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Scientific and Artistic Analysis of Oil Painting: A Study of Historical Development, Technical Characteristics, and Aesthetic Impacts

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Abstract

Oil painting is regarded as one of the most significant and enduring forms of artistic expression in the history of world art. Since the fifteenth century, it has played a pivotal role in shaping various artistic movements. Owing to its capacity for creating multiple layers of color, its high flexibility in color blending, its ability to render intricate details, and the long-term durability of artworks, this technique has consistently attracted the attention of artists and scholars alike. The present study aims to examine the historical, technical, and aesthetic dimensions of oil painting and to analyze the factors that have contributed to the development and longevity of this artistic medium. The research adopts a descriptive-analytical approach, and the required data were collected through library-based research and a review of reputable academic sources. The findings indicate that the evolution of the constituent materials of oil paints, the development of painting techniques, and advances in materials science throughout history have played a significant role in enhancing the visual quality of artworks. Furthermore, the unique characteristics of this medium have enabled oil painting to maintain a prominent position in contemporary art and academic art education.

Keywords: Oil painting, Visual arts, Art history, Painting media, Aesthetics, Color theory.

1 | Introduction

Art has always been one of the most fundamental means of human communication for conveying emotions, ideas, and cultural concepts. Among the various branches of visual arts, painting holds a distinctive position, as it enables the expression of complex human concepts through visual elements such as color, line, form, and texture. One of the most important painting techniques that has maintained its prominence among artists for several centuries is oil painting [1]. Oil paint is composed of various pigments mixed with drying oils. Due to characteristics such as its slow drying time, high blendability, and the ability to produce a wide range of

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visual effects, it has become one of the most popular painting media. From the fifteenth century onward, this technique rapidly spread throughout Europe and provided the foundation for the creation of many of the masterpieces of art history [1]. Artists such as Leonardo da Vinci, Rembrandt, Peter Paul Rubens, and Vincent van Gogh are among the painters who created a substantial portion of their enduring masterpieces using this technique. Historical studies indicate that the development of oil painting was not solely the result of advances in artistic skills; rather, changes in material compositions, painting media, and paint-manufacturing technologies also played a significant role in the evolution of this art form. Research in the field of artistic materials has demonstrated that variations in the proportions of oils, resins, and additives used in oil paints have a direct impact on the physical behavior of the paint, its degree of transparency, surface texture, and the durability of artworks. Today, oil painting has attracted scholarly attention not only for its artistic value but also from a scientific perspective. Studies related to paint chemistry, materials physics, art conservation and restoration, and art history have examined various dimensions of this medium. The findings of these investigations suggest that a scientific understanding of the structure of oil paint can play a crucial role in the preservation and maintenance of artworks, as well as in achieving a deeper understanding of the creative process. Despite the expansion of digital media and the emergence of new methods of artistic production, oil painting remains one of the most important means of artistic expression worldwide. Characteristics such as color depth, the possibility of gradual revision and refinement, long-term durability, and the capacity to create complex visual effects have ensured its continued use in art education, professional artistic practice, and the global art market. Although oil painting has been one of the principal artistic media in the world for more than five centuries, many of its technical, historical, and scientific dimensions still require thorough investigation and analysis. Changes in the composition of oil paints, the evolution of painting media used by artists, and the development of painting techniques throughout history have had a direct influence on the visual quality and longevity of artworks. Furthermore, the growing expansion of interdisciplinary studies at the intersection of art and materials science has highlighted the necessity of a more scientific understanding of this artistic medium. Therefore, the central question of the present study is: How has the historical evolution of oil painting materials and techniques influenced the technical and aesthetic characteristics of artworks, and what factors have contributed to the continued use of this medium in contemporary art?

