

# Color Pedagogy: Aligning Discipline-Specific Perceptions and Content Knowledge of Color in the Built Environment

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The purpose of this study is to evaluate the level of color knowledge and its perceived value by beginning and advanced interior design students. This study examines the perceived contribution of color in design by comparing more novice and upper-level students in relation to an index of their relative color knowledge. The present study builds upon and expands a precedent study conducted at Lund University that examined architecture students' in Scandinavia and the UK perceived value of color in the built environment and a measure of basic color content knowledge. The findings of a precedent study on color in architectural education provides impetus to the present study, which extends the color index to include the Council for Interior Design Accreditation (CIDA) guidelines that set educational standards in North America. In the present study, a random sample of students (N = 68) from an accredited and nationally ranked interior design program was administered a questionnaire to assess basic color knowledge and perceived value of color within major market sectors. Key variables were compared to the Swedish precedent study and further statistical analyses explored relationships between the level of color knowledge and research and an understanding of the multiple functions of color in the built environment.

## INTRODUCTION

Color is a significant tool that designers can use to shape the built environment. Without a developed understanding of how to wield this tool, designers may not have the necessary knowledge or experience to realize the full potential of color in the projects they are creating. Design students are expected to have mastered core competencies in color theory and application. CIDA Standard 10 on color states (2011):

Entry-level interior designers apply color principles and theories.

Student Learning Expectations

Student work demonstrates understanding of:

- a) Color principles, theories, and systems.
- b) The interaction of color with materials, texture, light, form and the impact on interior environments.

Students:

- c) Appropriately select and apply color with regard to its multiple purposes
- d) Apply color effectively in all aspects of visual communication (presentations, models, etc.). (p. II-19)

Learning to apply color theory in the design process is not optional in the education of entry-level practitioners. Therefore, the purpose of this study is to evaluate the perceived value of environmental color as well as the actual level of color knowledge of students in a CIDA accredited interior design program. This study expanded

upon a precedent study, *Color Research in Architectural Education—A Cross-Cultural Explorative Study* (Janssens & Mikellides, 1998) that evaluated the perceived value design students place on color as well as assessed color knowledge. While this study evaluates architectural students and my study examines interior design students, a similar conclusion is reached on the value of color instruction in design education, and the relatively inadequate knowledge base gained in formal design education. Although architectural and design students alike agree that color is an important part of the built environment, this importance is not always perceived as being effectively addressed in the actual education received.

## Color Framework

In order to assess color functions that students should learn to be proficient in during their education, a color planning framework was tested in this study as a typology expressing five categories of color functions: composition, communication, preference, response, and pragmatics (Portillo, 2009). This framework aligns well with CIDA's Standard 10.

## Color as a Compositional Element

First and foremost, design students need to understand how to use color as a tool in shaping three-dimensional space. Several leading color theory textbooks repeat the concept of spatially advancing and receding colors (Miller, 1997; Fehrman & Fehrman, 2000; Reed, 2010; Pile, 1997).

The spatial quality of advancing and receding colors can influence the visual perceptions of spaces (Miller, 1997); therefore, a designer can make a room feel wider or narrower than it is in reality through the explicit use of advancing and receding colors. The application of color on horizontal and vertical planes, for example, can affect the legibility of the space and result in a more or less successful design solution.

### **Color as Communication**

Color has the potential to serve as a symbol rich with meaning. Miller (1997) states, “You see and think symbols, therefore, your perception of what color says, what it stands for, how you feel about it is instantaneous” (p. 6). Understanding color as a form of communication allows a designer to create identity, meaning, and a sense of place (Smith, 2008).

The power of color communication is underscored in Smith’s study (2003) from *Environmental Colouration and/or the Design Process*. Here she explored color in the design process of architects and interior designers. Based on findings from the study, she concluded that the built environment could be understood as an object, product, communicator, and/or social domain. Therefore, although the results were exploratory, it reveals a less than optimal implementation of color as a key element in the built environment.

In *Color as a Cognitive Artifact*, Puhalla (2005) argues that color is like a language and the ability to organize hue, value, and chroma presents the opportunity to create a “structure that functions as language and message” (p. 59). In contrast, Kwon (2010) uses the theory of symbolic interactionism as a framework to argue that color meaning is not intrinsic (p. 27). Regardless, it is clear that culture influences color meaning. Hutchings’ (2004) study of folklore emphasizes color as a communicator of identity and reveals the importance of studying a region’s color associations when color planning since local economic, historical, and social factors influence meaning.

