



DOI: <https://doi.org/10.38027/ICCAUA2025EN0389>

Shaping Space with Color: Perception, Emotion, and Representation

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Abstract

Received: 22 January 2025
Revised: 10 June 2025
Accepted: 18 June 2025
Available online: 5 July 2025

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This article has been selected and peer-reviewed for publication in this journal as part of the 8th International Conference of Contemporary Affairs in Architecture and Urbanism, held on 8–9 May 2025 in Alanya, Türkiye.

Color plays a fundamental role in architectural design, influencing both perception and emotional response within a built environment. Beyond its aesthetic and psychological impact, color is also an essential tool in architectural representation, shaping the way ideas, concepts, and spatial intentions are communicated. From hand-drawn sketches to advanced digital renderings, the evolution of representational techniques has transformed how architects visualize and materialize design solutions. This paper explores the intersection of color, perception, and representation in architecture, analyzing how chromatic choices affect spatial experience, cultural interpretation, and design communication. Through a multidisciplinary approach, the study examines historical and contemporary examples, technological advancements, and material innovations that expand the possibilities of color application in both built space and architectural drawing. By bridging perception and expression, this research highlights the crucial role of color in architectural practice, not only as a design strategy but also as a medium for articulating spatial narratives and engaging with users.

Keywords: Color Theory, Architecture, Perception, Spatial Experience, Psychological Impact, Materiality, Digital Visualization, Design Strategy.

1. Introduction

In architectural education, drawing is not merely a representational technique—it is a cognitive and creative tool that shapes how future architects perceive, understand, and construct space (Aziz Amen 2017; Aziz Amen and Ahmad NIA 2021; Aziz Amen and Nia 2018). Central to this process is the notion of form, understood not only as a visual configuration but as a conceptual and spatial system that reflects and organizes design intentions.

This article arises from our experience as professors of architecture and drawing, working closely with students at different stages of their formation. Over the years, we have observed how the learning of form—through drawing, analysis, and experimentation—plays a crucial role in developing both technical competence and expressive clarity. It is through this lens that we aim to reflect on the pedagogical value of form and its role in structuring spatial perception and representation.

Our purpose is to contribute to the discourse on architectural pedagogy by highlighting the importance of drawing as a formative practice. By revisiting core concepts such as geometry, proportion, composition, and spatial balance, we argue for an integrated approach that combines analytical precision with creative freedom. The article is intended for educators, researchers, and students interested in the intersections between form, drawing, and architectural thinking.

2. Drawing as Language in Architectural Education

Drawing has historically represented an essential language in architecture, functioning both as a tool for expression and as a method for conceiving and analyzing space. As Bruno Zevi (1994) argues, drawing is thinking three-dimensionally; it anticipates form and function through a visual language that articulates intention, technique, and poetics. In this sense, the discipline of drawing in architecture and urbanism courses is not limited to mere graphic reproduction but constitutes a fundamental educational space for developing students' design reasoning and critical capacity. Rodrigues (2003) states that hand-drawing enables architects to give form to mental models, fostering continuous experimentation and creative problem-solving.

The articulation of the foundational elements of visual language—point, line, shape, color, and texture—forms the basis of architectural drawing, making visible the process of spatial construction. In the Bauhaus context, Paul Klee (1961) described “a line as a dot that went for a walk,” emphasizing the dynamic and expressive nature of this element.

Similarly, Kandinsky (2009) explored the emotional and symbolic power of color and shape, reinforcing the importance of sensory and compositional experimentation in drawing. These foundational elements not only stimulate spatial perception and creative expression but are also crucial for the precise communication of architectural ideas. Color contributes to the hierarchy and legibility of compositions; texture introduces information about materiality and atmosphere. Therefore, drawing in architectural education requires not only technical mastery but also aesthetic and critical sensitivity. Whether engaging with the pristine features of a natural landscape or the intricate layers of a culturally vibrant urban environment, architects are driven to design in a manner that acknowledges and responds to the unique essence of the place (Żychowska, M. J., 2024). This article aims to discuss the relevance of the drawing discipline in architectural education, emphasizing the exploration of visual elements as tools for developing design, expressive, and communicative skills. The theoretical approach reflects on the pedagogical implications of teaching drawing in architecture, considering the importance of visual language as a tool for conception, analysis, and communication throughout the design process.

