INTERPOSITION AND COLOR CONTRAST AS DEPTH ASPECT: FROM 2D MEDIA TO 3D SPACE PRODUCTION

Muvida[1]) Paramita Atmodiwirjo[2*]) Kristanti Dewi Paramita[2])

*)Corresponding author email: paramita@eng.ui.ac.id

1) Student of Department of Architecture, Universitas Indonesia, West Java, Depok 16424, Indonesia
2) Lecturer of Department of Architecture, Universitas Indonesia, West Java, Depok 16424, Indonesia

Abstract

This study attempts to dismantle the depth aspects produced by two-dimensional (2D) media such as paintings. as the basis for the production of three-dimensional (3D) space. In particular, we argue that painting as artwork with a flat surface can be transformed into 3D space by incorporating depth aspects. Even though it has a flat surface, painting as a 2D medium has the impression of 3D space and volume, which can be circumvented by constructing the perception of depth. To explore the production of 3D space through depth aspects, four 2D paintings were analyzed to find out how the depth aspects were constructed. The analysis reveals the perception of depth technique through interposition as the depth cues within the arrangement of layers. The analysis also reveals the color contrast as additional aspect that strengthen the perception of depth. Both the interposition and the color contrast become the important aspects that create the perception of depth in the production of the 3D space.

Keywords: *Depth; Space Production Two-Dimensional; Three-Dimensional; Interposition; Color Contrast*

INTRODUCTION

The purpose of this study is to explore the aspects of depth as the basis for architectural design method in the production of three-dimensional (3D) space. The exploration is conducted by unraveling the depth of two-dimensional (2D) flat media, namely paintings, with interposition as depth cues and the use of color contrast.

In this study, the 3D space refers to the real form of an object or figure in a certain environment, or an actual visualization of spatial elements (Montanez, 2014). 2D media such as painting has the potential to create the impression of a 3D space. When people see paintings, they can assume that they are looking at spaces and objects that have depth. Paintings become a media where people can enter the world created by the artist. However, the 3D effects created in the paintings does not always fully explain the original 3D space visualized in 2D media (Barney, 2022). Therefore, certain techniques in 2D painting that incorporate the depth aspect becomes necessary so that the viewer can figure out the 3D form within the painting.

In this study, we intend to look at the depth aspect by analyzing the depth perception that the painters create in their paintings. The depth aspect is an important strategy in the production process of the 3D space. The depth aspects can be created by constructing the perception of depth. Perception of depth is the ability to see 3D shapes from the flat or 2D objects (Watson & Enns, 2012). The human brain has the capability to picture the 3D shape of a flat or 2D medium but the process requires certaim parameters to capture the depth aspect. It becomes necessary to explore how the depth aspects can be incorporated in a flat surface In this study, paintings become the media to reveal how the depth aspect is created to produce the impression of 3D space.

LITERATURE STUDY
Depth perception by interposition

When looking at a painting, the viewer can indirectly see the depth created by the painting. But in reality, the painting just consists of a 2D surface. The artists can make the impression of a 3D image on a flat surface by creating visual illusions that

produce the depth perception of the viewers. The concept of depth perception as explained by Durao (2002) is how to see a 3D shape from a flat surface or 2D shape. Depth perception can be achieved through several cues such as perspective atmosphere, motion parallax, visual accommodation, binocular disparity, and convergence (VandenBos, 2007).