### **Color as Preference**

In contradiction to conventional wisdom, color preference is not unchanging. Eysenck’s study (1941) claimed that blue was the most preferred color, but research since that landmark study has shown how these preferences can change with factors such as age (Beke et al., 2008; Ou et al., 2012; Read & Upington, 2009), culture, (Ou & Luo, 2012; Park & Guerin, 2002) and application (Taft, 1997; O’Connor, 2010). Another well-regarded color theory text states, “Color preference could be influenced by other variables other than those of the color itself” (Fehrman & Fehrman, 2000, p. 80). This includes factors such as lighting, surrounding colors and

background, application, and market trends. Further reinforcing this concept, this textbook asserts that, “Color preference in real settings is partially determined by the social function of the interior space” (p. 98).

### **Color as Response**

Since we know that color carries meaning and identity, it can be used as an effective tool for engagement. Color can influence physiological, psychological, and behavioral responses (Portillo, 2009). As Mahnke (1996) states, “Color is a part of the conscious, subconscious, and unconscious, and an experience that is integral to human behavior” (p. 6). Understanding of this color function can be particularly useful in contexts such as corporate and educational settings as well as in retail environments (including restaurants and grocery stores) for triggering arousal, emotion, and time perception (Portillo, 2009). Bellizzi’s (1983) study suggests shoppers are more drawn toward the warm colors over the cool colors in a retail setting and it would be appropriate to use the former around the storefront to attract shoppers and also around impulse-buy items. Reed (2010) also notes, “Color has a direct relationship to the physical temperature we perceive and experience in a room” (p. 36). Some believe that this relationship between color and the human body is so strong that color is used as a form of alternative medicine called chromotherapy.

### **Color as Pragmatics**

Environmental color can assist in meeting pragmatic needs for a client. These needs could involve anything from contributing to safety (i.e., like making changes in flooring levels more obvious) to reducing the cost of upkeep (i.e., like installing darker value carpet in commercial spaces to maximize longevity) and even to support energy efficiency (i.e., lighter walls will absorb less heat than darker walls). Another example is the way paint color can also replace the use of otherwise expensive materials (i.e., cherry veneer walls) to create lower cost yet impactful spaces. Design students often do not consider budget constraints in their studio projects, but it is a very real consideration in the real world in which understanding color from a pragmatic perspective can be an asset.

## **METHOD**

### **Participants**

Participants (N=68) consisted of female undergraduate interior design students at the University of Florida. Due to the low number of males enrolled in this program, male students were excluded from the sample. The sample consisted of lower division (n=34) and upper division (n=34) students who ranged in age from 18 and 25 years.

**Procedure**

A content analysis of literature consisting of journal articles and textbooks used for teaching color courses at the college level was examined using criteria from the Color Planning Framework (Portillo & Dohr, 1993; Portillo, 2009). From this data and a precedent study completed at Lund University (Janassens & Mikellides, 1997), a color questionnaire and color knowledge test was developed for this study. The questionnaire is composed of six parts: (1) Color Education, (2) Color in Studio Design Work, (3) Color Across Market Sectors, (4) Market Sector Scenarios, (5) Color Knowledge Assessment, and (6) Demographic Questions.

The first section sought to evaluate students’ preferred methods for learning about environmental color as well as their satisfaction levels with the color instruction being offered. In the second section, questions were developed that assessed the importance of color in studio projects. These questions help evaluate the perceived value of color and the students’ confidence level in having requisite knowledge to achieve successful color solutions. Like the precedent study, students were also asked to describe which design and/or allied professionals they believed were most responsible for color planning in the built environment and interior spaces. Additionally, students rated their perceived knowledge of different color functions identified in the Color Planning Framework.

Sections three and four of the survey delved into the more specific application of color planning solutions across different market sectors. In response to these questions, participants rated the level of importance color plays in corporate, healthcare, residential settings, etc. These market types were selected through a content analysis of major project types identified on the websites of leading

design and architecture firms. The top ten markets were found to be assisted living for older adults, aviation & transit, corporate office, cultural (i.e., museums) educational, healthcare, hospitality, residential, retail, and sports & recreation facility types. In an open-ended response question, participants were then asked to elaborate on the top three choices they made and explain why they felt color was important in those market sectors.