2. The Psychology of Color in Architectural Spaces

Colors have a profound psychological effect on individuals, shaping their mood, behavior (Elliot and Maier in, Annu Rev Psychol 65:95–120, 2014), and overall experience of space. Research in environmental psychology has demonstrated that different colors elicit distinct emotional responses. For instance:

- Warm colors (reds, oranges, and yellows) are often associated with energy, warmth, and stimulation but can also induce agitation when used excessively.
- Cool colors (blues, greens, and purples) tend to evoke calmness, relaxation, and concentration, making them ideal for workspaces and healthcare environments.
- Neutral tones (whites, grays, and earth tones) offer balance and adaptability, often used to create a timeless and elegant atmosphere.

Understanding these psychological effects allows architects to make informed decisions when selecting color schemes for different building typologies, enhancing both functionality and user experience.

3. Material and Methods

This article adopts a qualitative, practice-based methodology grounded in our experience as professors of architecture and drawing. The investigation is based on a reflective analysis of student work developed in the context of second-year design and drawing courses at the University of Beira Interior, across three academic years.

3.1 Research Design

The study follows a descriptive and interpretative framework, guided by pedagogical observation and visual analysis. Rather than testing a hypothesis, it aims to understand how students perceive, construct, and represent architectural form through drawing. The guiding questions include:

- How do second-year students develop formal awareness through drawing?
- What compositional and perceptual strategies emerge in their work?
- In what ways does drawing support architectural reasoning and creativity?

3.2 Participants

The sample consists of 20 second-year architecture students, whose coursework was observed and analyzed over a three-year period. These students participated in studio-based learning environments focused on drawing, spatial composition, and visual representation. The group reflects a range of individual styles and approaches, allowing for a broad reading of learning patterns and visual language development (Table 1).

Table 1. Student Sample Overview.

Academic Year	Number of Students	Course Level
2021–2022	7 students	2nd year Architecture
2022–2023	6 students	2nd year Architecture
2023–2024	7 students	2nd year Architecture
Total	20 students	

3.3 Data Collection Methods

The primary material for this reflection includes:

- Student drawings, sketches, and compositional studies created in response to structured exercises;
- Studio observations and informal feedback exchanges during critiques and class sessions;
- Teaching materials such as prompts, project briefs, and rubrics;
- Visual documentation of final project submissions, including analog and digital media.

These materials were examined to identify recurring themes, strategies, and challenges related to the understanding and construction of form.

3.4 Analytical Approach

Analysis was conducted through interpretive review, focused on the relationship between **form, perception, and representation**. Emphasis was placed on how students use drawing to explore proportion, geometry, balance, and

spatial tension. Insights were drawn through a combination of direct observation, visual analysis, and theoretical reflection grounded in architectural pedagogy.

3.5 Ethical Considerations

All data used in this study was collected in the context of normal educational activities. No identifiable personal information is disclosed. This research did not involve invasive procedures or personal data collection, and therefore did not require ethical review under institutional guidelines.

3.6 Limitations

This study is limited by its qualitative and context-specific nature. It reflects our experience within a particular institution, educational framework, and student profile. The absence of formal interviews or student self-assessment is acknowledged, and could be addressed in future investigations.

4. Results

The analysis of student work over three academic years revealed several recurring themes and developmental patterns in the understanding and representation of form. The results highlight how second-year architecture students begin to internalize formal principles and spatial logic through drawing exercises that balance observation, abstraction, and composition.

The results of our analysis are synthesized in the chart below (Chart 1), which highlights the most significant themes observed in student engagement with drawing, form, and spatial representation. The chart summarizes five main themes observed in the drawings of second-year architecture students. The 1–10 scale reflects the relative frequency and impact of each theme, based on our teaching experience and qualitative analysis over three academic years.

