

THE EFFECT OF COLOR ON MOOD, COGNITIVE PERFORMANCE AND MENTAL HEALTH CONDITION AMONG SCHOOL STUDENTS

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ABSTRACT

This study explores the effect of color on mood, cognitive performance, and mental health condition among school students. The aim is to examine the impact of different color on student's mood, cognitive performance, and mental health condition of the students. The hypothesis of this study is that cool colors like blue and green enhance calmness, focus and positive mood. While warm colors such as red and yellow may stimulate alertness and also cause restlessness or anxiety and it may reduce focus and accuracy in mental task. There are totally 150 samples all are students with the age range of [13 - 17 years]. The study includes standardized questionnaire, like patient health questionnaire for adolescents (PHQ-A) 2002 to check mood, cognitive assessment questionnaire (CAQ)2008 to measure cognitive performance, strength and difficulty questionnaire (SDQ)2019 for mental health condition, a quasi- experimental design was employed. To evaluate the effectiveness of color exposure, the paired t-test was used to analyse the difference between cool color group and warm color group and also to see the difference in pretest and post-test of the students. The findings of this study is that cool colors had positive effect on student's mood, attention and emotional wellbeing, while warm colors will increase alertness leading to restlessness and distraction. This study concludes that color helps to improve students mental focus and emotional stability.

Key Words: Colour, Mood, Cognitive performance, Quasi Experimental Design and Mental health condition.

INTRODUCTION

The relationship between environmental factors and human psychological functioning has gained considerable importance in recent years, especially within educational contexts. Among the various environmental influences, **color** stands out as a powerful and pervasive element that significantly affects perception, emotional responses, and behavior. In school settings, where students spend a major portion of their daily lives, exposure to different colors through classroom walls, learning materials, digital screens, and surroundings plays a crucial role in shaping their psychological and academic experiences.

Color is not merely a visual phenomenon; it acts as a **psychological stimulus** that influences mood, cognitive functioning, and overall mental well-being. For school students, who are in critical stages of emotional and cognitive development, these effects become even more significant. The classroom environment, if designed effectively using appropriate color schemes, can enhance concentration, promote positive emotions, and support mental health. Conversely, poorly designed color environments may lead to distraction, stress, fatigue, and reduced academic performance.

In the modern educational scenario, students face increasing academic pressure, competition, and exposure to digital environments. These challenges often contribute to psychological concerns such as stress, anxiety, reduced attention, and emotional instability. Therefore, identifying simple, non-invasive, and cost-effective strategies to improve students' well-being is essential. One such approach is the strategic use of color in educational environments. Despite its importance, the combined effect of color on **mood, cognitive performance, and mental health condition** among school students has not been extensively studied, highlighting the need for the present research.

COLOR AS AN ENVIRONMENTAL STIMULUS

Color serves as the **primary independent variable** in this study and acts as a significant environmental factor influencing students' internal psychological states. Scientifically, color is perceived through the interaction of light with the human visual system, where different wavelengths are interpreted by the brain. Psychologically, however, color goes beyond perception and becomes a medium that can evoke emotions, alter physiological responses, and influence behavior.

Different colors are associated with distinct psychological effects. **Warm colors** such as red, orange, and yellow are known to stimulate energy, excitement, and alertness, whereas **cool colors** such as blue and green are associated with calmness, relaxation, and improved concentration. These responses are not only immediate but can also have long-term implications on students' behavior and mental well-being.

In educational settings, color is present in multiple forms, including classroom walls, furniture, textbooks, charts, and digital interfaces. These elements continuously interact with students' sensory systems, influencing how they perceive and engage with learning materials. Appropriate use of color can enhance visual clarity, improve engagement, and support learning, while excessive or poorly chosen colors may lead to overstimulation, visual fatigue, and distraction.

MOOD AS AN EMOTIONAL RESPONSE

Mood refers to a **relatively stable emotional state** that influences how individuals think, feel, and behave. Unlike short-lived emotions, mood is more prolonged and plays a crucial role in shaping students' learning experiences and classroom behavior. It acts as a mediator between environmental factors and cognitive performance.

Color has a direct impact on mood by triggering emotional responses through visual perception. For instance, exposure to bright and warm colors may generate feelings of enthusiasm and excitement, whereas cool and soft colors tend to induce calmness and relaxation. A **positive mood** enhances students' motivation, participation, and ability to focus, thereby improving learning outcomes. On the other hand, a **negative mood** may result in disinterest, fatigue, reduced attention, and poor academic performance. Mood also influences cognitive processes such as memory and perception. According to psychological theories, individuals tend to process information in a way that is consistent with their current mood. Therefore, understanding how color affects mood is essential for creating supportive learning environments that promote both emotional well-being and academic success.

COGNITIVE PERFORMANCE IN LEARNING

Cognitive performance refers to the **mental processes involved in acquiring, processing, and applying knowledge**, including attention, memory, perception, and reasoning. It is a critical determinant of academic achievement among school students.

The present study focuses on key dimensions of cognitive performance such as:

- **Attention and Concentration** – the ability to focus on tasks without distraction
- **Memory Retention** – the ability to store and recall information
- **Problem-Solving Ability** – the capacity to analyze and respond to academic challenges

Color influences cognitive performance both directly and indirectly. Directly, it affects **visual clarity and perception**, which are essential for understanding learning materials. Indirectly, it influences mood, which in turn affects cognitive efficiency. For example, calming colors like

blue and green can enhance concentration and reduce cognitive load, while overly bright or contrasting colors may increase distraction and mental fatigue.

In addition, structured and color-coded learning materials have been found to improve memory retention and organization of information. Thus, the strategic use of color can significantly enhance students' cognitive functioning and academic performance.

MENTAL HEALTH CONDITION OF STUDENTS

Mental health condition refers to the **overall psychological well-being** of students, including their emotional stability, stress levels, and ability to cope with challenges. In recent years, mental health concerns among school students—such as stress, anxiety, and depression—have increased significantly due to academic pressure, social challenges, and environmental factors.

Color plays a subtle yet important role in influencing mental health. **Calming colors** such as blue and green can reduce stress and anxiety, while overly bright or intense colors may increase tension and restlessness. A well-designed visual environment can create a sense of comfort, safety, and emotional balance, thereby promoting positive mental health.

The study examines mental health through multiple dimensions, including emotional symptoms, behavioral issues, peer relationships, and prosocial behavior. These aspects collectively provide a comprehensive understanding of students' psychological well-being.

INTERRELATIONSHIP BETWEEN COLOR, MOOD, COGNITIVE PERFORMANCE, AND MENTAL HEALTH

The four variables in this study are closely interconnected and influence each other in multiple ways:

- **Color influences mood** by triggering emotional responses
- **Mood affects cognitive performance** by influencing attention, memory, and thinking
- **Color and mood together impact mental health condition**
- **Cognitive performance also contributes to mental health outcomes**

Thus, color acts as a foundational environmental factor that has both **direct and indirect effects** on students' academic and psychological functioning. Mood serves as a mediating variable, linking environmental stimuli to cognitive and mental health outcomes.

