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Impact of Color Psychology on Students' Perception in Learning Spaces

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ABSTRACT Colors significantly impact students' perception, mood, behavior, and academic performance. However, individual responses to color may vary, so it is important to consider individual preferences and sensitivities when designing learning environments. This study aims to validate previous studies that highlight the use of color as a means of transmitting meaning and influencing students' perception and behavior. It also analyzes the effects of background colors on students' perception of interior environments. Therefore, the objective of this paper is to confirm earlier studies on the impact of background color on students' perception and to analyze how different colors in an interior space affect its users. The study reviewed previous models to test existing hypotheses and used a quantitative survey method with a questionnaire to assess students' perceptions at two universities in Lahore, Pakistan. Seven colors were chosen from the Munsell color system to test students' intuitive abilities. The results indicated that cool colors, such as, white, green, and blue, were preferred for educational institutions as they evoked feelings of optimism, curiosity, and contentment, positively affecting students' perceptions. Conversely, dark colors such as black and grey were associated with anxiety and fear. The study highlights the significant impact of colors on students' perception of learning spaces, concluding that colors affect behavior, performance, and mood.

INDEX TERMS academic performance, behaviors, feelings, learning environment, mood, student's perception

I. INTRODUCTION

Color is a crucial element in interior space. Any interior space that is well planned, can significantly enhance the psychological effects by using appropriate colors. As a fundamental tool for interior designers, color enables the expression of various ideas and themes, influencing how people feel within the space. As Eiseman and Hickey [1] noted, colors are the

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catalyst for feelings, molding moods and enhancing our lives. Color plays multiple roles within the whole interior space or sometimes in parts of that space. It influences an interior space in setting the mood or maintaining the ambiance. It also helps in altering the perception of a space's area or volume [2].

There are many factors which can enhance the people's perception of colors, including gender, age, culture, and the life experiences. Color perception can have a significant impact on cognitive task performance, as different colors can affect people's moods, attention, and mental processes in different ways. Research has suggested that certain colors can improve cognitive task performance, while others may have a negative effect. For example, red could be deleterious to cognitive task performance because it is associated with danger and failure. Red has been found to increase physiological arousal, including heart rate and blood pressure, and evoke stress and anxiety, leading to impairment in cognitive task performance [3]. The blue color, on the other hand, was found to have a calming effect on the mind and body, which can increase focus and productivity. Similarly, green has a positive impact on the nature-related cognitive tasks, evoking feelings of well-being and comfort [4].

Classrooms are among the indoor places where most of the human population spend time from an early age to adolescence. All physical components of an educational building directly contribute to the overall educational experience. These elements may stimulate users' perceptual responses by affecting their emotions [5]. Research on the psychological responses of colors in learning spaces gives an insight to the designer for a more user-centered design in creating an optimal environment. Considering the conceptualization that color may influence cognitive performance and subjective experiences, designers can develop more invigorating, productive, and gratifying learning spaces for students [6].

Color can have a significant impact on the moods of students in classrooms, as different colors can evoke different emotional responses. Choosing the right colors in a classroom can foster a positive learning environment, while inappropriate colors may have a negative effect and hinder learning. Understanding how different colors influence emotional responses helps educators create environments that are conducive to positive emotional states and optimal learning [7]. Colors have silent effect on the people regarding their psychological feelings and each person perceives colors

differently, which influences their attitudes. Therefore, it is necessary to know that which color and tone is required for a specific interior space so that the end user could get maximum benefit from it.

This study aims to explore the impact of colors on humans, with students as target audience. The colors used at educational spaces have strong influence on how people perceive them. The objective of the current study is to conduct a survey to determine the correlation between students' perceptions of color, preferences, and their selection of interior learning environments. Along with looking at students' vision in a restricted learning setting, the study also investigates the psychological effects of colors. By investigating the relationship between color and cognitive performance, attention, and readability of learning materials, the research seeks to provide insights into how color psychology can be applied in educational settings to create more effective and engaging learning spaces.