Depth cues include various visual cues that enable humans to make sense of the visual data received through the eyes. One of the depth cues is interposition, which involves the arrangement of several objects that are stacked and lead the sight to perceive the depth of an object. Interposition occurs in cases where an object overlaps another, leading the viewer to perceive depth (Foley et al., 1997). Interposition describes the layout of an overlapping object, where a viewer can see the position of each object whether it is behind or in front of another (Figure 1). The perception of depth is formed by reading the differences in these layouts. Interposition produces layers that determine the location of the objects in the painting, establishing a number of layers depending on each painting. In this study, the presence of these layers are utilized to analyze the use of colors, especially the color contrast applied by the painters in their paintings.
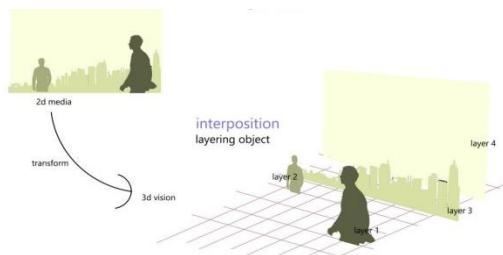

Figure 1: Example of Interposition

Depth perception by color contrast

In addition to interposition, color also plays an important role to elevate the human experience and change perception (McGee & Park, 2022). The perception of depth can also be influenced by color, and color contrast is one of the most important possibilities to create depth perception (Durao, 2002). The creation of the perception of depth is inseparable from color, as a form of visual reactions to architectural works. Color contrast becomes another parameter of depth perception (Durao, 2002) and the illusion of depth can be created with color textures (Bloch, 2016) and awakening them through the use of color contrasts.

Johannes Itten (1973) devised the seven methods for coordinating colors by utilizing the property of color contrast (Figure 2). The first type

of color contrast is the contrast to quality of hue, which is formed by the juxtaposition of different colors. The greater the distance between hues on the color wheel, the greater the contrast. The second type is saturation contrast, which is formed by the juxtaposition of light and dark values and their relative saturation. The third type, light and dark contrast, is formed by the juxtaposition of light and dark values, which is also called a monochromatic composition. The fourth type is warm and ool contrast, formed by the juxtaposition of colors that are considered warm (such as those that contain red, orange, and yellow pigments) or cool (those contain blue and green pigments). The fifth type is complementary color contrast, which is formed when there are two opposite colors on the color wheel. The sixth type is simulant contrast, which is formed when the boundaries between colors perceptually create vibrations or shadows. And the final type is extension contrast, also known as proportion contrast, which is formed by setting the field size proportional to the visual weight of color. Based on these different types of contrast, this study attempts to see how these color contrasts could possibly enhance the depth aspect when applied in 2D paintings to produce the 3D spatial effect.
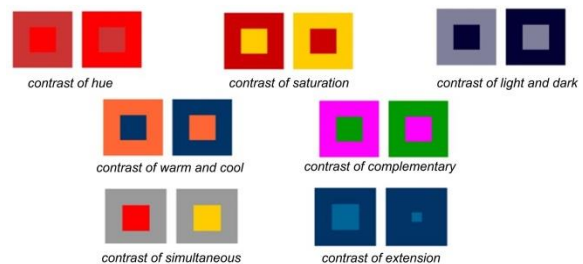
Figure 2: Color Contrast by Itten
(Source: Itten, 1973)

MATERIAL AND METHOD

This study was conducted by exploring four selected paintings as the case study, by analyzing how the interposition occurs and how the color contrast is implemented in these paintings. The purpose of this analysis is to identify aspects of depth constructed by painters in producing 3D space from the flat 2D paintings, in particular to identify various uses of interposition techniques and color contrasts. The four paintings are *Composition IV* by Wassily Kandinsky, *Horizontal Vertical* by Johannes Itten, one of the painting from *Variant* series by Josef Albers, and *Moonshine* by Paul Klee (Figure 3). These four artists are known for different strategies in using color and in creating the perception of depth in their paintings.