NEED AND SIGNIFICANCE OF THE STUDY

The need for this study arises from the growing challenges faced by school students in

maintaining emotional stability, cognitive efficiency, and mental health. While traditional approaches focus on teaching methods and curriculum, the role of environmental factors such as color is often overlooked.

This study is significant because it highlights how **simple environmental modifications** can serve as effective tools for improving students' well-being and performance. Understanding the impact of color can help in:

- Designing effective and psychologically supportive classroom environments
- Enhancing teaching materials and digital learning interfaces
- Promoting emotional well-being and reducing stress among students
- Improving cognitive performance and academic achievement

Moreover, the findings of this study can provide valuable insights for **educators, psychologists, school administrators, and policymakers** in creating learning environments that support both academic success and mental health.

REVIEW OF LITERATURE

Akram, A., et al. (2025). Impact of colors in classroom: A visual study on educational attention and psychological comfort. This study investigated how biophilic design principles embedded within high school learning environments shape students' stress responses and cognitive functioning. Through virtual simulation methodology, the researchers demonstrated that curved, nature-inspired architectural features fostered reduced stress levels alongside enhanced creative thinking and sustained attention.

Basharuddin, J. (2025). Art therapy using color in paintings and illustrations for higher education students in UITM Perak. This qualitative investigation explored how painting and illustration-based therapeutic interventions influenced the emotional experiences of university-level students. Conducted at UiTM Perak, the study employed interviews and case study analysis to understand how warm and cool color palettes differently shaped psychological outcomes. Results indicated that engaging with color through art facilitated emotional expression, alleviated academic-related stress, and promoted greater self-awareness.

Feline, R. M. (2025). Integrating color therapy into a smart desk lightning system for enhancing productivity and cognitive functioning in work environment. This research examined the intersection of color psychology, lighting ergonomics, and user experience design to develop an intelligent desk lighting solution tailored for contemporary work environments. Findings suggested that appropriately calibrated color-based lighting contributed to heightened

concentration, diminished stress responses, and overall improved occupational satisfaction among users.

Angra, S., et al. (2025). Impact of diet, colors and virtual reality on mental well-being of an individual: A pre-test analysis. This preliminary investigation explored how three distinct yet interconnected factors — nutritional intake, color stimulation, and virtual reality exposure — collectively influence individual mental health outcomes. The study revealed meaningful interdependencies among these variables in shaping mood regulation, stress management, and overall psychological well-being. The research advocates for integrated, multi-modal approaches in designing future mental health interventions.

Badal, V. D., et al. (2025). Dynamic influence of mood on subjective cognitive complaints in mild cognitive impairment: A time series network analysis approach. This investigation explored the dynamic relationship between mood fluctuations and self-reported cognitive difficulties in individuals experiencing mild cognitive impairment, comparing these patterns with those observed in cognitively healthy populations. The findings contribute valuable insights into personalized monitoring and intervention strategies for individuals in early stages of cognitive decline.

Li, B., et al. (2025). Research on the impact of lightning illuminance and color on creative performance and mood. This study systematically examined how variations in lighting intensity and color temperature interact to influence both creative output and emotional states in indoor environments. Results demonstrated that excessively low illuminance levels suppressed creative performance, whereas moderate lighting conditions proved most conducive to creative thinking. These findings carry practical implications for designing workspaces and learning environments that deliberately foster creative thinking.

Nie, J., et al. (2025). The lower correlated color temperature with higher illuminance nocturnal light environment improves cognitive performance and sleep quality.

Schneider, S., et al. (2025). The impact of color as a cue for aesthetics on cognitive load and learning performance in digital environment. This research investigated how color consistency and visual signaling strategies in website design affect learners' cognitive processing and academic performance outcomes. Experimental findings revealed that maintaining a uniform color scheme throughout digital learning materials improved both information retention and knowledge transfer while simultaneously reducing cognitive load. The study emphasizes strategic color application as a critical component of effective digital educational design.

Shahidi, R., et al. (2025). Combined effects of ambient light and color on cognitive performance and sleepiness in a simulated working environment. This research demonstrated that the combined interaction of ambient lighting conditions and interior color schemes meaningfully impacts both cognitive functioning and alertness levels in workplace settings. Findings indicated that sustainable building designs incorporating cool-toned lighting paired with blue interior walls produced measurable improvements in concentration, reduced daytime drowsiness, and enhanced overall work performance

Wang, F., et al. (2025). Simulating the effect of MR interface background color on task performance and mood under extremely dark light conditions on a space station. This study investigated the influence of mixed reality interface background colors on human performance and emotional states under severely limited lighting conditions representative of space station environments. Results confirmed that lighting illuminance and color temperature significantly shaped both creativity and mood, with blue and orange light demonstrating superior effects compared to standard white light.

Zhu, L., et al. (2025). The influence of plant landscape colors on education environments: Effects on college students' quality of life. This investigation examined the psychological and quality-of-life implications of plant landscape color diversity within university campus environments. Findings suggested that deliberate incorporation of varied plant colors into campus design, combined with mood-tracking tools encouraging emotional reflection, holds considerable potential for enhancing students' overall psychological health and academic resilience.

Song, L., et al. (2025). Comparative analysis of color mood perception in art and non-art university students: Hue, saturation, and brightness effects in the Munsell color system. This comparative study examined differences in emotional color perception between students with formal art training and those without such specialized backgrounds. The research suggests that artistic training meaningfully cultivates and refines individuals' emotional responsiveness to the visual environment.

Gulzaib, S., et al. (2024). Examining the relationship between mood traits, color preference, and well-being. This two-phase study explored the complex interplay between habitual mood tendencies, individual color preferences, and subjective well-being among young adult populations. Phase one findings, drawn from 153 participants, established that positive mood dispositions consistently strengthened life satisfaction. The research carries broad implications for therapeutic practice, marketing communications, and individual emotional self-regulation strategies.

Jin, Y., et al. (2024). The effects of plant colors on alleviation of anxiety in college students. This study systematically examined how exposure to plants of varying colors influenced anxiety-related psychological states among university students. Green and white plants emerged as the most effective in reducing feelings of tension, unease, and emotional distress, while yellow-toned plants contributed meaningfully to reducing worry to a lesser degree.

Liu, X. Y., et al. (2024). The effects of icon color combinations in information interfaces on task performance under varying levels of cognitive load. This study examined how different color combinations used in digital information interfaces affect users' task efficiency under varying degrees of cognitive demand. Using mood lighting literature alongside empirical survey data collected from 100 participants spanning ages 17 to 65, the study revealed that distinct lighting types including bright, warm, cool, and coloured varieties produced significantly different emotional and behavioural responses.