2 | Theoretical Literature on Oil Painting

Oil painting is considered one of the most important artistic media in the history of Western art. Art historical studies indicate that the development of this technique played a significant role in the emergence of realist styles and in enhancing artists' ability to depict light, shadow, and texture [2]. Due to its capacity for layering, extended drying time, and ability to create complex color mixtures, oil paint offers considerable advantages over other traditional painting media such as watercolor and tempera [3]. From a scientific and materials science perspective, oil paint consists of pigments combined with drying oils, such as linseed oil, whose physical behavior has a direct impact on the visual quality of the artwork. Research conducted in the field of material rheology has demonstrated that variations in the composition of oils and additives can significantly influence the transparency, flow properties, and final texture of the paint [4]. These characteristics have led to oil paint being recognized as one of the most versatile and adaptable artistic media. In the field of art studies, many scholars believe that the evolution of oil painting techniques is directly linked to the development of artistic styles. For example, during the Renaissance period, the use of thin and transparent layers of paint was widespread, whereas in later periods such as the Baroque and Impressionist eras, the application of thick brushstrokes and pronounced surface textures became increasingly common [5]. These developments indicate that oil painting was not merely an executional technique but also a determining factor in the formation of the visual language of art. Overall, the existing theoretical literature indicates that oil painting is an interdisciplinary medium situated at the intersection of art, materials chemistry, and history. In addition to its aesthetic value, this technique can also be examined from a scientific perspective. A thorough understanding of its properties and mechanisms can contribute to a deeper comprehension of the artistic creation process, as well as to the preservation and restoration of historical artworks.



Fig. 1. Rembrandt van Rijn. The Night Watch (also known as Militia Company of District II under the Command of Captain Frans Banning Cocq) /1642 /Oil on canvas.363 cm × 437 cm (approx. 142.9 in × 172.0 in). Rijksmuseum, Amsterdam /Baroque.

2.1 | The Importance and Necessity of Research

The importance of this research can be examined from several perspectives: A better understanding of the historical development of oil painting and its place in world art, an investigation of the technical and scientific characteristics of the materials used in this technique, helping to gain a deeper understanding of the process of creating artworks and the methods employed by artists, providing useful information for the conservation and restoration of artworks, and contributing to the development of interdisciplinary knowledge in the fields of art, materials chemistry, and art history.

2.2 | Research Objectives

The main objective of this research is to provide a comprehensive study of the historical, technical, and aesthetic characteristics of oil painting, considering its formation history and development. It also includes an analysis of the materials and media used in this technique, focusing on the most important methods and execution techniques. Furthermore, it examines the impact of the physical properties of paint on the visual quality of artworks. Finally, by considering the position of oil painting in contemporary art, the study addresses the main research problem through a scientific and technical investigation of oil painting.

3 | A Study on the Technical and Structural Evolution of Oil Painting

As shown in *Table 1*, which compares painting media, oil paint demonstrates significant advantages over other common media such as watercolor and acrylic in terms of both technical and aesthetic capabilities. The table indicates that oil paint, due to its long drying time, extensive ability for correction and layering, and capacity to create diverse textures, offers the highest level of flexibility among the media examined. In contrast, watercolor, while performing strongly in terms of color transparency, has considerable limitations in correction and the application of multiple layers. Acrylic, as a modern medium, provides a relative balance between fast drying time and ease of application; however, it does not achieve the same level of color depth and visual richness as oil paint. This comparison shows that the choice of each artistic medium depends on the artist's goals and the type of visual expression intended; however, oil paint still holds a prominent position among professional artists and in academic art education due to its unique characteristics [6]. As shown in the presented figures, oil painting is a multilayered and structured process that begins with the initial support (canvas) and continues through various preparation and paint layers. This layered structure includes the ground layer (gesso), the underpainting layer, the main paint layers, and finally the protective layer or varnish, each of which plays a specific role in the final quality of the artwork. Studies in the field of art materials and conservation indicate that this multilayer structure not only directly affects the durability and stability of the

work, but also plays a fundamental role in creating visual depth, controlling transparency, and determining light reflection quality. Furthermore, the composition of materials in each layer can influence the physical behavior of the paint as well as the degree of cracking or surface changes in the artwork over time [7].

Table 1. Comparison of painting media.

Oil Paint	Watercolor	Acrylic	Feature
Long	Short	Medium	Drying time
Very high	Low	Medium	Ability to correct
Very high	Medium	High	Durability
Very high	Low	High	Texture creation
Medium to high	High	Medium	Color transparency
Very suitable	Suitable	Suitable	Suitability for details

Fig. 2 schematically illustrates the layered structure of an oil painting and show that this type of artwork consists of several interdependent layers. At the lowest level, the primary support is a cotton or linen canvas, which serves as the mechanical backing of the work. Above this, the ground layer (gesso) is applied, typically composed of whitening materials such as lead white or similar compounds, preparing the canvas surface to receive paint. The next layer consists of oil paints, which are applied in multiple stages and may include underpainting and main paint layers depending on the artist's technique. Finally, the varnish layer is applied as a transparent protective coating on the surface of the artwork to protect it against environmental factors such as light, dust, and humidity. Studies in the field of art materials and conservation indicate that this multilayer structure plays an important role in the chemical stability, physical durability, and visual quality of oil paintings, and that the interaction between layers can significantly influence the long-term changes of the artwork [7].