We began the analysis of depth cues by identifying the layers in each painting from the front to the back as well as from the top to the bottom to understand the interposition that occurs within each painting. Then, we identified the color use in each layer, using color code to analyze the composition of colors in each layer and to identify the type of color contrast based on Itten's explanation of color contrast in his book *The Art of Color*. We also looked into the connection of one layer to another to see the color contrast relationship in the interposition. Then a conclusion was made for each painting regarding the main strategy in producing the depth aspect.
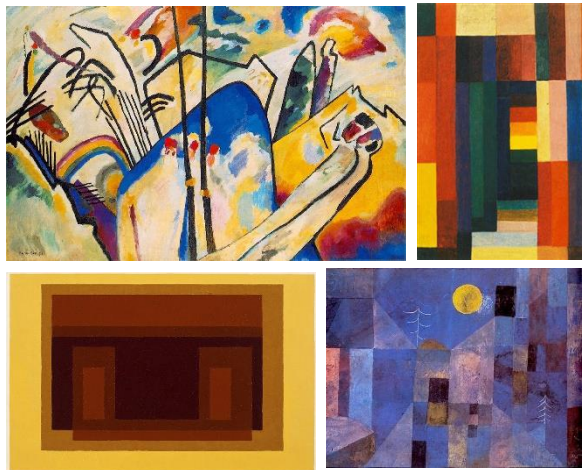

Figure 3: Case Studies of Paintings by Four Artists

RESULT AND DISCUSSION
Depth Aspects in Wassily Kandinsky's Painting

Wassily Kandinsky is one of the pioneers of abstract modern art. His painting is characterized by how he defined his imagination into abstract drawing and color. The painting analyzed in this study consisted of various objects that demonstrated the interposition and the use of various types of color contrast. In the first step of analysis, we identified the kinds of objects existed in the painting as the basis to determine the layers using the interposition technique and to examine the layering of the objects from the very front layer to the very back. We found ten layers in the painting that defined the depth, and in this interposition technique Kandinsky used bold black lines to differentiate one object from another (Figure 4). The use of the bold black lines allows the clear identification of the objects in the front layer and in the layer behind (Kandinsky, 2013).

In the second step of analysis, we classified the colors used in the painting and assign color code for each color to allow further identification. Kandinsky chose primary colors—red, yellow and blue—as the base color and used the saturation

technique to increase the level of intensity of the white color to create brighter color. He also combined primary colors to create the purple, green, and orange colors and saturate them to the brighter level. Finally, Kandinsky used the black color as the border line of each object. The colors are given the code A, A1, A2, A2a, and B. The codes were then used to identify the use of colors in each layer. We found that Kandinsky tended to use complementary colors with different brightness intensity in the first layer of the painting. Identification of color was conducted to all the ten layers of the painting (Figure 5).
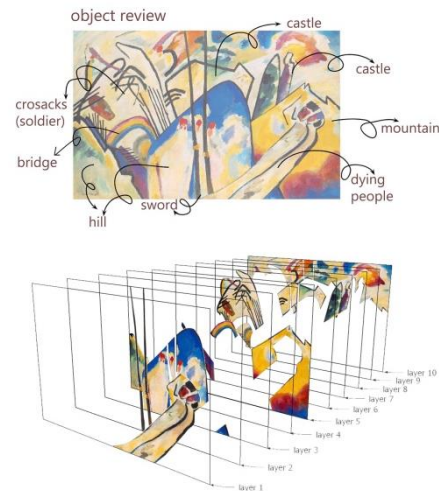

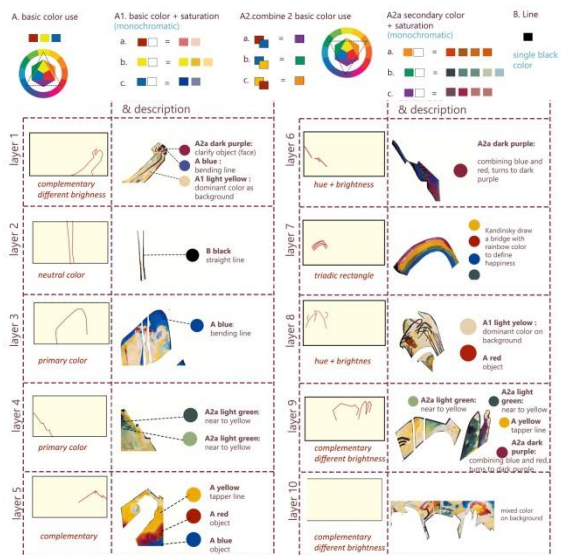**Figure 4**: Objects and Layers in Kandinsky's Painting