Liu, F., et al. (2024). Exploring the impact of color and daytime/nighttime on visual memory in VR teaching environments using explainable machine learning. This study investigated how color conditions and time-of-day lighting variations affect visual memory consolidation within virtual reality classroom settings, using machine learning approaches to interpret results. Findings revealed that visual memory performance was substantially stronger during simulated daytime conditions, with yellow-toned environments producing the most favorable memory outcomes.

Martinez, C. A., et al. (2024). Supporting the mental health of students of color at the secondary level: A group counselling curriculum. This study developed and evaluated a culturally responsive group counseling program specifically designed to address the mental health needs of high school students from racial minority backgrounds, who disproportionately face systemic discrimination and limited access to psychological support services.

Mohammed, E. M. (2024). The effect of colours used in secondary schools on the efficiency of learning. This quantitative investigation explored how the strategic application of color within secondary school environments affects the quality and efficiency of student learning outcomes. Results indicated a consistent preference for cool-toned color palettes within educational settings, suggesting that blues and greens may create environmental conditions more conducive to focused academic engagement than warmer alternatives.

Mostafavi, A., et al. (2024). Impact of illumination and correlated color temperature on cognitive performance: A VR-lighting study. This study employed virtual reality simulation technology to investigate how varying lighting conditions shape cognitive performance across different architectural contexts. These temporally nuanced findings advocate for dynamic,

context-aware lighting designs that adapt throughout the day to optimize cognitive functioning and overall occupant well-being.

Naz, F. (2024). Impact of color psychology on student's perception in learning spaces. This study examined how color functions as a carrier of psychological meaning within interior learning environments, shaping students' perceptions and experiences of educational spaces. The study reinforced the argument that intentional, evidence-based color planning in educational interior design carries measurable consequences for student comfort, motivation, and learning readiness.

Alizadeh, H., et al. (2023). Determining the relationship between cognitive performance and LED lamp color temperature and personality type in students. This study explored how LED lighting color temperature interacts with student personality characteristics to influence cognitive performance outcomes. The research additionally identified meaningful connections between individual personality dimensions and differential sensitivity to lighting conditions, suggesting that personalized lighting strategies may offer significant benefits in academic settings.

Kim, E., et al. (2023). Seasonal forest change of color and temperature: Effects on the mood and physiological state of university students. This study examined the differential effects of seasonal forest environments, characterized by distinct color palettes and temperature conditions, on university students' psychological and physiological states. Spring forest exposure, marked by vibrant green coloration and mild temperatures, proved particularly effective in improving mood, notably reducing tension while elevating energy and vigor.

Li, P. (2023). Color visual communication on consumer mood disorders in cultural product design. This study investigated the therapeutic potential of incorporating strategic color visual communication principles into the design of cultural products intended to address consumer mood disturbances. Results revealed statistically significant improvements in emotional states among the experimental group, demonstrating that thoughtful color application in product design extends beyond aesthetics to carry genuine psychological therapeutic value.

Sroykham, W., et al. (2023). Investigating the effects of color light on brain activity using NIRS: Implications for emotional regulation and cognitive function. This study investigated the neurological mechanisms underlying color-based learning interventions, particularly the use of color coding and text highlighting strategies in humanities education for medical students. The findings support the systematic integration of color-based pedagogical techniques across diverse academic disciplines as a neurologically grounded approach to improving cognitive engagement and educational outcomes.

Xia, G., et al. (2023). The effect of colour attributes on cognitive performance and intellectual abilities in immersive virtual environment This study extended earlier comparative research by delving deeper into the specific color attributes including hue, saturation, and brightness that most meaningfully influence cognitive performance and intellectual capabilities within fully immersive VR environments. Results suggested that specific combinations of color properties created more cognitively stimulating virtual environments, reinforcing the case for evidence-based color specification in educational and professional virtual reality applications.

Bandara, K. M. S., et al. (2022). Impact of colours in classroom interiors on mental health undergraduates with reference to depression, anxiety, and stress levels. This research examined the relationship between classroom interior color choices and mental health indicators specifically depression, anxiety, and perceived stress among undergraduate students. The study provides evidence-based guidance for higher education institutions seeking to leverage interior color design as a low-cost strategy for supporting student mental health.

Chen, R., et al. (2022). Effect of color temperature and illuminance on psychology, physiology, productivity: An experimental study. This controlled experiment involving 67 participants investigated how different combinations of lighting color temperature and illuminance levels influence psychological comfort, physiological responses, and workplace productivity. Results indicated that warmer color temperatures paired with higher illuminance levels produced greater subjective comfort, while productivity gains were consistently observed at illuminance levels exceeding 500 lux.

Diachenko, I., et al. (2022). Color education: A study on methods of influence on memory. This study evaluated the effectiveness of color-based educational methodologies in improving learning outcomes for medical humanities students. Findings confirmed that structured color education approaches significantly enhanced the quality of academic service delivery and improved knowledge retention among students, demonstrating the potential of deliberately designed chromatic learning environments to strengthen educational effectiveness.

Jiang, L. (2022). Expression of emotion and art in film and television animation from the perspective of color psychology. This study explored how color and lighting function as expressive emotional tools across multiple applied contexts, including animation, fashion, and educational environments for neurodiverse learners. carefully selected soft color palettes combined with controlled lighting conditions were found to create calming, supportive environments conducive to learning and emotional regulation.

Jin, T., et al. (2022). Combined effect of color and shape on cognitive performance. This study examined how the simultaneous interaction of color and shape as perceptual information

carriers influences cognitive processing, decision-making, and icon recognition. Using a perceptual load paradigm across varying cognitive demand levels, results demonstrated that combined color-shape effects were negligible under high cognitive load conditions, while their integration meaningfully facilitated iconic cognition at medium and low cognitive load levels. These findings have direct applications for interface design, wayfinding systems, and visual communication in environments where cognitive efficiency is a priority.

Jones, J. M., et al. (2022). Art-based mindfulness at school: A culturally responsive approach to school mental health. This evaluation study assessed the effectiveness of a digitally mediated, art-based mindfulness program implemented across elementary school settings. Particularly noteworthy were the significant gains in school connectedness observed among Black and Asian American student populations who initially reported lower levels of belonging. Results affirm the value of culturally responsive, creative digital interventions in promoting equity-informed approaches to school mental health.

Research Gap

Although previous research has extensively examined the relationship between color and psychological responses, most studies have primarily focused on individual aspects such as mood or emotional reactions. Limited attention has been given to understanding the combined effect of color on multiple psychological domains, particularly mood, cognitive performance, and mental health condition simultaneously.