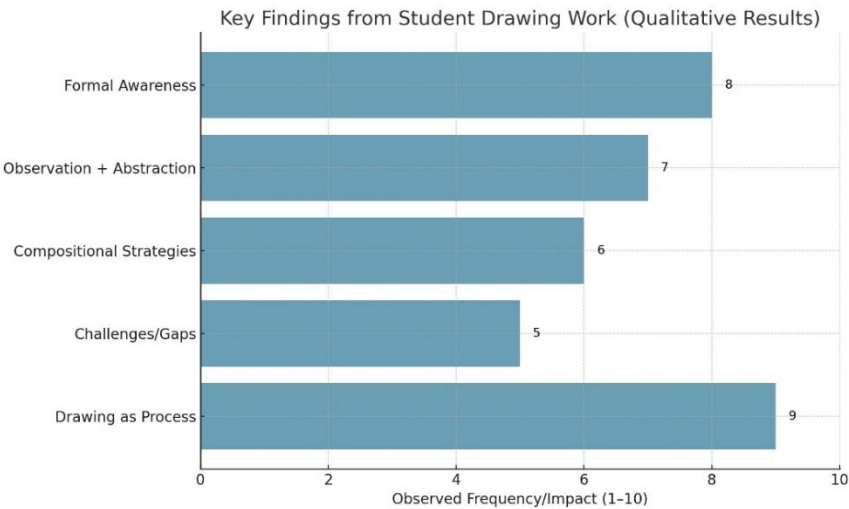


Chart 1. Key Findings.

4.1 Development of Formal Awareness

Students demonstrated a growing ability to perceive and construct architectural form through geometric relationships, proportion, and spatial tension. Early exercises showed hesitation and simplification, but over time, their work evolved toward more complex, structured, and intentional compositions.

4.2 Integration of Observation and Abstraction

Drawing from reality (objects, spaces, models) led students to sharpen their perception of scale, materiality, and spatial relationships. Meanwhile, abstract drawing exercises encouraged conceptual thinking and experimentation. The most successful outcomes occurred when students could fluidly shift between these two modes.

4.3 Compositional Strategies

Several students adopted clear compositional frameworks, such as centrality, axuality, or rhythmic repetition, to organize their drawings. These strategies revealed an intuitive understanding of balance, hierarchy, and movement within the drawing plane. In some cases, students began to articulate narrative or symbolic content through form and layout.

4.4 Challenges and Learning Gaps

Common difficulties included:

- Misunderstanding of spatial depth and scale;
- Over-reliance on outlines without attention to volume;
- Weak integration between drawing intention and compositional logic.

However, iterative practice and feedback sessions helped most students overcome these gaps, leading to visible improvements in visual clarity and conceptual coherence.

4.5 Drawing as a Thinking Process

Students increasingly used drawing not just to represent but to explore and develop ideas. Sketchbooks, process diagrams, and drafts showed how drawing became a **tool for architectural reasoning**, allowing students to test hypotheses about form, space, and structure before committing to final designs.

5. Cultural and Symbolic Interpretations of Color in Architecture

Perception is fundamental in architectural drawing. It shapes how designers interpret spatial configurations and communicate their intentions through visual language. Elements such as line, shape, tone, texture, and **color** are not merely aesthetic tools—they are essential to how space is perceived, understood, and felt (Wallschlaeger & Snyder, 1992, p. 14). Among these, color holds a particularly complex role, as it carries both perceptual and symbolic weight. While color can be used to express materiality, atmosphere, and spatial hierarchy, its interpretation is not universal. Color perception is influenced by cultural frameworks, individual experiences, and historical traditions. Architectural color schemes have long reflected local customs, climatic responses, religious beliefs, and social values. A few well-known examples include:

- In traditional Chinese architecture, red is associated with good fortune, celebration, and prosperity.
- In Islamic architecture, blue and turquoise often symbolize spirituality, protection, and the infinite nature of the divine.
- In Scandinavian modernism, white and neutral tones are employed to reflect light and create psychological clarity during long, dark winters.

These cultural associations highlight the need for sensitivity and awareness when applying color in architectural design and representation. A color choice that conveys warmth and welcome in one context might suggest mourning or taboo in another. Architects and students alike must consider the symbolic, emotional, and cultural dimensions of color, especially in global or intercultural design contexts.