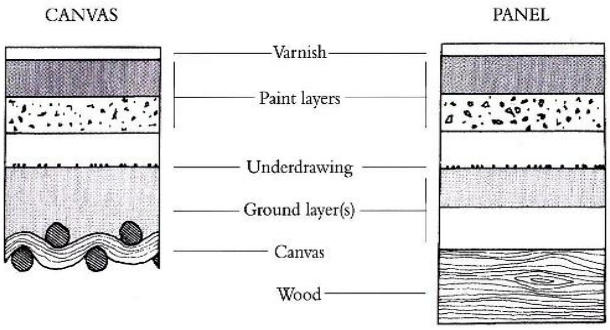


Fig. 2. Layered structure of an oil painting.

After examining the various layers of oil painting and the role each plays in the formation and preservation of the artwork, it is necessary to also consider the painting surface or support. The support is the foundation on which all these layers are applied. In *Fig. 3*, on the left side, the structure of the canvas is shown, which from bottom to top consists of the fabric canvas, ground layers (ground layers), underdrawing, paint layers, and finally varnish. This structure is more flexible because its base is textile. On the right side, a wooden panel is shown, whose base is wood. On the wood surface, ground layers, underdrawing, paint layers, and finally varnish are also applied. This type of surface is generally harder and more stable than canvas and preserves details better. Overall, the image shows that both supports follow similar painting stages, but their main difference lies in the nature of the substrate (fabric in canvas and wood in panel). Their physical properties can affect durability, flexibility, and even the painting process itself. Two common supports in oil painting

are canvas and wooden panel, each with its own structure and characteristics. *Fig. 3* presents a comparison of these two supports and the arrangement of different layers on them.

Fig. 3. Differences in the layered structure of painting on canvas



and wooden panel.

4 | Materials and Tools Used in Oil Painting

Table 2. The most important materials used in oil painting.

Material	Application
Pigment	Color creation
Linseed oil	Paint adhesion and fluidity
Thinner	Paint thinning
Canvas	Painting surface
Brush	Design execution
Palette knife	Texture creation

In oil painting, various materials and tools are used, each of which plays an important role in the quality and execution of the artwork. The most essential component is pigments, which are responsible for creating color and visual effects [8]. These pigments are mixed with linseed oil to produce a uniform and usable paint. Linseed oil, in addition to providing adhesion, increases the fluidity of the paint and enables better execution of details and multiple layers. Thinner or solvent is also used to dilute the paint and adjust its consistency, helping the artist to apply a variety of techniques. Among the tools used in oil painting, the canvas is of particular importance as the main painting surface and provides a suitable foundation for the durability and presentation of the artwork. Brushes are the primary tools for transferring paint onto the canvas and are used in various sizes and shapes to create lines, surfaces, and details. In addition, the palette knife is a widely used tool in oil painting for creating texture, impasto, and special effects on the painting surface. The proper combination of these materials and tools plays an important role in creating high-quality and long-lasting artworks.

5 | Main Methods of Oil Painting

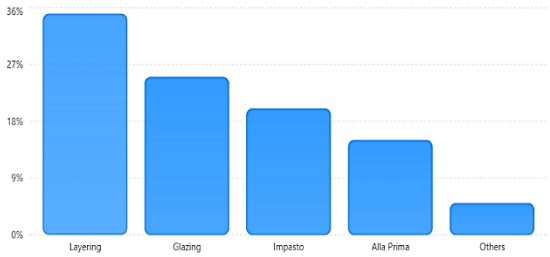


Fig. 4. Main methods of oil painting.

5.1 | Layering Method

Among the tools used in oil painting, the canvas is the main painting surface and provides a suitable foundation for the preservation and display of the artwork. The brush is the primary tool for transferring paint onto the canvas and is used in various sizes and shapes to create lines, surfaces, and details. In addition, the palette knife is a widely used tool in oil painting, used for creating texture, impasto, and special effects on the painting surface. The proper combination of these materials and tools plays an important role in producing high-quality and durable artworks.