Figure 5. Color Rule and Color Use in Each Layer

In the analysis we also tried to connect each and every layer, from layer 1-layer 2, layer 1-layer 3, to layer 9-layer 10, to define the use of color contrast technique in the painting (Figure 6).
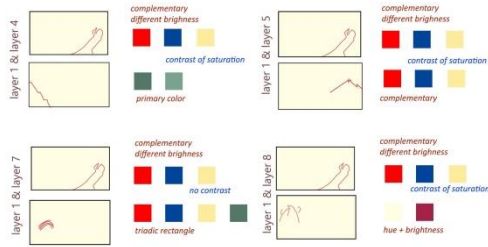

Figure 6. Examples of Color Contrast in Each Layer

Depth Aspect in Johanness Itten's Painting

Johannes Itten is a Swiss expressionist painter, designer, teacher, writer, and theorist associated with the Bauhaus school. Itten (2004) established the theory of color contrast. In this study we analyzed Itten's painting *Horizontal Vertical* that demonstrate the depth of space.

First, we analyzed how Itten used grid in his painting. For every square in the grid in his painting, he uses different colors. Unlike Kandinsky, this painting demonstrates the different perception of depth which we use to analyze and define the layers in the painting. Itten's painting comprises horizontal and vertical interposition. The horizontal interposition defines layers from top to the bottom, while the vertical interposition defines layers from the front to the back. In total, there are six layers of horizontal interposition and seven layers of vertical interposition (Figure 7).
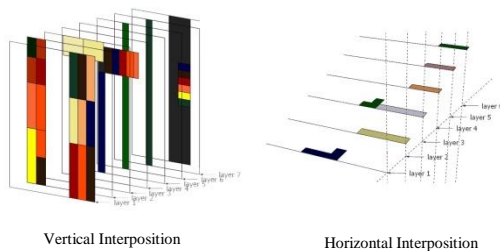

Vertical Interposition   Horizontal Interposition

Figure 7: Layers of Itten's Painting

Next, we classified the colors used in the painting and give each color a certain code so that it will be easier to continue to the next step. Itten chose the split analogous colors for his painting which are green, yellow, orange, red, and blue. Itten, like Kandinsky, also tended to increase the color

