



The Innovation and Influence of Cubism in Architectural Education and Design

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Abstract. This paper discusses the innovation and influence of cubist painting on architectural education and future design. The traditional perspective painting technique is limited to a single perspective, which limits the innovation of objects and spatial forms. At the beginning of the 20th century, Cubism broke through the inherent thinking and introduced a new teaching method for architectural education through multiple perspectives, spatial decomposition, and geometric treatment. This paper analyzes the specific application of Cubism in architectural education in detail, including improving the understanding ability of plan, color, and space, and application in actual architectural design. Studying the relevant courses at Harvard University, UC Berkeley, MIT, and other institutions, shows the profound influence of Cubism on modern architectural education and future architectural design.

Keywords: Cubism, architectural education, spatial decomposition, geometric processing, innovative teaching methods, creative architectural design

1 Introduction

The traditional perspective painting technique is the most basic way for many artists to recognize the types of visual creation. Still, the creation only through visual effects, in reality, will limit the innovation of objects and spatial forms. At the beginning of the 20th century, artists, feeling the limitations of their creative process, sought a more intuitive and modern way of presenting objects and spaces, and presented visual effects with a new form of artistic expression. French painter Paul Cezanne reduced nature into three basic geometric shapes, circular cones, and spheres, and shaped the image composition, which inspired cubist artists to rethink the form and structure. Paul Gauguin's formalistic painting style promoted the development of Cubism. In 1912, the French artists Jean Metzinger and Albert Gleizes published the Cubist Manifesto in Paris, of-

ficially announcing the birth of Cubism. Cubism emerged and developed in this context, breaking the inherent limitations of thinking and advocating multiple perspectives, spatial decomposition, definition, and geometric processing methods, becoming one of the most important art movements in the early 20th century^[4]. Cubism is a form of artistic creation that reshapes the expression of art. This not only has an important role and influence in the field of painting creation and sculpture but also has triggered important exploration and practice in architectural education.

2 Innovation of Architectural Education Teaching Methods

Traditional architectural education usually relies on a single perspective law which is the traditional perspective technique in the process of painting to teach students how to draw and understand architectural space. Usually, three-dimensional buildings, in reality, are drawn into planar figures from a single perspective^{[1][2]}. However, the architectural space is not flat, but three-dimensional. The space experience and visual effects of each angle are different. Therefore, when the space is presented from a single visual angle, it is not the entire space and the thinking is not coherent. The concept of multiple perspectives of Cubism breaks the tradition so that students can observe and understand buildings from multiple angles. Case study and investigation are crucial teaching methods in the learning process of architectural design. Through the observation of paintings, students can learn how to analyze architectural space from different perspectives and dimensions, guide students to form the ability of observation and analysis of things learn to obtain the source of form from things, and establish the concept of spatial relations in two-dimensional planes.

3 Improve Students' Understanding Ability of Plane, Color, and Space

3.1 Formal Cognition and Way of Thinking

Architectural design is a thinking process from two-dimensional plane drawings to three-dimensional ones, in which the optimal solution is repeatedly explored in multiple dimensions. Cubism painting emphasizes the abstract and geometric processing of forms. This abstract and geometric method is very suitable for students who have just come into contact with architectural design, guiding students to establish the concept of abstract space and abstract extraction of future design inspiration. Cubist painting introduces the concepts of time and motion and creates dynamic effects by dividing and reorganizing planes, a method that is also widely used in modern architectural design. Such an educational approach is also incorporated into the learning process of architectural design, recombining these fragments to represent multiple perspectives of the object - reconstruction^{[3][5]}.

Fernand Leger's masterpiece *The City* shows the hustle and vitality of the city by breaking down the building objects, Bridges, billboards, and street scenes into basic geometric shapes and plane fragments and then recombining these fragments. Leger breaks down and simplifies the form of an object, transforming it into outer basic geometric shapes such as circles, rectangles, and straight lines. He used these shapes to represent various elements of the city. Leger juxtaposed, overlapped, and arranged the simplified basic geometric shapes to create a multi-level and segmented spatial structure, making the urban scene present a mechanical aesthetic feeling. The contrast and mutual use between these shapes enhanced the sense of structure and rhythm of the picture. The multiple perspectives of the building and the composition of the principles of formal beauty are very suitable for architecture students to study and analyze. What is worth learning is not only the abstract and geometric treatment of Cubist artists in form but also their attempt to express the essence and structure of objects through simple lines and geometric shapes instead of being satisfied with extracting creative inspiration that only copies the images in nature.