5.2 | Glazing Technique

Glazing is one of the most important and traditional techniques in oil painting. It is based on applying thin and transparent layers of paint over previously dried underlayers. In this method, the artist mixes pigment with a medium to create semi-transparent layers through which light passes and, after reflecting from the underlying layers, produces a deep, luminous, and vivid effect in the artwork [9]. Unlike opaque painting methods, glazing preserves the details and texture of the underlying layers, and each new layer only alters the color, temperature, and light quality of the image. This technique is particularly effective for creating spatial depth, color harmony, rich shadows, and subtle light transitions. Successful glazing requires patience and adherence to the principle of allowing each layer to dry completely before applying the next. Many great painters of the Renaissance and Baroque periods, including Leonardo da Vinci and Rembrandt, used this method to achieve complex and highly realistic lighting effects.

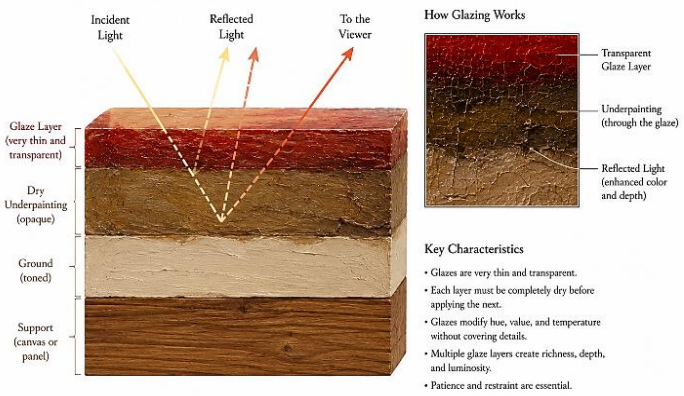


Fig. 5. Steps of the glazing technique.

5.3 | Impasto Technique

In the impasto technique, paint is applied in thick layers onto the canvas or painting surface in such a way that brush or palette knife marks are clearly visible. This technique creates a raised, three-dimensional texture in the artwork and gives the painting greater depth, movement, and expressive quality. Impasto is an

important painting method in which paint is applied very thickly onto the surface (usually canvas or wood), so that brush or palette knife strokes remain clearly visible, creating a raised and three-dimensional surface. This method is mostly used in oil painting because oil paint, due to its high viscosity and long drying time, allows for heavy layering. As a result, the painting is not only a two-dimensional surface but also gains a textured and vivid quality that reflects light differently [10]. Historically, impasto has existed since early artistic periods, but it became particularly prominent during the Baroque era and later in modern art. Artists such as Rembrandt and later Vincent van Gogh used this technique to create depth, emotion, and movement in their works. In fact, this method is not only a technique of applying paint but also a form of emotional expression, as the thickness of the paint and the visible brushstrokes can convey the artist's energy and psychological state to the viewer. The raised texture created in the impasto technique, in which paint is applied thickly onto the canvas surface, contributes significantly to this expressive effect.



Fig. 6. Impasto technique.

6 | Conclusion

Oil painting, as one of the most important artistic media, integrates technical knowledge, material chemistry, and visual aesthetics. The findings of this study indicate that the multilayer structure of this technique, from the initial support to the varnish layer, plays a fundamental role in the final quality of the artwork. This structure not only enhances the durability and stability of artworks but also enables the creation of visual depth, light control, and textural diversity for the artist. Therefore, it can be concluded that the historical success of oil painting is directly related to the physical properties and material composition of the medium. On the other hand, historical analysis shows that changes in medium compositions and application techniques have had a significant impact on various artistic styles. Variations in the proportions of oils, resins, and pigments have altered the rheological behavior of paint, leading to the emergence of different styles ranging from smooth and precise surfaces in the Renaissance period to expressive impasto textures in modern art. This indicates that oil painting is not merely an artistic tool, but a dynamic system rooted in material science that directly influences the visual language of the artist. Finally, despite advances in modern technology and the emergence of digital media, oil painting still holds a prominent position in contemporary art and academic education. This continuity can be attributed to its high flexibility, capacity for personal expression, and historical and cultural value. Thus, it can be concluded that oil painting is not only a traditional technique but also a living and enduring medium in the visual arts, with extensive potential for further research and artistic creation.

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