Furthermore, a majority of existing studies have been conducted in controlled laboratory settings, which may not accurately reflect real-life environments such as schools. There is a lack of research exploring how color influences students in natural educational settings, where multiple environmental and contextual factors interact.

Another important gap is that prior studies have often emphasized short-term or immediate effects of color, without examining the impact of repeated or structured exposure over a period of time.

In addition, there is a scarcity of research focusing specifically on school students, especially within the Indian context. Cultural and environmental differences may influence how individuals perceive and respond to colors, yet this aspect remains underexplored in the literature.

Moreover, earlier studies have rarely compared the differential effects of warm colors versus cool colors within the same research framework. Most studies examine color in isolation rather than making direct comparisons between different color categories.

Therefore, the present study attempts to address these gaps by:

- Examining the combined impact of color on mood, cognitive performance, and mental health condition
- Conducting the study in a real school setting
- Implementing a structured multi-day intervention (6 days)
- Focusing on school students within the local context
- Comparing the effects of warm and cool colors

By addressing these gaps, the study aims to contribute to a more comprehensive understanding of how color influences psychological and cognitive outcomes among students.

METHODOLOGY

Aim:

This study aims to examine the effect of different colors on mood, cognitive performance, and mental health conditions among school students.

Objective of the study:

- To assess the mood of school students under different color conditions.
- To evaluate the cognitive performance of students exposed to different colors.
- To assess the mental health condition of students under different color environments.
- To compare mood, cognitive performance, and mental health scores across different color conditions.
- To determine whether color exposure significantly influences students' psychological and cognitive functioning.

HYPOTHESES:

H1: Mood differs significantly between school students exposed to warm colors and those exposed to cool colors.

H2: Cognitive performance differs significantly between school students exposed to warm colors and those exposed to cool colors.

H3: Mental health condition differs significantly between school students exposed to warm colors and those exposed to cool colors.

Variables of the Study

Independent Variable (IV):

The independent variable in the present study is color exposure. This refers to the visual stimuli presented to the participants in the form of different colors during the intervention sessions. The independent variable was manipulated at two levels:

Warm Colors (e.g., red, orange, yellow): These colors are generally associated with stimulation, energy, and heightened emotional arousal. Exposure to warm colors is expected to influence participants' mood and cognitive responses by increasing alertness and activity levels.

Cool Colors (e.g., blue, green, violet): These colors are typically linked with calmness, relaxation, and reduced emotional intensity. Exposure to cool colors is assumed to promote a soothing effect, thereby influencing psychological well-being and cognitive functioning. Thus, color exposure (warm vs. cool) serves as the manipulated factor to observe its effect on psychological outcomes.

3.4.2 Dependent Variables (DV):

The dependent variables are the outcomes that are measured to assess the effect of the independent variable. In this study, there are three dependent variables:

1. Mood
2. Cognitive Performance
3. Mental Health Condition

Control Variables

Certain variables were controlled to minimize their influence on the results. These include:

- Age of participants
- Educational setting
- Duration of exposure to colors
- Time of assessment

Sample and sampling technique:

Sample Size:

The present study comprised a total sample of 150 school students selected from local areas. The participants belonged to an age range of [e.g., 13–17 years], representing adolescents in a school setting.

The sample size of 150 was considered sufficiently large to ensure adequate statistical power, thereby enabling reliable detection of differences and relationships among the variables under

investigation. A larger sample size helps in reducing sampling error and enhances the accuracy and stability of the results.

For the purpose of the study, the total sample was divided equally into two experimental groups based on the type of color exposure:

Warm color group (n = 75)

Cool color group (n = 75)

This equal distribution of participants ensured balanced group comparison, minimizing bias and allowing for clearer interpretation of the effects of the independent variable (color exposure) on the dependent variables (mood, cognitive performance, and mental health condition).

Furthermore, selecting school students as the sample population was appropriate, as this developmental stage is particularly sensitive to environmental influences such as color, which may impact emotional and cognitive functioning.

Sampling Technique:

The present study employed a non-probability convenience sampling technique for the selection of participants. Convenience sampling involves selecting individuals who are readily available, easily accessible, and willing to participate in the research study.

In this study, participants were chosen from a school setting based on their availability during the data collection period and their willingness to take part in the intervention. This approach was particularly suitable due to practical considerations such as limited time, accessibility constraints, and administrative feasibility within the school environment.

Convenience sampling allowed the researcher to efficiently gather data without disrupting the regular academic schedule of the students. It also facilitated smooth implementation of the intervention sessions, as participants were easily reachable and could consistently attend the study sessions.

After the selection of participants, they were systematically assigned into two groups—warm color and cool color groups—with equal numbers in each group to maintain group equivalence. This ensured that both groups were comparable and that any observed differences in outcomes could be attributed to the intervention rather than unequal group sizes.

RESEARCH DESIGN:

The present study adopted a quasi-experimental research design with a pre-test and post-test approach to examine the effect of color on mood, cognitive performance, and mental health condition among school students. This design was chosen as it allows for the systematic investigation of cause-and-effect relationships in a natural setting where complete randomization is not feasible.

In this study, the independent variable—color exposure—was manipulated at two levels: warm colors and cool colors. Based on this, participants were divided into two experimental groups: the warm color group and the cool color group. Each group consisted of an equal number of participants to ensure balanced comparison and reduce group-related bias.

Before the intervention, a pre-test was administered to all participants to assess their baseline levels of mood, cognitive performance, and mental health condition. This initial measurement served as a reference point for evaluating the effectiveness of the intervention.

Following the pre-test, participants were exposed to a structured color-based intervention over a period of 6 days. During this phase, each group was systematically exposed to their respective color conditions through controlled activities. The intervention was designed to ensure consistency in duration, environment, and exposure across both groups.

After the completion of the intervention, a post-test was conducted using the same standardized instruments. This helped in identifying any changes in the dependent variables as a result of the color exposure.

The design enabled both within-group comparisons (pre-test vs. post-test) and between-group comparisons (warm color group vs. cool color group). This dual comparison strengthened the ability of the study to determine the effectiveness of the intervention.

STUDY MEASUREMENTS:

Patient Health Questionnaire-9 (PHQ-A) for Adolescents:

Source: Developed by Johnson et al. (2002), adapted from the adult PHQ-9 (Kroenke et al., 2001).

Structure: 9-item self-report tool assessing depressive symptoms over the past two weeks on a 4-point Likert scale:

0 = Not at all

1 = Several days

2 = More than half the days

3 = Nearly every day

Total score: 0–27 (minimal: 0–4; mild: 5–9; moderate: 10–14; moderately severe: 15–19; severe: 20–27).