brightness too. He also increased the level of the darkness. The colors were given code a, b, c, d, and e. The brighter colors were given code a1, b1, c1, d1, e1 and the darker colors were given code a2, b2, c2, d2, and e2 (Figure 8).
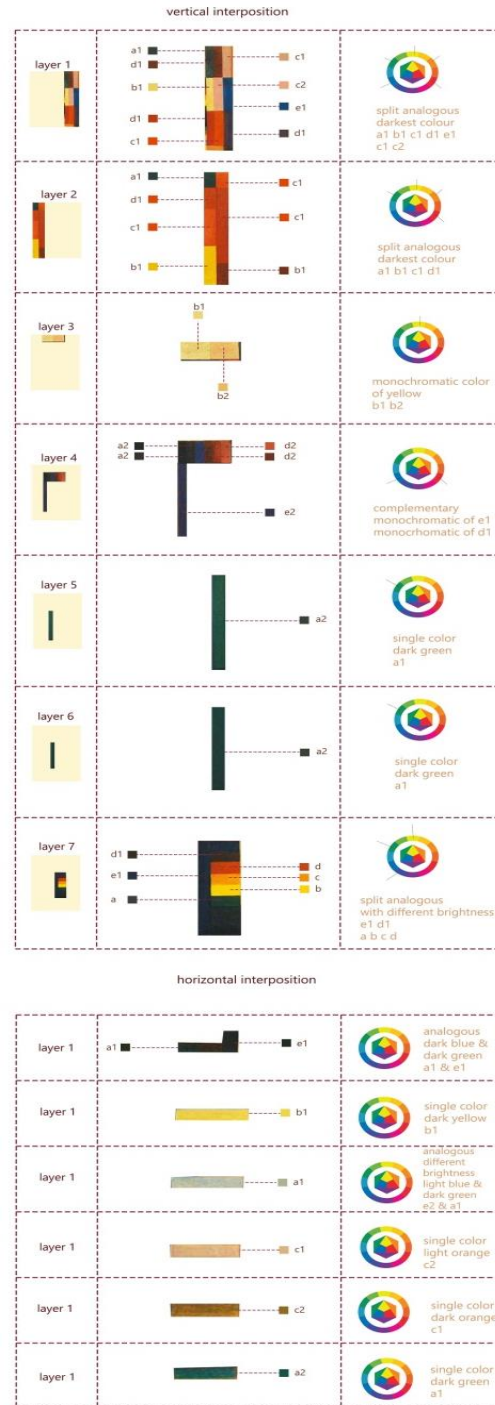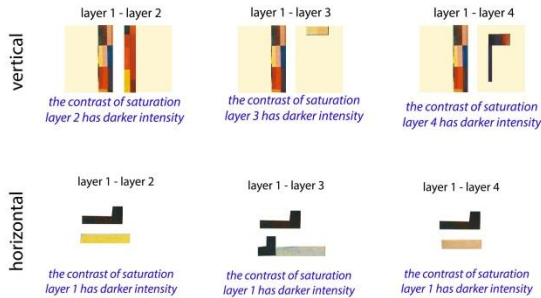

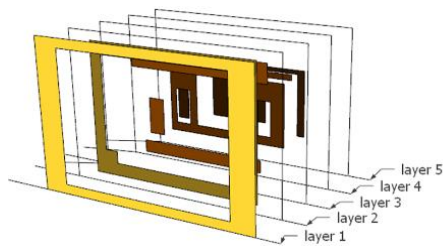**Figure 8**: Color Rule and Color Use in Each Vertical and Horizontal Layers

Similar to Kandinsky's painting analysis, we tried to connect each and every layer, from layer 1-layer 2, layer 1-layer 3, and so on to define the use of color contrast technique in the painting (Figure 9).

Figure 9: Examples of Color Contrast in Each Layer

Depth Aspect in Josef Albers' Painting

Josef Albers is considered one of the most influential abstract painters of the twentieth century, as well as an important designer and educator well-known for his experimental approach to spatial relationships and color theory. Albers came up with the discovery that the square as a shape can be subjected to color, as illustrated in his other painting *Homage to the Square* (Albers & Weber, 2013). In a *Variant* painting analyzed in this study, he created a basic composition of three or four squares located inside one another, on bricks. This shape gives him the freedom to be concerned only with color. This painting of also shows its perception of depth (Figure 10).


Figure 10: Layers of Albers' painting

Our analysis indicated that there were five layers of interposition in the painting. Albers used one particular color, which is yellow, as a base color in his painting with increasing intensity of darkness. The colors were then given the code a, a1, a2, a3, a4, and a5. Then the codes were used to identify the colors in each layer (Figure 11). Then, we tried to connect each and every layer, from layer 1-layer 2,

layer 1-layer 3, and so on to define the use of color
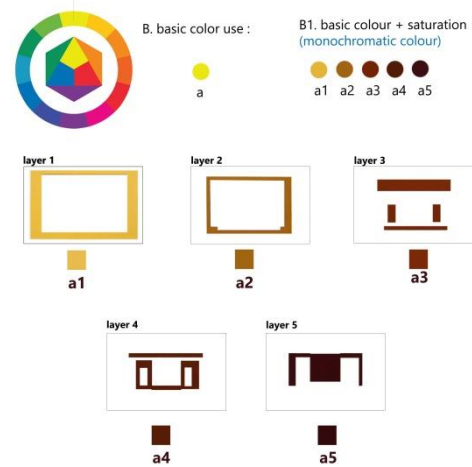
contrast technique in the painting (Figure 12).