II. Review of Literature

A. COLOR THEORY

Due to its superior color separation, the Munsell Color system is one of the color systems that is standardized globally along with many other color systems. Albert H. Munsell created the Munsell Color System, in the early 20th century. It is a three-dimensional color model that is based on three attributes of color: hue, value, and chroma [8]. These three attributes of color are depicted in Figure 1 under the Munsell Color System. The hue is represented by a circular arrangement of colors around a vertical axis, with the center of the circle representing neutral gray. The value is shown on a vertical axis with white at the top and black at the bottom. The chroma is represented by the distance from the center of the circle to the edge. To attain success while experiencing the psychology of using colors in interior spaces, the interior designer should consult the color wheel to achieve perfect combination of different colors as described in Figure 2. The most valid and easiest way is to use them by following one of the standard color harmonies. These harmonies are the beautiful color combinations obtained from the relevant positions on the color wheel. Figure 3 describes the combinations of colors in these color harmonies in a way which are very soothing and satisfying to the eyes. There are seven basic color harmonies named as monochromatic, complementary, split-complementary, and double split-complementary, analogous, triadic, and neutral [9].

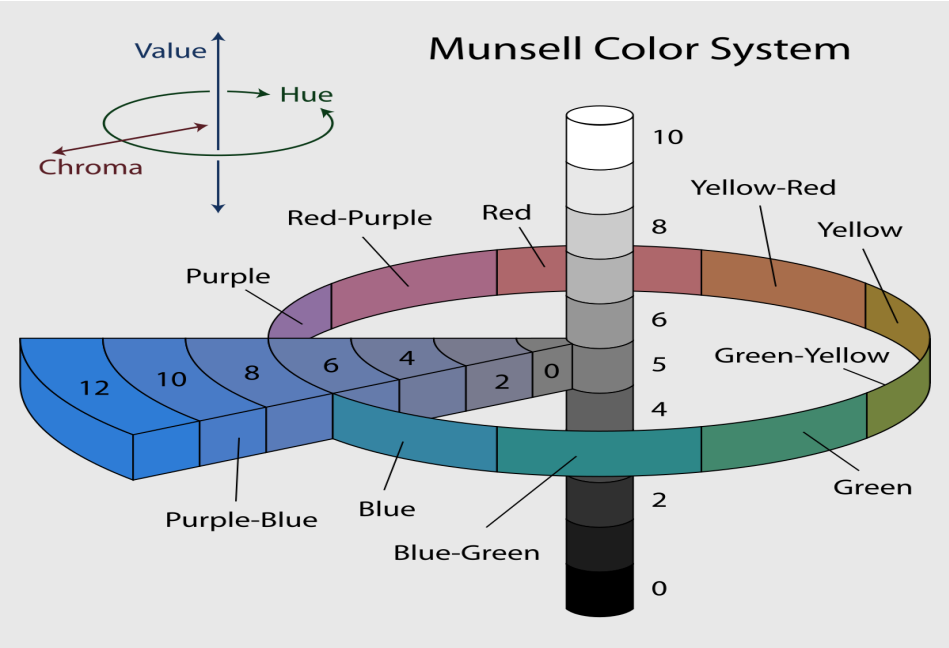

FIGURE 1. Munsell color system [8]