Reliability & Validity: High internal consistency [0.88]; Johnson et al., 2002; Richardson et al., 2010); test-retest ICC = 0.84 – 0.92 (Borner et al., 2014). Strong diagnostic validity (sensitivity/specificity = 88% at cutoff ≥ 11 ; AUC = 0.89 ; Lewinsohn et al., 2012) for Major Depressive Disorder in adolescents. Convergent validity: $r = 0.75$ – 0.85 with CDI/BDI.

Purpose: Screens severity of depressive symptoms and emotional mood disturbances in adolescents aged 11–17.

COGNITIVE ASSESSMENT QUESTIONNAIRE:

Developed by Broadbent et al. (1982); revised factor structure by Rast et al. (2008).

Structure: 25-item self-report tool assessing frequency of everyday cognitive lapses (e.g., forgetfulness, distractibility, absent-minded actions). Uses a 5-point Likert scale:

0 = Never

1 = Very rarely

2 = Occasionally

3 = Quite often

4 = Very often

Scoring: Sum of all items (range: 0–100); higher scores indicate more cognitive failures (lower efficiency). Subscales: Forgetfulness (memory), Distractibility (attention), False Triggering (action slips).

Reliability & Validity: High internal consistency ($[\alpha = 0.80]$ – 0.90 ; Broadbent et al., 1982; Rast et al., 2008); satisfactory test-retest reliability ($r = 0.70$ – 0.85). Strong construct validity via factor analysis confirming three-factor model; correlates with cognitive tasks ($r = 0.40$ – 0.60) and validated across populations (e.g., adults, clinical groups).

Purpose: Measures self-reported cognitive slips in daily life to assess attention/memory efficiency in non-clinical and clinical populations.

Mental Health Condition Assessment (Strengths and Difficulties Questionnaire -SDQ)

Source: Developed by Goodman (1997); version used: 2019 edition (Goodman et al., 2010, updated scoring bands).

Structure: 25-item parent/teacher/self-report assessing emotional/behavioral mental health in children/adolescents (ages 4–17); 3-point Likert scale:

0 = Not true

1 = Somewhat true

2 = Certainly true

Scoring: Subscale sums + Total Difficulties Score (Emotional Symptoms + Conduct Problems + Hyperactivity/Inattention + Peer Problems; 0–40); higher difficulties = greater problems. Prosocial Behaviour (0–10); higher = better functioning. Includes Impact Supplement in 2019 version.

Reliability & Validity: Acceptable-good internal consistency ($\alpha = 0.70$ –0.83 per subscale; Goodman, 2001); test-retest $r = 0.70$ –0.85 over 4–6 months. Good construct/criterion validity (sensitivity 80–90% at revised cutoffs; AUC = 0.82–0.90); 5-factor structure; internationally validated across cultures/populations.

Purpose: Screens emotional/behavioral strengths/difficulties for early mental health identification.

PROCEDURE:

Sample selection :150 school students aged 13 to 17 years will be recruited. This age group is chosen to focus on a specific developmental stage relevant to cognitive and emotional changes.

Group assessment: participants will be divided into two groups of 100 each using a quasi-experimental method.

Group A (cool colors): participants exposed to environments with cool colors like blue and green.

Group B (warm colors): participants exposed to environments with warm colors like red and yellow.

Pre-Intervention Assessment:

Baseline measures were administered to both groups using:

- Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982) for cognitive lapses.
- Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997, 2019 ed.) for emotional/behavioral health.
- Mood Questionnaire for happiness levels.

Clear instructions ensured accurate completion.

Intervention Protocol

Participants engaged in six 45–60-minute sessions over consecutive weeks, supervised by trained facilitators. Activities targeted cognitive enhancement and mood improvement via color exposure.

Warm Color Group (energizing hues):

- Coloring/drawing/painting with red/orange/yellow.
- Sorting/matching warm-colored objects.
- Memory/attention games with warm stimuli.
- Problem-solving worksheets and visual searches.
- Group art, affirmations, and interactive alertness games.

Cool Color Group (calming hues):

- Coloring/drawing/painting with blue/green/violet.
- Sorting/matching cool-colored objects.
- Memory/concentration tasks with cool stimuli.
- Relaxation exercises and guided calming visuals.
- Stress-reduction art and attention activities.
- Session attendance and engagement were recorded.

Post-Intervention Assessment:

Immediately after the final session, pre-test instruments (CFQ, SDQ, Mood Questionnaire) were re-administered to evaluate intervention effects on cognition, mental health, and mood.

Data Management

Responses were verified for completeness, scored per instrument manuals (subscale/totals), coded, and entered into SPSS for analysis. Missing data were handled via listwise deletion.

Intervention plan:

Overview of intervention:

The intervention in the present study was designed to examine the effect of color exposure (warm and cool colors) on mood, cognitive performance, and mental health condition among school students. The intervention was carried out in a structured and systematic manner over a period of 6 consecutive days.

At the beginning of the study, participants were divided into two groups: the warm color group and the cool color group, with equal numbers in each group. Prior to the intervention, a pre-test assessment was conducted to measure baseline levels of mood, cognitive performance, and mental health condition using standardized instruments.

During the intervention phase, each group was exposed to their respective color conditions. The warm color group was exposed to colors such as red, orange, and yellow, which are generally associated with stimulation, energy, and heightened emotional responses. The cool color group was exposed to colors such as blue, green, and violet, which are linked with calmness, relaxation, and emotional stability.

Each session of the intervention was conducted in a controlled environment, such as a classroom, to ensure uniformity in conditions. The exposure to colors was implemented through various structured activities, which may have included visual presentations, colored materials, or tasks designed using specific color backgrounds. Each session lasted for a fixed duration, ensuring consistency across all participants.

The intervention was carried out daily for 6 days to allow sufficient exposure and to observe potential changes in the psychological and cognitive variables. Care was taken to maintain similar conditions for both groups in terms of timing, duration, and instructions, so that the only variation was the type of color exposure.

At the end of the intervention period, a post-test assessment was conducted using the same instruments administered during the pre-test. This helped in identifying any significant changes in mood, cognitive performance, and mental health condition as a result of the intervention.