In section five, students were given a basic color knowledge assessment test with fifteen questions posed in a true or false format (See Table 1). The questions were assigned as either “true” or “false” using a random number generator. Importantly, the participants also had the option to respond to the item with “I don’t know” (in addition to true or false) to discourage guessing.

Before data was gathered, the questionnaire was pilot tested by MID and Ph.D. students in the UF interior design program. Once revisions from the pilot study were made, the proposed study design and survey was submitted for IRB approval. After IRB approval was obtained, permission to administer the questionnaire in interior design classes was granted from the University of Florida professors teaching critical tracking courses at different levels within the program.

The survey was administered at the beginning of pre-determined class times using the online survey tool “Qualtrics.com.” Once each student turned in a consent form, they were given a link and password to take the online survey. First and second year students were considered to be in the “lower division” of the program while third year and fourth year students were in the “upper division.” All statistical analyses were conducted using SPSS v. 20. When analyzing the results, an alpha level of .05 was used for all statistical tests.

**Table 1.** Color Knowledge Assessment Questions

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1.	The ability to perceive color is not dependent on light.
2.	Metamerism is defined as the capacity of colors to change under different lighting conditions.
3.	Saturation describes the estimated lightness or darkness of a surface color.
4.	There is a universal color order system.
5.	Color cannot affect the perceived sizes, shapes, and location of objects and the sizes and shapes of enclosures.
6.	Colors that share a common hue will relate and harmonize better than color schemes that do not.
7.	Two complementary colors will make each other appear more saturated and vivid.
8.	Advancing colors are primarily lower in value, more highly saturated, and warmer in hue.
9.	The perceived weight of an object can be affected by the brightness and saturation of the hue.
10.	Color preferences remain constant regardless of the application’s context.
11.	With age, the lens of the eye starts to yellow and the pupil gets smaller in diameter which effects the colors and amount of light perceived in the environment.
12.	The most legible color combination for signage is black on yellow.
13.	Cultural background can influence color communication.
14.	All languages have at least three color terms.
15.	Darker colors can be used on the walls to assist in energy savings.

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## RESULTS

### *Perceived Value of Environmental Color by Interior Design Students*

It was hypothesized that both beginning and advanced interior design students would recognize the value of color in the built environment, regardless of the level of color knowledge. As expected, both upper (n=34) and lower (n=34) division students reported that color in design education was very important, an average of 6.26 out of a 7-point scale (See Figure 1). Similarly, the architecture students surveyed in the precedent study also reported a “positive attitude toward color research [applied to architecture]” (Janssens & Mikellides, 1997, p. 332).

This study sought to further explore students’ perceptions of the role color played in different market sectors of interior design. It was predicted that the upper division students would identify the influence of color across a greater number of market sectors due to their experience with working on a larger variety of studio projects than their lower division counterparts. Using one-tailed significance with alpha set at  $p < .05$ , the more advanced students were found to report color being more impactful in assisted living, healthcare, and hospitality sectors than did the lower division students (See Figure 2). No other statistically significant differences were found between groups in aviation & transit, corporate office, cultural, educational, residential, retail, or in sports & recreation facilities.