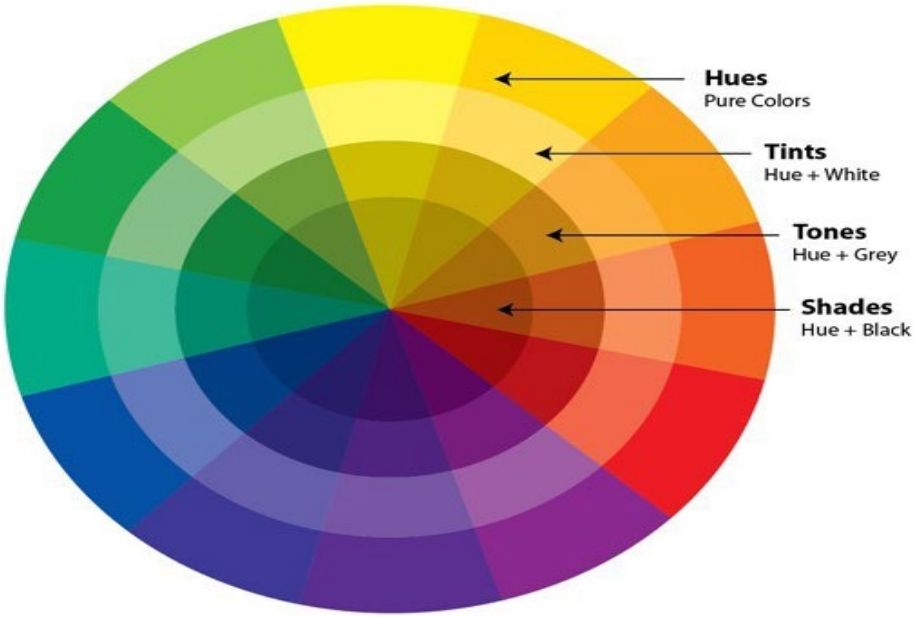

FIGURE 2. Color wheel [9]

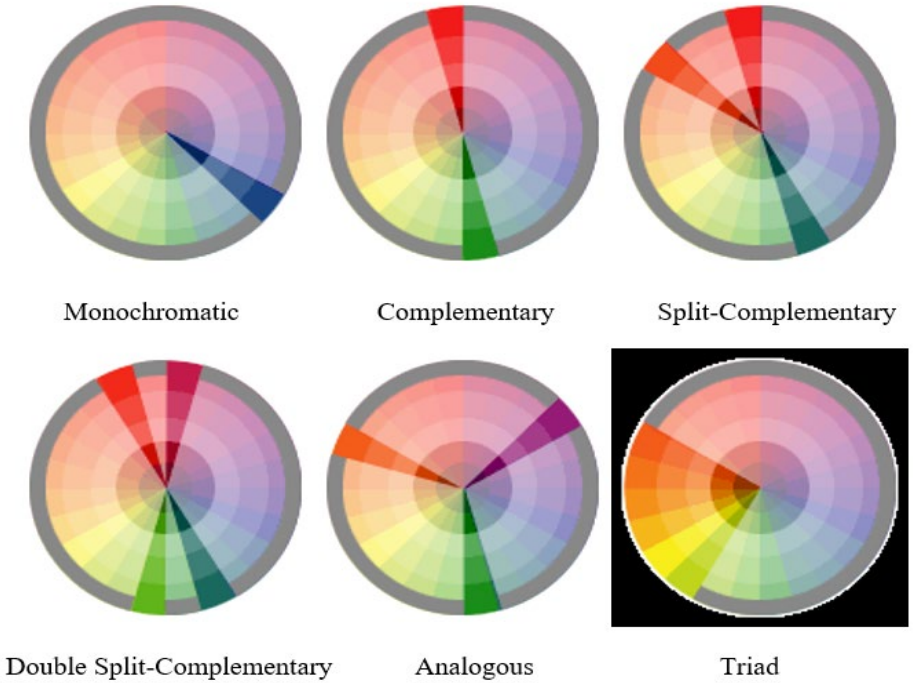

FIGURE 3. Color harmonies [9]

The built environment of a classroom contributes a huge impact in formulating the perception of students and learning outcomes. By designing classrooms that are comfortable, engaging, and conducive to learning, teachers and administrators can help students feel more positive about the learning experience and achieve greater academic success. In other words, it simply means that colors and lighting can significantly affect the mood, feelings, focus, alertness, perception, and learning of the students. For example, warm colors combined with natural lighting create a calm and welcoming environment, while bright colors and artificial lighting are energizing and increase attention [10]. Designing a classroom with light and color means making it a comfortable, engaging, and stimulating place that fosters good learning and growing experience. Colors do have immense power to influence the mood and energy levels. Usage of soft and calm colors make the environment of the room peaceful and conducive to work, such as blue or green color. With these, the accent ones, like yellow or orange pop up, bringing their fun and enthusiasm to the space. Natural light has been shown to improve the overall learning environment and well-being of students [11].

B. SPACE PERCEPTION THEORY

Johnson and Ruiter define perception as "the process by which sensory information is actively organized and interpreted by the brain to make sense of the environment" [11]. It is not only the passive process of reception of sensory information; it involves active organization and interpretation of that information. In other words, perception includes processing sensory data to create meaning and understand the world, rather than merely experiencing sensations. Most factors that are generally thought to be behind the individual differences in the perception of color include genetics, environment, and personal experience. Perception has been an issue that many psychologists have tried involving in their work with an aim to bridge human beings with the world through experiences [12]. Our world is three-dimensional, and our awareness of space is crucial in how we interact with the environment and the spaces around us. When it comes to experiencing spaces, four senses - sight, hearing, touch, and smell - come into play [13]. However, this research specifically concentrates on visual spatial perception and utilizes visual sensors to analyze it.