Intervention Frame-Work:

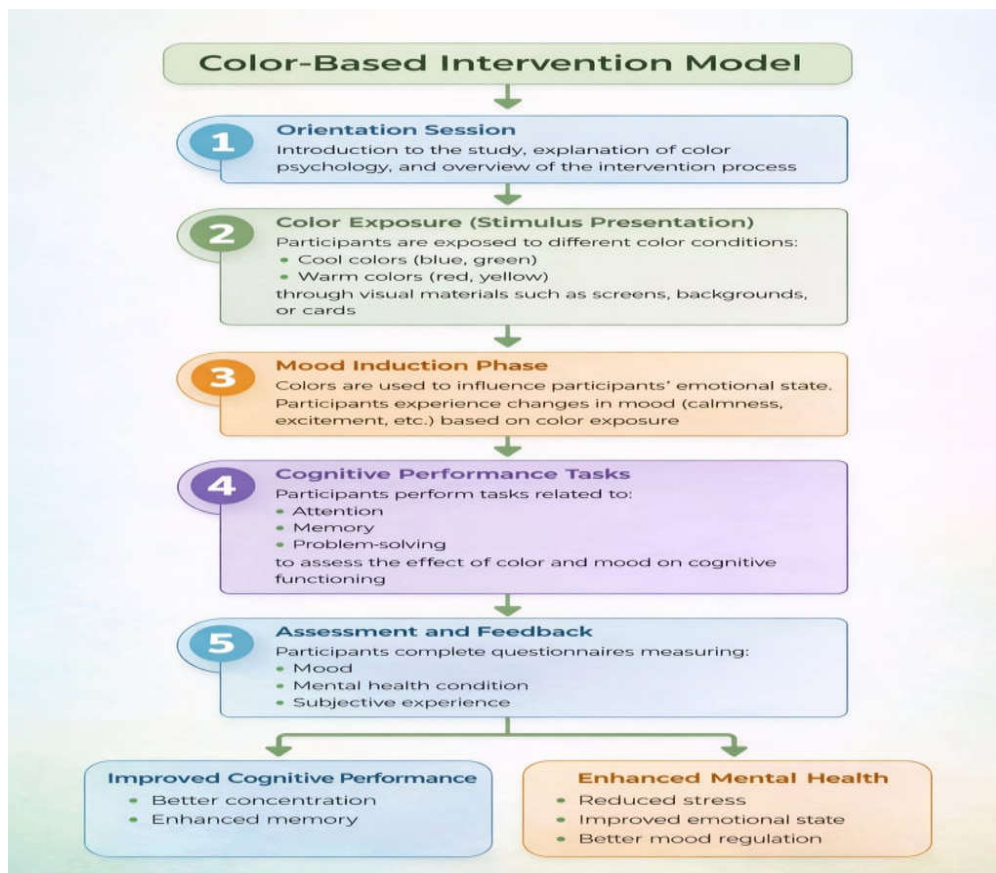


Figure 1: Intervention frame-work model of color:

Inclusion Criteria:

- Adolescents aged 13–17 years (school grades 8–12).
- Enrolled in participating urban schools in Pollachi, Tamil Nadu.
- Mild to moderate depressive symptoms (PHQ-A score 5–14).
- No prior formal color therapy exposure.
- Ability to read/write English at grade level.
- Parental consent and participant assent obtained

Exclusion Criteria:

- Severe depression or acute mental health crisis.
- Diagnosed neurodevelopmental disorders (e.g., ADHD, autism spectrum).
- Color vision deficiencies (e.g., confirmed color blindness).
- Current psychotropic medication or psychotherapy.
- Chronic medical conditions affecting cognition/mood (e.g., epilepsy, head injury)

Ethical Consideration:

- **Confidentiality & Anonymity:** No personally identifiable information was collected. All responses remain confidential and will be used strictly for research purposes.
- **Voluntary Participation:** Participants took part voluntarily and had the right to withdraw at any stage without facing any negative consequences.
- **Data Protection & Security:** All data is securely stored and will be safely disposed of after the research is completed, in accordance with ethical guidelines.

RESULTS AND DISCUSSION

The present study examined the effect of cool and warm color conditions on mood, cognitive performance, and mental health among school students. Statistical analyses using t-tests revealed significant differences in mood and overall cognitive performance under both color conditions. However, while total mental health scores showed significant changes, several sub-dimensions of mental health did not demonstrate statistically significant differences. The findings of the present study suggest that both cool and warm color conditions play a significant role in influencing mood and cognitive performance among school students. The significant improvement in these variables indicates that environmental color can impact psychological functioning. However, the mixed results observed in mental health dimensions imply that color may have a limited or selective effect on deeper aspects of mental health, highlighting the need for further research in this area.

TABLE 1: Descriptive Statistics of Overall Study Variables

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MOOD	150	12	38	25.09	4.695
CP TOTAL	150	16	84	49.59	12.576
CP DIM1	150	5	28	17.73	4.096
CP DIM2	150	7	26	17.59	3.960
CP DIM3	150	4	30	17.40	4.659
MHC TOTAL	150	2	112	13.25	8.713
MHC 1	150	0	8	3.01	1.793
MHC2	150	0	8	3.29	1.619
MHC 3	150	0	8	3.27	1.634
MHC 4	150	0	10	3.02	1.736
MHC 5	150	0	10	7.24	2.091
Valid N (listwise)	150				

The above table shows the descriptive statistics of mood, cognitive performance, and mental health condition among the participants.

- **Mood and Cognitive Performance (CP):** The sample reported a mean mood score of 25.09 (\$SD = 4.695\$). Regarding coping mechanisms, the CP TOTAL mean was 49.59, with relatively balanced scores across its three sub-dimensions (CP DIM1, DIM2, and DIM3), all hovering around the 17.40 to 17.73 range.
- **Mental Health Continuum (MHC):** The MHC TOTAL showed a mean of 13.25. Interestingly, while MHC sub-scores 1 through 4 remained consistent (means between 3.01 and 3.29), MHC 5 stood out with a notably higher mean of 7.24, suggesting that participants scored significantly higher in this specific aspect of mental health compared to others.

TABLE-2: Pre-Test and Post-Test Comparison of Mood, Cognitive Performance, and Mental Health Condition Using Paired Samples t-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	POSTMOOD	29.6467	150	4.76021	.38867
	PREMOOD	25.09	150	4.695	.383
Pair 2	CP TOTAL	49.59	150	12.576	1.027
	PRECPTOTAL	24.1867	150	5.72102	.46712
Pair 3	POSTCPDIM1	15.9667	150	3.55289	.29009
	CP DIM1	17.73	150	4.096	.334
Pair 4	POSTCPDIM2	15.1200	150	3.51778	.28723
	CP DIM2	17.59	150	3.960	.323
Pair 5	POSTCPDIM3	15.3867	150	3.96425	.32368
	CP DIM3	17.40	150	4.659	.380
Pair 6	POSTMHCTOTAL	26.8867	150	4.15559	.33930
	MHC TOTAL	13.25	150	8.713	.711
Pair 7	POSTMHC1	2.0933	150	1.82579	.14908
	MHC 1	3.01	150	1.793	.146
Pair 8	POSTMHC2	2.3533	150	1.70328	.13907
	MHC2	3.29	150	1.619	.132
Pair 9	POSTCPDIM3	15.3867	150	3.96425	.32368
	MHC 3	3.27	150	1.634	.133
Pair 10	POSTMHC4	2.2400	150	1.82702	.14918
	MHC 4	3.02	150	1.736	.142
Pair 11	POSTMHC5	7.9467	150	2.03917	.16650
	MHC 5	7.24	150	2.091	.171

The paired samples statistics indicate that post-test mood scores ($M = 29.64$, $SD = 4.76$) were higher than pre-test scores ($M = 25.09$, $SD = 4.69$), suggesting an improvement in mood. Cognitive performance total scores also showed an increase in the post-test, whereas the mean scores of cognitive performance dimensions (CP DIM1, CP DIM2, and CP DIM3) decreased in the post-test compared to pre-test. Similarly, mental health total scores increased substantially from pre-test ($M = 13.25$, $SD = 8.71$) to post-test ($M = 26.88$, $SD = 4.15$), indicating improvement. However, the individual mental health components (MHC1 to MHC4) showed slight decreases in post-test scores, while MHC5 showed a small increase. Overall, the results suggest improvements in overall mood and mental health, with mixed changes observed in specific cognitive and mental health dimensions.