Figure 11: Color Rule and Color Use in Each Layer
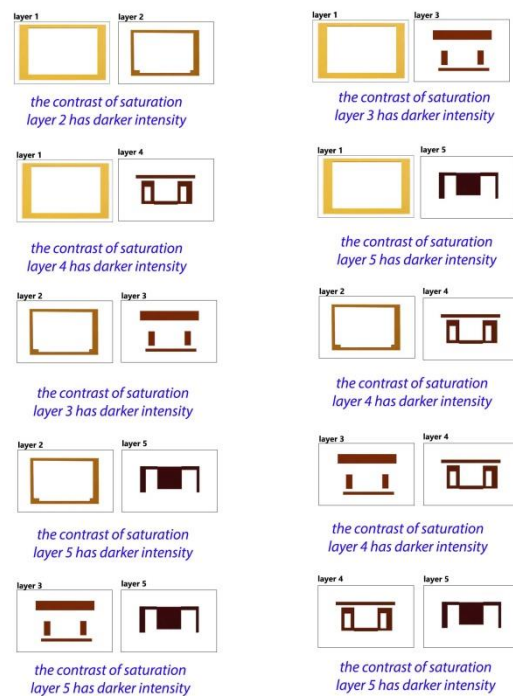
Figure 12: Color Contrast in Each Layer

Depth Aspect in Paul Klee's Painting

Paul Klee was a Swiss-born German artist. His highly individual style was influenced by movements in art that included expressionism, cubism, and surrealism. Klee was a natural draftsman who experimented with and eventually deeply explored color theory. He also studied orientalism painting. In this study we analyzed

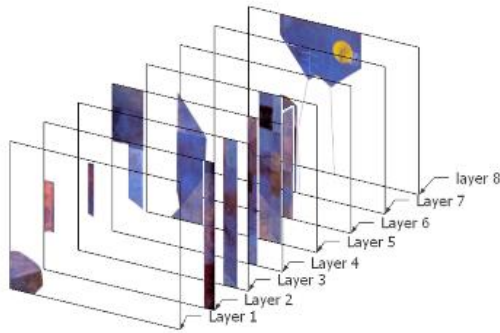Klee's painting *Moonshine* that shows the perception of depth.

Figure 13: Layers of Klee's Painting

This painting has eight layers that we analyzed to identify the depth cues (Figure 13). We classified the colors used in the painting and assigned certain code for each color (Figure 14). In this painting, Klee increased the level of the brightness and the darkness of the colors. Klee also combined the two colors to create purple, on which he also increases the brightness and the darkness level. The next analysis is to identify the colors used in each layer.
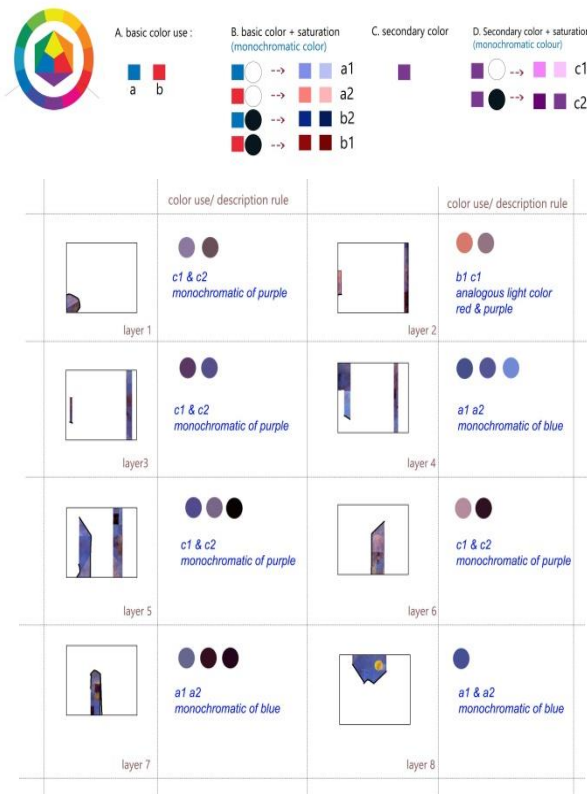