C. PSYCHOLOGICAL EFFECTS OF COLORS

Color psychology is the study of how color affects human behavior and emotions. Different colors can elicit different emotional responses and can be used strategically to influence mood, behavior, and perception. Understanding the emotional effects of color can be useful in a variety of settings, from designing a classroom to creating a marketing campaign. By using color strategically, it is possible to evoke specific emotions and influence behavior in subtle but powerful ways [13]. The psychological effects of color are different for various people, and they can raise certain feelings. Hospitals use color to help promote healing. Similarly, the restaurants also use color that make people hungry, as some advertisers do.

As color and mood are interconnected, so the psychological impact of color should be considered while working with an interior space to select a color pallet. Perceiving psychological meaning of color includes the awareness that color is practiced within conditions, environments, and circumstances. For example, a person’s reaction to red while in a hospital is quite different when he or she visits a child in a kindergarten setting. Similarly, experiencing a yellow-green color in a hotel while waiting for someone is quite different while experiencing it when one eats three meals a day in a

room painted that color. So, there are various contextual factors influencing a person's response to color [14]. Colors have a direct impact on human's mood and play a significant role in his life. Different people react differently to different situations. Colors strongly influence individuals, their routines, and lives in general [15].

D. COLOR PRESENCE IN VISUAL PERCEPTION

According to Palmer and Schloss [16], colors are described in "color-in-context theory" (CIC) by the "color-in-context" (CIC) theory of. The interpretation and color perception not only based on the physical properties of the color but also on the context in which it is seen. Examples of such factors are lighting conditions, objects from which the color is surrounded, past experiences and cultural background of the viewer. Emotional experience can have a significant impact on color perception. For example, in good mood one tends to see more saturated colors in comparison to when in bad mood. However, in a bad/unpleasant mood, one likely notices colors as dull and without saturation. The affect relation with color perception has great implications in several domains such as design, marketing, and psychology [17]. The color of the environment influences the way an individual perceives and experiences his environment. Different colors create an individual's emotional and psychological response. They will also influence the mood, behavior, and the perception of the environment. For example, warm colors such as red, orange, and yellow are always associated with the feelings that bring about energy, excitement, and passion. There are color schemes that can adapt to atmospheres of social conglomeration like restaurants, sports arenas, or entertainment places, aiming at making a very vibrant and exciting activity that only calls for socializing. On the other hand, cool colors like blue, green, and purple are mostly associated with calm, relaxed, and peaceful feelings. This, therefore, makes the colors appropriate for use in serene and peaceful surroundings, such as spas, hospitals, learning spaces, and offices, since those surroundings enhance the capability for relaxation, focus, and output [18]–[20].

E. PERCEPTION OF STUDENTS ABOUT SCHOOL COLORS

In any learning space, color is always a significant aspect, because it has a direct impact on students' moods and conduct. Color can improve learning atmospheres. It has varied impacts in different areas and at different ages. When researchers looked at color preferences in school for people of all

ages, they discovered that youngsters chose red for their classrooms while adults preferred blue. AL-Ayash *et al.* [21] found that students felt good feelings (such as happiness, hope, and joy) when they saw bright colors like blue, white, and yellow, and negative emotions (such as despair, fear, and shame) when they saw black, grey, and other dark colors. Another research in Australia observed the emotional linkages of college students. Kurt and Osueke [4] discovered that bright colors evoke pleasant emotional connections whereas dark hues evoke negative ones. According to Mikellides [13], young people preferred black and had both good and negative feelings when it came to it. Students felt more apprehensive when exposed to hot color surfaces compared to when exposed to cool color surfaces. Past studies provide ambiguous results on the impact of color on pupils' perceptions and behavior; there is still much debate over the color effects. As an example, Jalil *et al.* [22] found that blue hue has awaking effects in learning spaces and improves students' performance. Yildirim *et al.* [23] claimed that red has an awareness impact in classrooms, noting that students made less errors in their assignments. Apart from its waking impact, it also has dodging effect, as it is viewed as a cautionary sign when employed in learning interior spaces, making pupils fearful and uncomfortable [4], [5], [18]. Negative effects are also observed in other hues that are thought to have solely positive effects on children, such as blue, which has a sleepy effect; it diminishes student attentiveness [24].