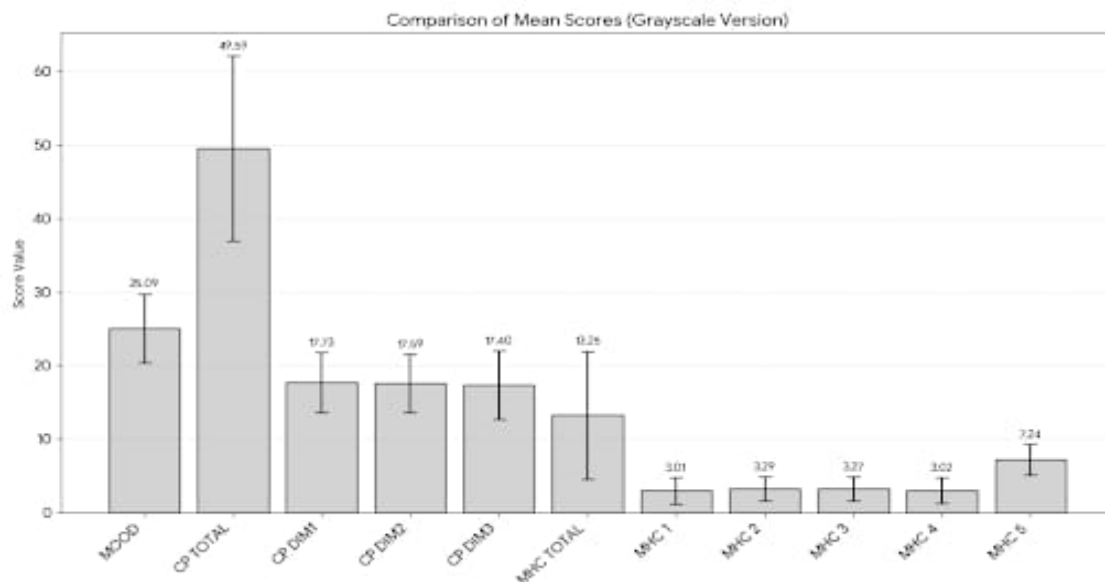


FIGURE 2: The figure shows that the pre-test results for mood, cognitive performance and mental health condition among school students.

1. Dominance of Cognitive Processing (CP TOTAL):

The most striking feature of the data is the CP TOTAL score, which exhibits the highest mean value. This suggests that the cognitive processing tasks or measurements represented the most substantial numerical weight in the study.

- **Variability:** The error bar for CP TOTAL is noticeably larger than most other variables. This high standard deviation indicates that while the average is high, there was significant individual variation; some participants excelled remarkably in cognitive tasks, while others scored much closer to the average of the secondary scales.

2. Consistency in Mood and Cognitive Dimensions

Following the overall cognitive total, we see a tier of moderately high scores:

- MOOD: Participants reported a generally positive mood, maintaining a score that sits comfortably in the upper mid-range of the overall data set.
- CP DIM1, DIM2, and DIM3: These specific dimensions of cognitive processing are exceptionally consistent, with means of 17.73, 17.59, and 17.40, respectively. This near-uniformity suggests that the different facets of cognitive processing (e.g., memory, focus, speed) were developed or utilized to a similar degree within this sample group.

3. Analysis of Mental Health Continuum (MHC)

The mental health variables show a distinct hierarchical structure compared to the cognitive ones:

- MHC TOTAL (13.26): The total mental health score is significantly lower than both the mood and the total cognitive scores. This suggests that the participants' perceived mental health flourishes at a lower numerical intensity than their cognitive output or emotional state.
- MHC 1–4: Dimensions 1 through 4 are the lowest-scoring variables in the study, ranging from 3.01 to 3.29. The small standard deviation bars here indicate a high level of group consensus; most participants scored consistently low in these specific sub-facets of mental health.
- MHC 5 (7.24): Interestingly, MHC 5 acts as an outlier within its group, scoring nearly double the other MHC dimensions. This suggests that the fifth dimension of mental health (often related to social integration or specific psychological growth) was a much stronger contributor to the participants' overall well-being than the other four facets.

4. Comparison of Error Bars (Reliability of Results)

- High Stability: The MHC sub-dimensions (1–4) and the CP dimensions (1–3) show relatively short error bars, meaning the intervention or measurement had a predictable and stable effect across the 150 participants.
- High Sensitivity: CP TOTAL and MHC TOTAL show much larger error bars. This indicates that "Total" scores are far more sensitive to individual differences, baseline capabilities, and personal circumstances than the specific sub-dimensions.

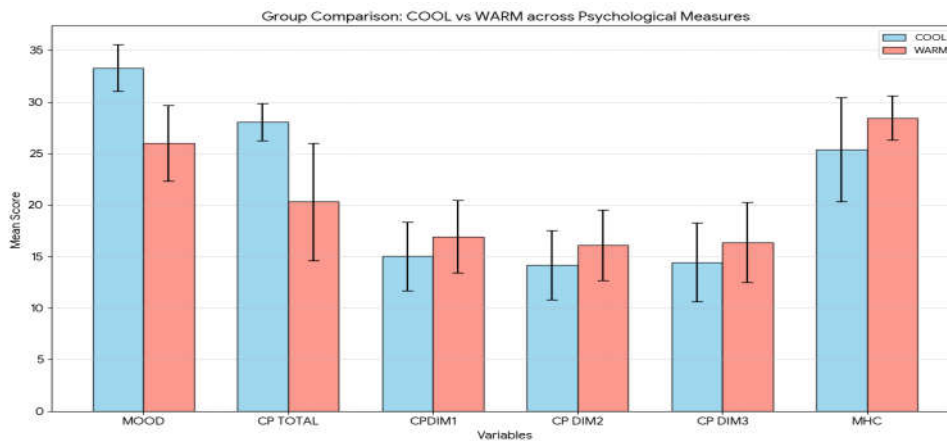


FIGURE 3: Shows the comparison between the COOL and WARM group scores for Mood, cognitive performance and mental health condition among school students.