3.2 Perception of Color and Application of Materials

By studying the theory of colors, students could get practice through design training. For example, this training can continue the reconstruction of cubist painting in the form of cognition. Students can exercise their ability to observe the colors of things and cultivate their ability to match colors by collecting colors in paintings, to improve their aesthetic taste^[10] of colors. In addition, materials in actual architectural works can be selected to find the same material to complete the collocation. The color composition training would be completed based on the reconstructed Cubist plane works through the use and texture of color, material, and texture. This training could benefit learning and understanding how to use color and material in architecture to enhance the spatial effect. It also breaks through the restrictions on the material application of watercolor gouache in traditional color education.

Picasso's cubist masterpiece, *Three Musicians*, employs distinctive and opulent colors to captivate people's eyes. Contrasting colors are adopted in the painting to intensify the vividness and expressiveness of the figures within it. For instance, one musician in the painting wears dons red and yellow attire, while another wears blue and white clothes. The application of diverse colors not only confers the symbolic significance of different colors but also endows the picture with rich connotations. Picasso divided the clothes of the characters and the surrounding environment into distinct color blocks and shapes, and subsequently recombined them in the picture, augmenting the sense of rhythm and dynamic visual effect of the painting. By analyzing and studying similar cubist paintings, students could not only comprehend the visual impact and psychological perception brought about by colors but also learn the coordination and application of colors.

3.3 Cultivation of Spatial Perception

Cubist painting can promote students from two-dimensional plane thinking to three-dimensional thinking, and cultivate their spatial imagination and innovation ability^{[6][7]}. Analyzing and studying the potential spatial levels and fragments in the Cubist painting will help students establish the expression techniques of cubism through the plane works in their minds, and students will learn how to use geometric shapes and spatial composition in architectural design to create architectural works with complex spatial structures. For example, students can use the same painting to analyze the complex and simplified geometric shapes that have been completed in the front and back spatial layers in the plane to transform them into dioramas and give meaning to the building. They can explore the spatial relations, spatial organization, and spatial experience of the reconstructed plane works through the method of modeling, and establish the clear expression of abstract forms and the establishment of spatial concepts. To practice the way of thinking from two to three dimensions.

3.4 The concrete Application of the Cubism Method in Practical Teaching

In the professional courses of the Department of Architecture of Harvard University, Architectural Representation: Origins + Originality and Architectural Representation II: Projective Realities refers to Cubism to explore the relationship between two-dimensional drawing and three-dimensional construction, using geometric relations and design methods to create and represent architectural forms. Arch 100B, a freshman in the Department of Architecture at the University of California, Berkeley, also uses cubist principles to explore how space and form are designed in traditional design projects. Arch 209, the sophomore design course, focuses on the expression forms and methods of traditional and modern architecture, including a series of expressions and influences of Cubism on modern architecture. The Visual Arts and Architecture program at MIT's School of Architecture and Planning explores the impact of the visual arts (including Cubism) on architectural design. Students will study the work of cubist artists, such as Picasso and Braque, and apply these artistic principles to architectural design.

In August 2022, teacher Ma Zitong introduced Cubism into the first-year architecture curriculum at Changchun Institute of Technology. This innovative four-week course aimed to merge art and architecture through practical exercises involving both teachers and students. The course began with selecting a Cubist painting for morphological observation. For example, Sun Yongjia from Urban Planning 2351 choose Fernand Léger's <Elements Mecaniques> as the base painting (Fig1). She analyzed and summarized the painting's basic elements, including composition techniques, form relationships, and spatial levels. And then reconstructed the painting's framework, creating black-and-white two-dimensional works to convey depth and three-dimensional space (Fig.2). Color Composition (Fig.3.): she explored abstract associations through color, expressing emotions using at least three colors. This exercise developed students' ability to convey feelings and ideas through color combinations. Three-Dimensional Composition (Fig.4. and Fig.5.): Building on planar and color compositions, students

created three-dimensional spaces of varying sizes and heights, organized around a pathway for human experience. Models had to include elements like blocks, plates, and rods, exhibit height variations, and follow a 1:100 scale.