III. METHODOLOGY

To comprehend the influence of colors on students' perception in learning environments, it was necessary to conduct a literature review on color theory and how individuals respond to different colors. This involved examining how the presence of specific colors in educational facilities impact students' perception. The study focuses on investigating the relationship between the dependent variable, which is students' perception, and seven independent variables representing different colors.

A. PARTICIPANTS

Respondents were undergraduate students from the Department of Interior Design, Lahore College for Women University and the Department of Mechanical Engineering, University of Engineering and Technology Lahore. There were total 85 participants, 35 of whom were male, and 50 were females. The participants aged between 20-25 years.

B. COLOR SAMPLES

The choice of the colors to be used in the questionnaire was informed by a review of literature. Maximum studies have shown that red, blue, yellow, purple, and white colors can be effective in educational settings. Most studies focus on how these colors affect the behavior of students and performance while learning in the classroom, but this research aims to explore how these colors affect student perception. The goal is to determine whether they could be used to design modern classrooms which are compatible with modern teaching and learning techniques. Total seven colors were selected including green, blue, yellow, and purple along with neutral colors like grey, white and black, based on Munsell color system majorly and former studies.

C. PROCEDURE

A flexible research methodology (survey) is employed as a tool for data collection to accomplish the goal of this study. The elements from the research that were discussed in the preceding section were used to develop the questionnaire. 85 out of 110 randomly selected surveys were returned. The survey asked students about their favorite colors, their feelings towards the chosen colors. Eight positive and negative emotions were utilized to measure each student's perspective about colors they suggested for the classroom. To demonstrate the colors to the participants, the questionnaire also includes seven boxes filled with test colors. Unlike correlational experimental research, the methodology opted for this study is to evaluate cause-and-effect relationship between two variables. The impact of color psychology on students' perception in learning spaces is analyzed by Microsoft Excel.

IV. RESULTS AND DISCUSSION

A. FINDINGS OF COLOR PREFERENCES BY STUDENTS FOR LEARNING SPACES

As with many studies, there are notable differences between male and female participants regarding their recommendations and perceptions of color. According to the findings, mostly students of both genders picked cool colors like white, purple, blue, and green as their choice for adorning classrooms as demonstrated in Table I. Overall, white color received the highest score, followed by blue and green. When it comes to gender orientation, each gender has a dominant hue. While it was expected that

women would choose purple, 25% of them chose white, while more than 25% of men chose blue. Students favored white among the neutral colors utilized in most contemporary educational building designs, and only one to four percent of both respondents gave recommendation in the favor of black color in learning spaces.

TABLE I

THE COLOR PREFERENCE BY THE STUDENTS TO HAVE IN THEIR CLASSROOM

Preference Color	Male		Female		Total	
	Frequency	%	Frequency	%	Frequency	%
Yellow	2	5.7%	9	18.0%	11	12.9%
Green	9	25.7%	6	12.0%	15	17.6%
Blue	9	25.7%	11	22.0%	20	23.5%
Purple	2	5.7%	7	14.0%	9	10.6%
Grey	2	5.7%	2	4.0%	4	4.7%
Black	1	2.9%	0	0.0%	1	1.2%
White	10	28.6%	15	30.0%	25	29.4%
Total	**35**	100.0%	**50**	100.0%	**85**	100.0%

B. FINDINGS OF COLORS' IMPACTS ON STUDENTS' PERCEPTION

Female respondents were more expressive than male respondents when relating their feelings and perceptions to colors. Both male and female participants perceived yellow as a positive color that made them feel hopeful, while some females expressed that it made them feel emotional. As per their perception, the green color is also associated with positive emotions like harmony, balance, and satisfaction. Blue color was perceived to possess the emotion of efficiency and serenity. Where 29% of men associate vision with the purple, 23% of women associate containment with this color as depicted in Table II. When it comes to present-day colors, most designers employ grey, black, and white these days. Students view grey as color of depression, and most respondents—both male and female—describe black as oppression and fear. As stated in the literature assessment, colors like black and grey tend to arouse hostile feelings. Majority of the male (52%) and female participants (37%) associated white classrooms with the feeling of being active and energized. Therefore, according to this study, light colors are more suited to be used in the design of learning places to enhance the learning capacity of students.

