate tactility and soft visual appeal. The center console and door panels are accented with gray ash wood trim, which echoes the light gray interior and creates a distinctive modern aesthetic.



Fig. 4 Cardamom Brown Interior Design of the Volvo XC90

3.2 Practical Application of the User Demand Mechanism of Emotional Design in Teaching

In the teaching practice of emotional design, students are guided to break through the traditional framework of basic functions and formal aesthetics, and deeply understand the key role of color as a medium for users' emotional projection and self-expression. The course makes it clear that users are no longer satisfied with standardized solutions; their deep-seated needs lie in expressing personality, identity and emotional sustenance through the cockpit environment. Through user research, students are instructed to observe different groups and understand the emotional and cognitive characteristics of differentiated groups. For example, young people from Generation Z pursue individuality and uniqueness, high-end users seek restrained and noble experiences, and family users prefer a warm and comfortable atmosphere.

Special training is designed to help students put the concept of personalized customization into practice. The training goal is not only to accurately match users' aesthetic preferences, but also to master how to build a "sense of exclusivity" and "narrativity" in the interior. The functional cockpit space is transformed into a carrier of users' emotions, values and attitudes towards life. The ultimate goal of teaching is to enable students to drive consumption from mere satisfaction of functional needs to the establishment of emotional resonance and a sense of belonging through design, making it a core hub for brand differentiation competition.

Take Porsche's personalized customization service as an example. As one of the core projects of its high-end customization division, it aims to provide car owners with unique color choices to meet extreme personalization needs. The Porsche Taycan Turbo S customized with Ding Yi's "Ten Signs" series draws inspiration from the deep blue of the user's private yacht. The Porsche team spent months developing the exclusive color "Aegean Blue". Details from Ding Yi's painting Ten Signs 2022-2 are used as decorative elements, and the "Ten Signs" motif appears extensively throughout the interior. Screen printing technology is applied to interior components to present the "Ten Signs" elements on various trim panels. The interior details correspond precisely to their positions in the original painting, creating a feeling of sitting in the middle of a work of art while driving. See our example below.



Fig. 5 Porsche Ding Yi "Ten Signs" Custom Interior Design

4. Prospects for Automotive Interior Color Design Under the Influence of CMF Theory

4.1 The Leap of Technology-Enabled Design in Teaching

The development of automotive interior color design has benefited from advances in various technologies. Today, progress in materials science and surface treatment technologies has brought greater possibilities to automotive interiors. New materials, such as synthetic leather, sustainable materials, recycled fibers, and 3D knitted fabrics, offer a richer selection of colors and textures while embodying the concept of sustainable development. In addition, advanced surface treatment technologies, including nano-coatings and UV-resistant treatments, have improved color durability by preventing fading and aging, while also enabling special effects such as matte finishes and metallic lusters.

Featuring immersion, interactivity, and intelligence, digital design and virtual reality (VR/AR) technologies simulate a broader driving perspective for drivers. With these tools, designers can quickly simulate multiple color schemes, adjust effects in real time, and reduce both costs and development time. For consumers, virtual cockpit technology delivers an unprecedented interactive experience, allowing users to intuitively “preview” interior color combinations and improve the efficiency of personalized customization. To cultivate students’ ability to master these cutting-edge technologies, digital design tools and intelligent color-matching software are integrated into teaching.

Intelligent display and dynamic lighting technologies are applied to key areas such as instrument panels, center consoles, and door trim panels, enabling dynamic display functions through intelligent color adjustment systems. The main color tones can automatically switch according to different driving modes, achieving a perfect integration of visual cues and functional modes. In terms of emotional design, advanced ambient lighting systems adopt high-precision RGB LED technology that supports dynamic multi-color gradient effects. Such intelligent lighting not only adjusts automatically according to driving scenarios but also creates a personalized cockpit atmosphere based on color psychology principles. Practical design tasks are carried out in class to guide students in combining dynamic lighting effects, context awareness, and color psychology. This integrated teaching model enables students not only to understand technical principles but also to master their systematic application in innovative interior color design.

Take the BMW i Vision Circular concept car as an example (see Figure 6). It fully embodies the principles of the circular economy by simplifying the number of complex components, material groups, and surface textures. The entire vehicle is manufactured using 100% recyclable and bio-based raw materials. Equipped with a groundbreaking 3D-printed crystal touch interface combined with a sculptural floating instrument panel, it creates a new human-machine interaction paradigm with seamless “digital-physical” integration. This design realizes a natural transition between virtual information and physical control, greatly improving interaction efficiency and safety during driving.