From a pedagogical standpoint, teaching students about the cultural meanings of color deepens their ability to design with empathy and contextual relevance. In our experience, architecture students often approach color from a purely compositional or aesthetic perspective. However, when introduced to its symbolic and cultural potential, they begin to use color more strategically and expressively in their drawings.

In drawing exercises that explore cultural contexts—whether through vernacular architecture studies, reinterpretations of historical buildings, or conceptual design challenges—students are encouraged to:

- Research and apply culturally appropriate palettes;
- Reflect on the emotional and psychological effects of color;
- Develop visual narratives that resonate with a specific cultural or geographic audience.

This expanded awareness fosters not only better graphic communication, but also a more thoughtful and ethical design practice, where architectural representation becomes a bridge between form, meaning, and human experience.

6. Color and Spatial Perception

Colors stimulate the visual senses, with sight widely regarded as the most dominant of the human senses. This underscores the essential role of vision in perceiving and being affected by color—an influence that spans disciplines from art and design to architecture, marketing, and consumer behavior (Ndom, Elegbeleye, and Ademoriti, 2011). In the architectural field, color is not merely a surface treatment or decorative layer; it plays a decisive role in how space is sensed, understood, and navigated.

Contemporary research has moved beyond purely scientific or physiological interpretations of color perception, emphasizing instead that spatial cognition is socially and culturally constructed. Our perception of color and space is shaped by factors such as cultural background, gender, age, emotional state, and professional experience (Levinson, 2003: 62; Levinson & Wilkins, 2006: 26). These findings reinforce the idea that spatial experience is subjective and contingent—an intersection of biological response and social conditioning.

Beyond its emotional and cultural connotations, color directly influences how we perceive the scale, depth, and function of a space. There is broad consensus that the strategic use of color—sometimes in combination with patterns, textures, and geometry—can visually manipulate or amplify spatial characteristics (Stamps, 2005: 736). Some of the most common and pedagogically valuable effects include:

- Expanding or contracting spaces: Light or cool colors such as whites, pale blues, and light greys tend to open up a room, making it feel more spacious. In contrast, dark or saturated tones create a sense of enclosure, intimacy, and sometimes even monumentality.
- Guiding movement and orientation: Contrasting colors can help define circulation routes, highlight entrances or focal points, and facilitate intuitive navigation. This use is especially important in complex buildings such as schools, hospitals, and transportation hubs.
- Enhancing material expression: The interplay between color and surface texture can emphasize or soften material qualities. For example, a rough concrete wall painted in a warm hue may appear more tactile and inviting, while a glossy white finish might emphasize cleanliness or abstraction.

In architectural education, introducing students to the spatial effects of color helps them move beyond static representation toward a more immersive and experiential understanding of form and environment. Through drawing exercises, they come to appreciate how color can shape spatial memory, affect psychological comfort, and even alter the behavior of those who occupy a space.

We encourage students to experiment with color in both observational and conceptual drawings, testing how different palettes influence the reading of volume, depth, and orientation. These exercises often result in greater spatial awareness, improved composition, and a deeper engagement with the sensory qualities of architecture.

7. Technological Innovations and the Future of Color in Architecture

Advancements in digital design tools and material science have revolutionized the way architects approach color. It not only offers diverse media for visually, aurally, and interactively experiencing architectural design (Ellis, 1991), but also enables designers to perceive, understand, and manipulate three-dimensional building elements within the virtual reality environment. Virtual Reality shows strong potential as a design tool for planning light and color in architecture, but its effectiveness is limited by gaps in understanding human color perception. A study comparing real and virtual spaces revealed differences in how participants perceived light, color, and spatial qualities (Billger, M. et al, 2004). Key developments include:

- Digital rendering and augmented reality (AR): These tools enable architects to simulate and test color schemes in virtual environments before implementation.
- Smart materials and responsive facades: Innovations such as thermochromic and photochromic materials allow buildings to change color dynamically in response to environmental conditions.
- Sustainable color strategies: The use of natural pigments, bio-based coatings, and reflective materials contributes to energy efficiency and environmental performance.
- These technological advancements expand the possibilities of color application, offering new opportunities for creative expression and functional optimization.