TABLE II

FEELINGS AND EMOTIONS EXPERIENCED BY STUDENTS IN RESPONSE TO COLORS

Colors	Male Perception	Female Perception
Yellow	Optimism (30%)	Optimism (24%), Emotional (12%)
Green	Harmony (21%), Balance (15%)	Harmony (18%), Satisfaction (15%)
Blue	Efficiency (28%)	Efficiency (13%), Serenity (12%)
Purple	Containment (23%)	Vision (29%)
Grey	Depression (38%)	Depression (40%)
Black	Oppression & Fear (46%)	Oppression & Fear (65%)
White	Efficiency & Clarity (52%)	Efficiency & Clarity (37%)

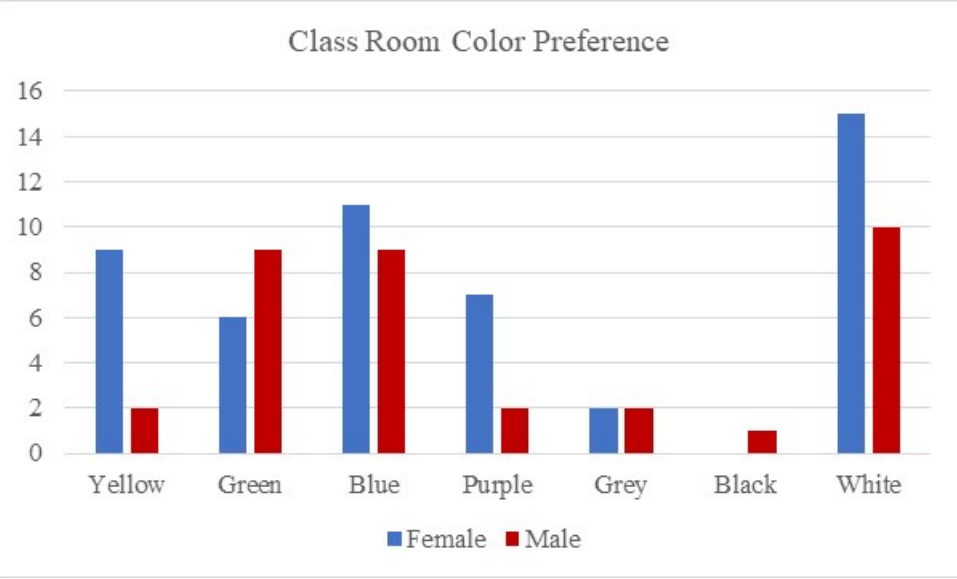

FIGURE 4. Bar chart showing classroom color preferances

V. DISCUSSION

According to the study, men and women differ significantly in their suggestions about colors for learning spaces. The specifics of the test are shown in Table I. Blue, grey, black, and white colors are perceived similarly by men and women. This finding aligns with the research of Mikellides [13] which indicates that college students prefer cool colors over warm ones and tend to avoid dark colors because of their negative effects. However, Kurt and Osueke's [4] research on the effects of colors on the moods of students, revealed that respondents favoured red after blue, green, yellow, and purple,

with white being the least favorite. This contrasts with the current study, which finds that white is highly preferred. However, the results of respondents about blue, green, yellow, and purple colors support the present study. According to the findings, this study also suggests that cool colors such as white, blue, and purple should be preferred in learning spaces rather than warm ones as illustrated in Figure 4. Warm colors like yellow have negative effects, which may explain why students did not recommend them. Another thing to notice is that participants chose white the most, which is the color of their present spaces. Figure 5 shows that they perceived it as the color of efficiency and clarity.