Fig. 6 Interior Design of the BMW i Vision Circular Concept Car

4.2 The Evolution of Humanistic Value-Oriented Design in the Curriculum System

Nowadays, automotive interior color design shows a clear trend toward humanistic value orientation, with in-depth innovations in three dimensions. To develop students' relevant design capabilities, the teaching system needs to strengthen training in integrating cultural elements into design.

In the dimension of emotional design, intelligent color systems can adjust color tones through biometric recognition, and students are trained to match color schemes with simulated emotions in teaching. In the dimension of cultural narration, designers transform regional cultural symbols into modern color language; for instance, the Hongqi L5 fully embodies distinctive Chinese cultural characteristics. In the dimension of human-centered care, functional color schemes are developed, such as Volvo's lighting system against seasonal affective disorder and high-contrast colors friendly to people with color vision deficiencies. Students are trained to design targeted solutions by integrating multidisciplinary knowledge.

Based on research, students practice applying color psychology, engineering and materials science to develop customized automotive interior color schemes. This multi-dimensional integrated design philosophy marks the transformation of automotive interiors from cold mechanical spaces into warm human-oriented mobile living spaces. Color is no longer merely a decorative element, but also an important medium carrying emotional resonance, cultural identity and humanistic care.

Taking the Hongqi L5 as an example, it takes the "ruyi" as its core design element and pursues symmetrical and elegant beauty. The center console features a "large ruyi" shape with a full LCD instrument panel, and the doors are embedded with white jade "small ruyi" door handles carved with cloud-and-dragon patterns, highlighting its cultural heritage. The interior adopts the intangible cultural heritage Fujian Shen's lacquerware and top-grade Scottish calfskin. Its layout draws on traditional Chinese overhanging eaves, and the seats reference classic round-back armchairs, presenting an oriental aura through intangible cultural heritage craftsmanship (see Figure 7).



Fig. 7 Hongqi L5 Interior Design

4.3 Reconstruction of Value Dimensions of the Sustainable Deepening Concept in Color Teaching

Driven by the concept of sustainable development, automotive interior color design is undergoing a green revolution. Designers no longer focus solely on the aesthetic effects of color; instead, through natural dyeing processes, the original color presentation of recycled materials, and dye-free processes, color itself becomes a visual carrier of environmental value.

To equip students with the abilities required by this transformation, the core teaching content should integrate the trinity sustainable design thinking of materials, processes and color, and strengthen the teaching practice of material color application. In practice, students are encouraged to select natural materials with their own hands, compare and evaluate the original color beauty and performance of different recycled materials, and intuitively experience how material properties directly influence color selection and final presentation.

Within the interdisciplinary curriculum system, the above teaching content is organically combined with disciplines such as materials science, environmental engineering and CMF design. Such teaching and training enable students to understand that the concept of sustainability has evolved from a restrictive condition into a source of innovation, redefining the aesthetic standards of automotive interiors.

Take the Mercedes-Benz Vision EQXX concept car as an example (see Figure 8). With exquisite detailed design, this concept car embodies its environmental commitment. It innovatively adopts biodegradable pure plant-based silk door handles, integrating the concept of sustainable development into every accessible detail.

The interior materials also uphold the environmental philosophy: the seats are made from refined cactus raw materials and mycelium, while the carpets are finely woven from 100% bamboo fiber. This ingenious design not only demonstrates Mercedes-Benz's breakthroughs in material technology, but also highlights the brand's firm determination to lead the green transformation of the automotive industry.



Fig. 8 Interior Design of the Mercedes-Benz Vision EQXX Concept Car

5. Conclusion

Future interior color design will place greater emphasis on dynamic interaction and personalized expression. Through the integration of smart materials, digital craftsmanship and sustainable technologies, color will evolve from static decoration to dynamic experience. Meanwhile, the evolution of consumer aesthetic trends demands that design not only deliver visual pleasure, but also carry emotional resonance and cultural identity.

Teaching reform requires the reconstruction of the curriculum system and the innovation of practical approaches. Within an interdisciplinary curriculum framework, core teaching modules of "intelligent color interaction" and "humanistic value-driven design" shall be established. In teaching practice, students will be guided to explore dynamic color interior design through material experimentation. In cultural narration, they will be trained in emotional color strategies and the

translation of regional symbols, while incorporating sustainable materials and using recycled materials and dye-free processes for color expression.

Automotive interior color design should pursue collaborative innovation among technology, humanities and ecology. Students will be cultivated to empower design with technology and convey value through design, ultimately driving the evolution of automotive interiors toward a warmer and more sustainable future.

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