8. Case Studies: Iconic Uses of Color in Architecture

Several architectural projects exemplify the strategic use of color to enhance spatial experience and cultural meaning:

- Luis Barragán's Houses (Mexico): Vibrant hues of pink, orange, and yellow create striking visual compositions and emotional resonance).
- Jean Nouvel's Institut du Monde Arabe (France): The dynamic façade features shifting shades that respond to sunlight, blending modernity with cultural symbolism.
- Richard Rogers' Lloyd's Building (UK): Exposed color-coded service elements clarify the building's function and circulation hierarchy.
- UNStudio's Arnhem Central Station (Netherlands): The integration of color gradients in lighting and materials enhances wayfinding and user experience.
- SANAA's Rolex Learning Center (Switzerland): Subtle color transitions complement the fluidity of the architectural form, reinforcing its open spatial concept.
- Comparative Analysis and Conclusion:
 - Examining these case studies reveals how color is employed for different purposes, from reinforcing cultural identity (Barragán, Nouvel) (Jover, L.N., Alba, C.L.M. 2022), to improving functionality and spatial perception (Rogers, UNStudio, SANAA). Across these examples, common strategies emerge:
 - Color as an emotional and cultural signifier: Barragán and Nouvel use color to evoke strong cultural and symbolic meanings.
 - Color for navigation and wayfinding: Rogers and UNStudio employ color to guide movement and clarify spatial organization.
 - Color as a design integrator: SANAA uses subtle chromatic shifts to complement architectural form and reinforce spatial fluidity.

This comparative analysis highlights the versatility of color in architecture, demonstrating its capacity to shape both perception and functionality within the built environment.

9. The Role of Teaching Color in Architectural Drawing and Representation

In architectural education, drawing remains an essential tool for conceptualizing and communicating design ideas. The use of color in architectural drawings plays a critical role in illustrating spatial qualities, materiality, and atmosphere (Fig.1). Hand-drawn sketches, digital renderings, and physical models all benefit from a thoughtful application of color, allowing architects to:

- Emphasize hierarchy and depth: Varying shades and hues help distinguish different spatial elements and create a sense of depth.
- Convey materiality and lighting conditions: By simulating textures and light effects, color enhances the realism of visual representations.
- Guide design interpretation: Clients, stakeholders, and students gain a clearer understanding of a project's intent when color is strategically integrated.



Figure 1. Example of students work, from Drawing 2, at UBI University, Portugal.

In contemporary architecture courses, students are encouraged to experiment with different media and color applications to develop their ability to visualize and articulate spatial concepts effectively (Pinto, L. M., & de Matos, R.:2024). The integration of digital tools further expands the potential for color-driven exploration in architectural representation.

9.1. Complementary Reflections on Drawing and Visual Elements

From perception, communication, and atmosphere, color in architectural drawing serves functions ranging from the distinction and hierarchy of elements to the creation of atmospheres and sensory experiences. Although often secondary in technical projects, color is an essential tool for visual communication and spatial perception (Yaseen, R. H., & Mahmood, R. :2018).

Kandinsky (2009) emphasized the emotional power of color and its capacity to evoke sensations and meanings. In architectural education, working with color involves understanding harmonious relationships, contrasts, and its role in reading designed spaces. Conscious color application can transform the experience of space, adding symbolic, cultural, and functional values.

Drawing as a Language in Architectural Education holds a central place not only as a technique for representation but as a medium for spatial conception and critical reflection. It is a visual language that bridges the idea and the built form, between thought and projected reality. According to Francis D.K. Ching (2001), “drawing is visual thinking,” reinforcing the idea that drawing goes beyond transcription—it is an intellectual and sensitive process.

By developing this language, architecture students learn to construct and interpret spatial representations, understand proportions, volumes, and formal relationships. Drawing instruction should promote not only technical accuracy but also expressive freedom and critical observation, helping students build a personal visual repertoire and design sensitivity.