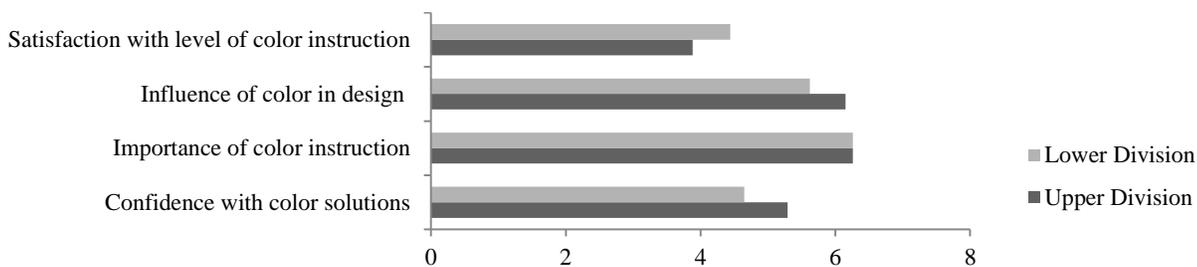


Figure 1. Perceived value of color in design

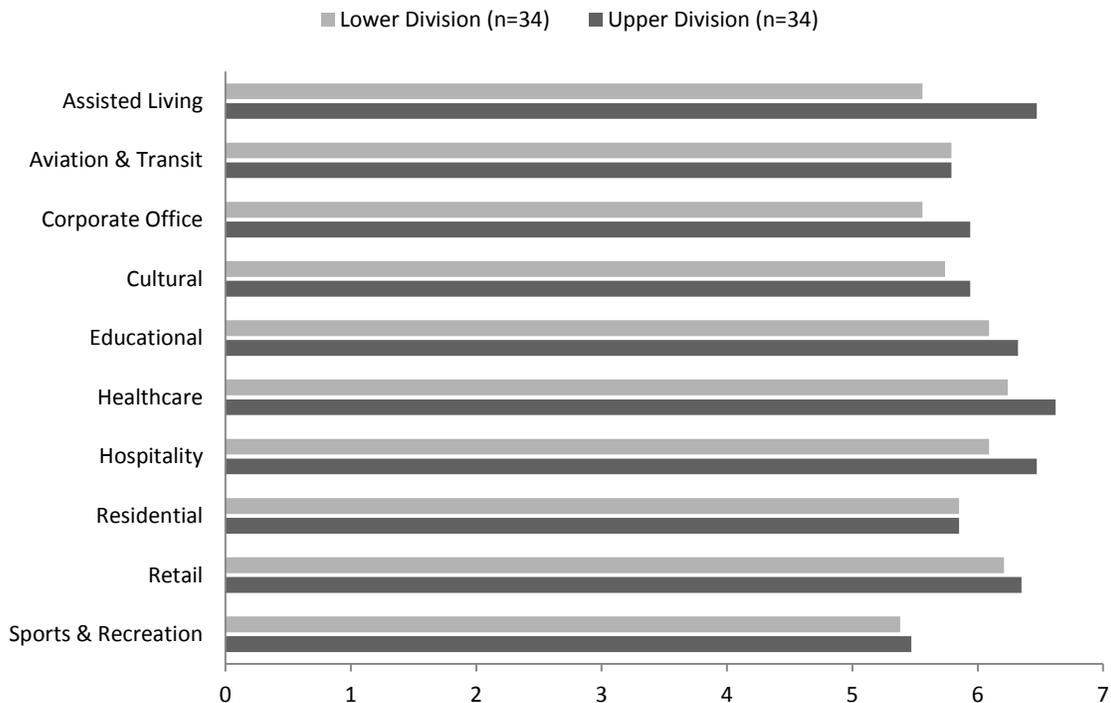


Figure 2. Perceived value of color in different market sectors

**Level of Perceived Knowledge of Environmental Color by Interior Design Students**

Beginning and advanced interior design students were asked to rate their perceived knowledge of five different color functions in the field. It was predicted that upper division students would have a higher perceived knowledge in each of the five color functions presented and also that they would report a greater number of different color functions than would the beginning students (high=3-5 color functions, low=0-2 color functions).

A statistically significant difference between upper division (n=34) and lower division students (n=34) was evident in a one-tailed t-test with a significance level set at  $p < .05$  (See Table 2). The compositional function involved using “color as a tool to create focal points, define form and space,” was not as recognized by lower division students ( $M=3.68, SD=.806, t(63.11)=2.155, p=.0175$ ) while upper division students reported a higher perceived knowledge ( $M=4.06, SD=.649, t(66)=2.155, p=.0175$ ).

The second color function that revealed a significant difference between the two groups was “color as a tool to influence visual perceptions and behavior.” Upper division students again showed a higher perceived knowledge of this color function ( $M=3.91, SD=.933, t(66)=2.551, p=.0065$ ) than did the lower division students ( $M=3.29, SD=1.060, t(64.96)=2.551, p=.0065$ ). The other color functions did not seem to differ between groups (color’s ability to communicate meaning; meet material, lighting, and resource needs; or reflect current market trends) as shown in Table 2. Overall, the data suggests that more advanced interior design students perceive color more in compositional and human response terms than do their lower division counterparts. The role of color in communication, preference, and pragmatics seems to be well recognized across the design students.