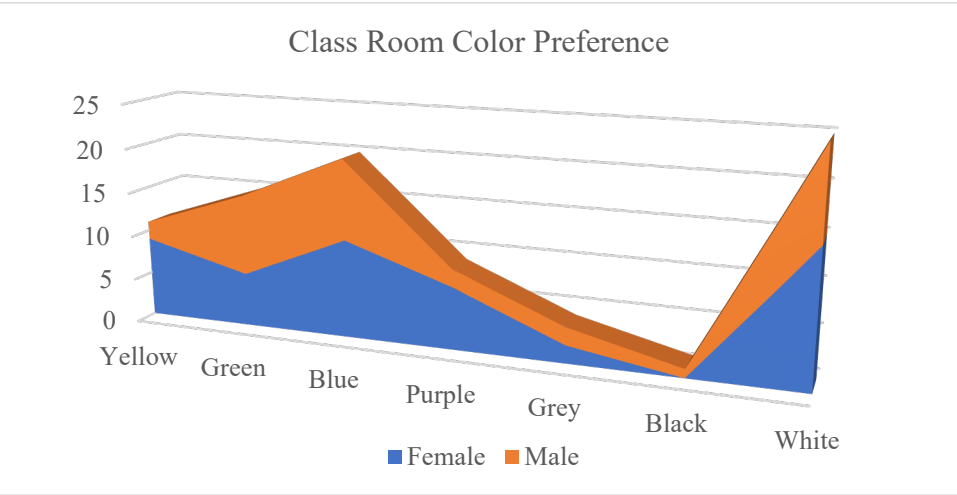

FIGURE 5. Line chart showing classroom color preferances

A. IMPLICATIONS OF THE STUDY

The implications of this study are important for educators and interior designers. It shows how understanding the psychological impact of color can improve students' mood, behavior, and academic performance. By considering individual preferences and cultural differences, educational spaces can be designed to foster positive emotional responses and better cognitive functioning. This leads to more engaging and effective learning environments.

B. LIMITATIONS

This study has some limitations. It included only 85 participants from Lahore, which might not reflect the larger student population. The data is

self-reported, which can lead to biases. Additionally, the study looked at just seven colors from the Munsell system, missing out on a broader range of colors. It also focused only on indoor educational settings, without considering online or outdoor learning environments.

C. FUTURE DIRECTIONS

Future research should involve larger, more diverse samples and cross-cultural studies to improve generalizability and compare color perception across various backgrounds. Longitudinal and experimental studies with control groups can establish causal relationships and explore long-term effects. Using advanced technologies like Virtual Reality (VR) and Augmented Reality (AR), along with investigating comprehensive color schemes and environmental factors, will provide more precise data and practical guidelines for designing educational spaces

D. CONCLUSION

The findings of this study not only confirm many existing theories and results of other researchers but also uncover the psychological characteristics and impacts of colors on the emotions of individuals in learning spaces. According to the literature analysis, earlier research showed a considerable influence of colors on how people perceive and react to them. Colors influence the perception of environment, which resultantly affect the behavior, performance, and feelings. It's noteworthy that color experience in humans is through visual sensors, which has an impact on their physical and mental health. The psychology of color has a strong impact on user's mind. A group of colors was rated by respondents as their favorite for a learning environment. By taking the recommendations of students into consideration, ideal learning quality in classroom designs can be attained using light colors which are deemed soothing and energetic by the students.

According to this research, it is concluded that color psychology has a strong impact on the students' perception about their moods and feelings and it varies from person to person as per their personality and background. In general, students prefer cool colors over warm colors in their classrooms, as warm colors may have a negative impact on their academic performance. While most of the earlier research found that white had negative effects, this paper's findings revealed that most students see white in classrooms favorable and relate it to boosting energy and student engagement. Most

students believed that blue, yellow, and green represented optimism, serenity, and pleasure. They advised not to use dark colors like grey in classroom design as it negatively affects their perceptions.

This paper supports existing research on how colors affect learning environments by surveying students in Lahore, Pakistan, and emphasizing cultural influences on color perception. It provides practical tips for educators and designers on using colors to improve students' well-being and highlights areas for future research. By connecting theory and practice, it offers guidelines for creating effective and engaging educational spaces.

CONFLICT OF INTEREST

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

DATA AVALIABILITY STATEMENT

The data associated with this study will be provided by the corresponding author upon request.

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