9.2. The Line: Structure and Spatial Communication

The line is the fundamental element of architectural drawing, performing structural, representational, and expressive functions. It defines contours, limits, directions, proportions, and formal relationships—essential for constructing space graphically. In drawing instruction, the line is addressed in both its technical and communicative dimensions, enabling students to understand geometry, scale, and the organization of forms (Çetin, Ç. T., & Yüksel, Y. D. :2020).

In technical communication, the line acquires a normative role, used in orthogonal projections, sections, and plans, essential for objective building description. Mastery of line types—continuous, dashed, thin, or thick—is crucial for reading and creating technical drawings, in accordance with conventional architectural standards (Paans, O. :2024).

Simultaneously, the line is key in constructing perspective, a system that simulates human vision and depth perception. Perspective drawing, using vanishing points, brings students closer to a three-dimensional understanding of space. This approach is essential in architectural drawing education, merging technical knowledge and sensitivity to foster immersive spatial representations.

We must also consider the expressive dimension of the line. Paul Klee’s notion of the line as “a point that went for a walk” highlights its gestural and poetic character, expressing the author’s intention. In architectural design, the line suggests atmospheres, reveals compositional dynamics, and conveys ideas synthetically and subjectively, becoming an essential tool for graphic reasoning and personal expression.

9.3. Form: Composition and Spatial Representation

In architecture, form is a core pillar of design language. It arises from the articulation of lines and volumes, producing visual structures that provide identity, order, and expressiveness to space. Form is not just external configuration but a conceptual and graphic synthesis of design intentions, representing spatial, functional, and symbolic relationships (Stankovic, D. et al.:2018).

In drawing education, understanding form demands mastery of geometry, proportion, symmetry, tension, and spatial balance. These interdependent relationships structure architectural space. The ability to analyze and conceive 2D and 3D forms is essential for developing coherent, functional, and aesthetically qualified design solutions.

Form is deeply connected to spatial perception. Through drawing, students learn to see, measure, decompose, and reorganize the visible world, training their eye and mind to recognize patterns, scale, and volumetric articulation. Observational and abstract representation exercises—based on reality or imagination—significantly consolidate visual, conceptual, and compositional skills.

Furthermore, students should understand form as a contextual and dynamic phenomenon, interacting with place, function, and materiality. Recognizing form as a system fosters comprehension not just as a final product but as an ongoing process of experimentation and interpretation (Chang, D., & Park, J. :2021).

In this sense, formal construction should be seen as both a critical and creative operation, combining geometric rigor with expressive freedom. Integrating this view into the learning process prepares architects to articulate technique, sensitivity, and intent in creating meaningful, functional, and culturally rooted spaces.

9.4. Texture: Materiality and Visual Sensibility

Texture bridges drawing and materiality. It refers to the surface of objects, the way light interacts with materials, and visually perceived roughness or smoothness (ZHANG, Y., & Xu, H. : 2021). In architectural drawing education, texture must be explored as a means to represent construction reality, contributing to project expressiveness and material perception.

Graphically representing textures encourages students to closely observe building materials—wood, concrete, glass, stone—and their visual and tactile characteristics. This practice fosters a more sensitive and realistic design approach, linking spatial conception with constructive aspects.

10. Conclusions

The strategic use of color in architecture enhances both functional and experiential aspects of design, influencing perception, emotion, and spatial dynamics. As architects continue to explore innovative applications of color through emerging technologies and cultural awareness, its role in shaping the built environment remains as crucial as ever. Understanding the psychological, cultural, and technical dimensions of color allows architects to create spaces that are not only visually compelling but also meaningful and responsive to human needs.

This paper highlights the significance of chromatic choices in architectural practice and encourages further interdisciplinary research on the evolving relationship between color, perception, and material innovation in contemporary design. Teaching color in architectural drawing is not only about aesthetics—it is a critical component of spatial literacy, helping future architects design environments that are more legible, inclusive, and emotionally resonant.

The exploration of visual elements—lines, shapes, colors, and textures—significantly enhances aesthetic repertoire, graphic thinking, and spatial sensitivity. Thus, pedagogical practices that value drawing as a critical and creative language reaffirm its importance in shaping future architects.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interests

The Author(s) declare(s) that there is no conflict of interest.

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