1. Significant Advantage in Mood and Cognitive Totals

The most prominent finding in this chart is the superior performance of the COOL group in primary overall measures:

- **MOOD:** The COOL group reports a significantly higher average mood score compared to the WARM group. The error bars show that the COOL group was also much more consistent (lower variance), whereas the WARM group had a broader range of emotional responses.
- **CP TOTAL:** Similarly, overall cognitive performance was notably higher in the COOL condition. This suggests that the "cool" environment or stimulus was more conducive to general cognitive processing.

2. The Inverse Relationship in Specific Cognitive Dimensions

A very interesting trend appears when looking at the sub-dimensions of cognitive processing (CPDIM1, CP DIM2, CP DIM3):

- Despite having a lower CP TOTAL, the WARM group consistently outperformed the COOL group across all three individual cognitive dimensions.
- This suggests that while the COOL group may have had a higher "baseline" or cumulative score, the WARM condition might specifically enhance individual facets of cognitive tasks, such as focused attention or specific problem-solving dimensions.

3. Mental Health Resilience (MHC)

The MHC (Mental Health Continuum) scores reveal a different dynamic:

- The WARM group achieved a higher mean score in mental health compared to the COOL group.
- **Stability of Response:** The error bar for the WARM group in the MHC category is remarkably small. This indicates that the warm condition had a very stable and uniform positive impact on the mental well-being of the participants. In contrast, the COOL

group's mental health scores were highly variable, suggesting that "cool" conditions might affect people's mental well-being in very different ways depending on their individual personality or baseline.

4. Interpretation of Variability (Error Bars)

- COOL Group: Shows high stability (small error bars) in CP TOTAL and MOOD, but high variability in MHC.
- WARM Group: Shows high stability in MHC, but significantly higher variability in CP TOTAL. This indicates that while the warm condition is great for consistent mental health, its effect on total cognitive output varies greatly from person to person.

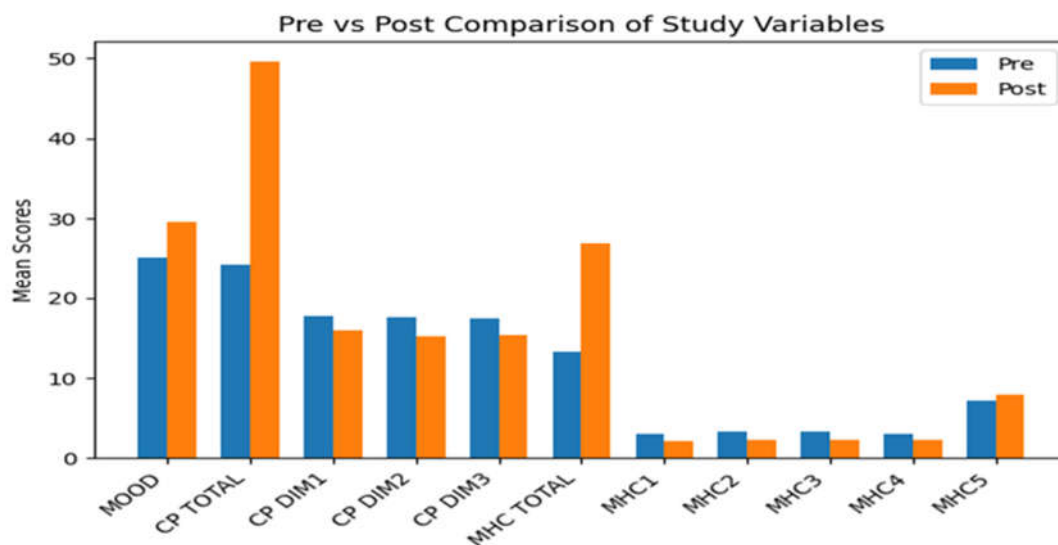


FIGURE 4: shows the comparison between pre-test and post-test scores for mood, cognitive performance, and mental health among school students.

The comparison between pre-test and post-test scores reveals notable changes in mood, cognitive performance, and mental health among school students. The findings indicate a clear improvement in mood, as the post-test mean score is higher than the pre-test mean, suggesting that the intervention positively influenced students' emotional well-being. Similarly, the total cognitive performance score showed a substantial increase in the post-test, reflecting an overall enhancement in cognitive functioning. However, when examining the individual dimensions of cognitive performance (CP DIM1, CP DIM2, and CP DIM3), a decline in post-test scores was observed, indicating that these specific cognitive domains did not improve and may have been differentially affected by the intervention. In terms of mental health, the total score increased significantly in the post-test, suggesting a strong improvement in overall psychological well-being. Despite this, most of the individual mental health components (MHC1 to MHC4) showed slight decreases in post-test scores, indicating limited or variable

changes across these dimensions, whereas MHC5 demonstrated a marginal improvement. Overall, these findings suggest that the intervention was effective in enhancing general mood and overall mental health, while producing mixed effects across specific cognitive and mental health subcomponents.”

CONCLUSION

The study clearly demonstrates that color is not merely a decorative or aesthetic component of the environment but a functional element capable of influencing human behavior and mental processes. Both cool and warm colors were found to have beneficial effects, although their nature and intensity differed. Cool colors appear to facilitate calmness, emotional balance, and sustained concentration, making them suitable for learning environments that require focus and stability. On the other hand, warm colors seem to promote energy, alertness, and cognitive engagement, which may be useful in settings that require active participation and stimulation.

The observed improvement in cognitive performance is particularly significant, as it suggests that environmental factors such as color can directly influence learning-related processes, including attention span, memory retention, problem-solving abilities, and overall academic efficiency. Similarly, the enhancement in mood indicates that color exposure can play a role in reducing negative emotions such as anxiety, stress, and irritability, while fostering positive emotional states. The improvement in mental health condition further reinforces the idea that supportive environmental design can contribute to students’ psychological well-being and resilience.

From a practical perspective, the findings of this study have important implications for educational institutions, educators, designers, and policymakers. The visual environment of a school—including classroom walls, furniture, lighting, teaching materials, uniforms, and digital interfaces—can be strategically designed using appropriate color schemes to create a more supportive and engaging learning atmosphere. Such modifications do not require extensive resources, making them a feasible and sustainable approach to enhancing students’ overall development.

Furthermore, color-based interventions offer several advantages over traditional psychological interventions. They are non-invasive, easy to implement, cost-effective, and capable of influencing a large number of individuals simultaneously. As a result, they can serve as a complementary strategy alongside existing educational and mental health support systems.

The study thus contributes to the growing body of research emphasizing the importance of environmental psychology in education and opens new avenues for practical applications aimed at fostering holistic student development.

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