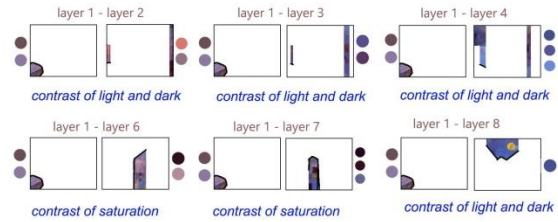**Figure 14:** Color Rule and Color Use in Each Layer

Figure 15: Example Color Contrast in Each Layer

As in other previous analysis, we also tried to connect each and every layer, from layer 1-layer 2, layer 1-layer 3, and so one, to define the use of color contrast technique in the painting (Figure 15)

Interposition and Color Contrast Methods Summary

The analysis of four paintings demonstrates various uses of interposition and color contrasts. The implementation of color contrast in these paintingas can be summarized into the barcharts illustrating the different color contrasts used as the strategy to create depth (Figure 16). The chart illustrates the extent to which each painting shows the use of different types of color contrast.
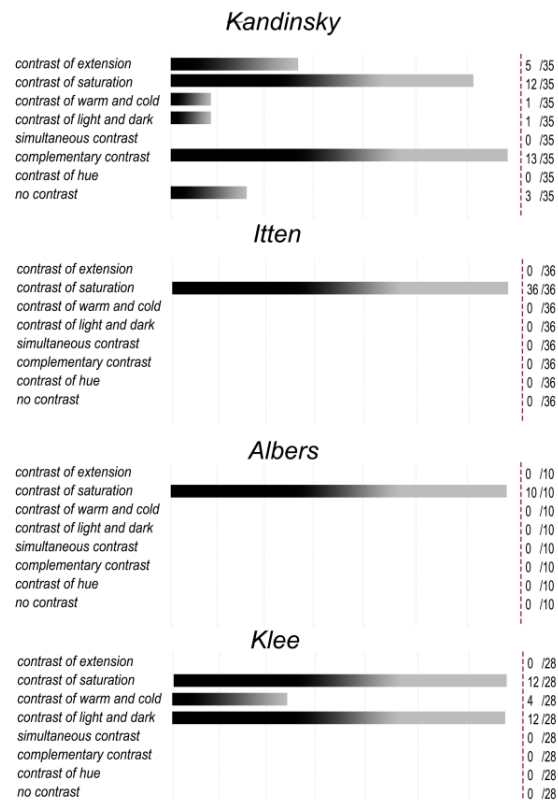

Figure 16: The Use of Color Contrasts as Depth Aspect in Four Paintings

Analysis of Kandinsky's paintings indicate the dominant use of saturation contrast and complementary contrast, while the painting also shows the use of other types of color contrast, such as contrast of extension, warm-cold contrast, light-dark contrast as well as no-contrast. Despite applying various color contrast, the use of interposition technique that is emphasized by the use of black bold color as the borderline of each object seems to play important role in producing the depth perception that could be perceived between objects within the painting. In both Itten's and Albers' paintings, the contrast of saturation seems to become the main color contrast technique to create the depth in their paintings. Meanwhile, the interposition in Itten's painting may differ depending on each individual perception. In Klee's painting, the color contrast seems to become an auxiliary tool to support the interposition technique. The painting demonstrates the use of saturation color contrast and light-dark contrast as the method to produce the depth.