**Table 2.** Perceived Knowledge of Different Color Functions

Variable	Mean (SD)	p-value
Color as a tool to create focal points, define forms and space		
Lower Division	3.68 (.806)	.0175*
Upper Division	4.06 (.649)	.0175*
Communicate Meaning		
Lower Division	3.44 (.824)	.134
Upper Division	3.68 (.912)	.134
Color as a tool to influence visual perceptions and behavior		
Lower Division	3.29 (1.060)	.0065*
Upper Division	3.91 (.933)	.0065*
Color as a tool to meet material, lighting and resource needs		
Lower Division	3.29 (1.001)	.092
Upper Division	3.62 (.985)	.092
Color as a tool to reflect current market trends		
Lower Division	3.12 (1.122)	.1895
Upper Division	3.35 (1.070)	.1895

From the data collected on each color function, students were grouped into those perceived to be using a high number of different color functions (n=39) and those perceived to be using a low number of functions (n=29). As predicted, when compared to education level, a significant difference was revealed between upper and lower division students’ perceived use of color functions  $X^2(1, N=68)=7.275, p=.007$  (See Table 3). In general, student confidence levels in their use of color showed a significant difference between student groups between lower division ( $M=4.65, SD=1.070, t(64.180)=2.274, p=.013$ ) and upper division ( $M=5.29, SD=1.268, t(66)=2.274, p=.013$ ). The advanced students reported feeling more confident in their color solutions than did the beginning students.

**Table 3.** Perceived Number of Color Functions being Used by Students

Variable	Lower Division (n=34)	Upper Division (n=34)	X <sup>2</sup>
# of Color Functions being used:			
High	41.2%	73.5%	7.275*
Low	58.8%	26.5%	

**Color Content Knowledge Level of Upper and Lower Division Students Compared to Actual Knowledge Level**

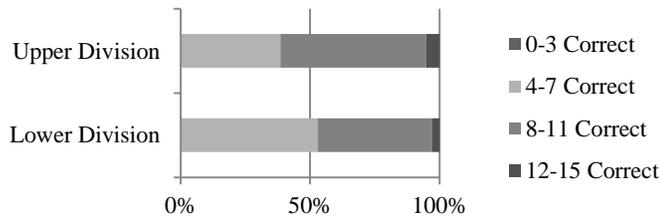
When using a one-tailed t-test, the average number of correct responses on the color knowledge test was significantly different between lower ( $M=7.5882, SD=1.84420$ ) and upper division students ( $M=8.3529, SD=1.87297$ ),  $p=.0475$  (See Figure 3).

The results showed that the advanced students scored better on the color test. Specifically, the juniors and seniors more frequently gave a correct response on items concerning the appearance of complimentary colors  $X^2(2, N=68) = 11.455, p=.002$ , and on color vision and age-related vision changes  $X^2(1, N=68) = 10.350, p=.001$ . As a whole, upper division students showed more mastery of color knowledge than did their entry-level counterparts. Still, these differences were not as large as expected, a finding that may lend itself to several explanations. For one, a dedicated color theory course is not taught on a regular basis in the program. Moreover, the content knowledge test developed for this study measures fundamental knowledge rather than the applied knowledge needed for studio. Other explanations include a possible cohort effect and the relatively low sample size of the study.

The precedent study showed that students saw the role of color in the built environment and in architectural education as important; however, no statistical difference was found between beginning and final year architecture

students, but their measure of actual color knowledge (like that of this study) has its limitations. Multiple measures of basic and applied color knowledge should be explored further in on-going research.

**Figure 3.** Color knowledge assessment results



## DISCUSSION

Confidence in color solutions appeared to increase as students progressed through their educational trajectory as did color knowledge. Yet the significantly lower satisfaction level relating to color instruction reveals a need for improvement in the coverage of this subject matter. Color can be taught in a number of different ways across

interior design programs. Some of these methods include teaching color as a dedicated course, integrated within other core classes, tied with lighting, or side by side with materials, but the field could benefit from evaluating if one method is more effective in educating students that have a stronger understanding of environmental color. Poldma (2009) claims teaching color and lighting together should be embraced as a more effective contextual approach. Nevertheless, further research is needed to evaluate different forms of color instruction in top interior design programs.

As previously discussed, a limitation of this study is the method for assessing actual color knowledge. Although it accounts for fundamental color knowledge that interior design students should *understand* about environmental color, it does not account for the students' actual knowledge in *applying* environmental color. Further evaluation of students' ability to apply color knowledge should be evaluated in the future, perhaps through portfolios by seasoned practitioners in the field, as well as over time, to avoid possible cohort effects.

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