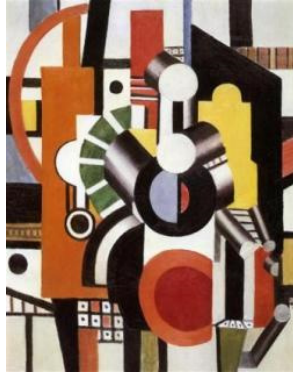


Fig. 1. Fernand Léger's <Elements Mecaniques>, 1919, <https://www.wikiart.org>



Fig. 2. Black, white, and gray collage; 2-5 by Sun Yongjia from Urban Planning 2351



Fig. 3. Emotions color expression



Fig. 4. 3D composition cardboard model based on the formal works: top view

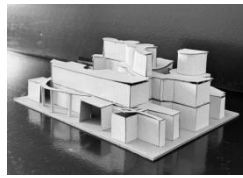


Fig. 5. 3D composition cardboard model based on the formal works: 3D view

Compared with the students in class 2151, who are taught traditional single-perspective techniques and conventional composition methods, the students in class 2351 demonstrate significantly richer spatial imagination, creativity, and color-matching abilities as they progress into their sophomore design course. This advanced preparation provides a solid foundation for their future endeavors in professional design. Adopting Cubist principles in the class 2351 curriculum enhances students' spatial understanding and innovation capabilities, making them particularly distinguished in these areas.

4 Specific Applications of Cubism to Actual Architecture

4.1 Influence on Architectural Design

Cubism not only has an important influence on art and education but also practical architectural design creation. Le Corbusier's method of simplifying and decomposing the spatial hierarchy and forms of Cubist painting is directly applied to design. The well-known Longchamp Church fully demonstrates the profound influence of Cubism in architectural practice. Le Corbusier created a dynamic and changing architectural appearance by breaking the building blocks into multiple geometric shapes and plane segments. The roof and wall of the building are tilted at different angles and directions, making the light and air change differently on the building surface over time. This spatial decomposition not only enhances the visual fluidity of the building but also enriches people's sense of space experience. Many shapes, such as triangles, squares, and ovals, are used in the Church of Longchamp. Le Corbusier combines and repeats these geometric shapes that you use in architecture, itinerating the single body of the geometrized institution. These geometric shapes not only simplify the structure and

form of the building but also enhance the sense of integration and modernity of the building through their regular arrangement and combination.

4.2 Outlook on Future Architectural Design Combined with Digital Technology

With the continuous advancement of digital technology, the principles and expressions of Cubism are continually being enriched and expanded. This evolution is significantly influencing and transforming traditional design methodologies, enabling the creation of more complex and innovative architectural designs. In future architectural education and design processes, the integration of Building Information Modeling (BIM) and Virtual Reality (VR) technology will allow architects to apply the geometric shapes and spatial decomposition techniques of Cubism to every detail of architectural design, thereby enhancing both the accuracy and operability of their projects.

By utilizing VR technology and the novel perspectives and analytical methods inspired by Cubism, designers can immerse themselves in the spatial experience, allowing for an optimization of building structures and spatial layouts. This immersive approach not only minimizes material waste and reduces energy consumption but also promotes the development of energy-efficient building designs, contributing to the sustainable growth of the construction industry.

5 Summary

Cubism, as one of the most important artistic revolution movements in the 20th century, was not only limited to the expression of art but also had a profound influence and inspiration on the field of architecture. Through the analysis of the works of pioneering artists such as Le Corbusier, Picasso, and Fernand, we can see how Cubism understands the appearance and internal spatial structure^[8] of architecture through the decomposition of space, the geometric treatment of forms, and the expression of multiple perspectives. This innovation not only enabled architects to create more creative Spaces but also expanded people's perception and understanding of architectural space.

In the field of architectural education, the introduction of Cubism provides architecture students with a new visual learning and expression method. The traditional perspective techniques are supplemented and expanded by multiple perspectives and spatial decomposition, enabling students to understand and express the complexity of architectural space in multiple dimensions. The innovation of this teaching method not only promotes students' creative thinking but also cultivates their sensitivity and professionalism in spatial organization and structural design.

Cubism has significantly influenced architectural education and design, introducing a new visual language and creative methodologies. With advancements in digital technology and sustainable design, Cubism inspires architects to create intelligent, sustainable, and humanistic works. Integrating Cubist principles with tools like BIM and VR enhances design precision and efficiency, promoting environmentally conscious practices and fostering a progressive future in the construction industry.

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