The analysis of the four paintings indicates that 2D painting that has a flat surface can have depth aspect through the implementation of interposition and color contrast technique. The implementation of the interposition in each painting may demonstrate different techniques, however, they share the main strategy of showing relative size of object and defining the stacked layers in the painting. Among the use of various color contrast technique, the contrast of saturation is found as the most common strategy compared to other types of color contrast.

CONCLUSION

This study intends to explore the possibility of architectural design method that focuses on the depth aspect as the basis for 3D space production. Four paintings by well-known artists were analyzed by dismantling the layers formed within the paintings and the use of color in each layer. The types of color contrast were identified in each painting and its layers in order to define how the use of color create the aspect depth. The analyses revealed a variety of interposition techniques through the arrangement of layers within the painting. The four paintings also demonstrate a variety of techniques in applying the color contrast in the painting that plays a role in strengthening the perception of depth.

The method of interposition and color contrast as the strategies to establish depth aspect suggest a possibility in producing 3D space based on 2D media. While this study focuses on the painting as 2D media, this study opens further possibilities to expand the method for other 2D media or flat surface

arrangement as the basis of 3D space production by incorporating depth aspect. The method of interposition and color contrast identified in this study is also limited to the four painting. There may be other possibilities of how interposition and color contrast could be implemented.

The study suggests the important role of layers within 2D medium or surface composition that produce the relationship between various objects and colors within the medium or surface, as a strategy to establish depth aspect and to produce depth perception. The study indicates that the careful consideration of how the layers are arranged could define the possible transformation of 2D medium into 3D space.

REFERENCES

Albers, J., & Weber, N. F. (2013). *Interaction of color*. Yale University Press.

Barney, N., & Sheldon, R. (2022, November 18). *What is 3d (three dimensions or three-dimensional)*. WhatIs.com. https://www.techtarget.com/whatis/definition/3-D-three-dimensions-or-three-dimensional

Bloch, I. (2016). Intimacy: Eragatory's experiments in materiality, deep texture and mood. *Architectural Design*, *86*(6), 20–25. https://doi.org/10.1002/ad.2105

Durao, M. (2002). Color in space architecture. *AIAA Space Architecture Symposium*. https://doi.org/10.2514/6.2002-6107

Edwards, A. S. (1955). Effect of color on visual depth perception. *The Journal of General Psychology*, *52*(2), 331–333. https://doi.org/10.1080/00221309.1955.9920248

Foley, H. J., Bates, M., & Matlin, M. W. (1997). *Sensation and perception*. Routledge.

Froner, B., Purves, S. J., Lowell, J., & Henderson, J. (2013). Perception of visual information: The role of colour in seismic interpretation. *First Break*, *31*(4). https://doi.org/10.3997/1365-2397.2013010

Itten, J., & Haagen, E. van. (1973). *The art of color the subjective experience and objective rationale of color*. John Wiley & Sons.

Kandinsky, W. (2013). *Point and line to plane*. Martino Publishing.

Montanez, T (2014). An architecture of dimensions: 2D, 3D, 4D, etc. *Architecture Thesis Prep*, 273. https://surface.syr.edu/architecture_tpreps/273

Klee, P., & Grohmann, W. (1985). *Paul Klee*. Harry N. Abrams.

McGee, B., & Park, N.-K. (2022). Colour, light, and materiality: Biophilic interior design presence in research and practice. *Interiority*, *5*(1). https://doi.org/10.7454/in.v5i1.189

VandenBos, G. R. (Ed.). (2007). *APA dictionary of psychology*. American Psychological Association.

Watson, M. R., & Enns, J. T. (2012). Depth perception. *Encyclopedia of Human Behavior*, 690–696. https://doi.org/10.1016/b978-0-12-375000-6.00130-0