Computer Classroom Wall Colour Preference and the Relationship with Personality Type of College Students

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The computer classroom is widely used in colleges and high schools in the United States. In order to create a more comfortable and effective teaching environment, the most preferred wall colours for a computer classroom were examined in the study. Also, personality types of students were tested to determine if type had an impact on wall colour preference. The sample consisted of 145 undergraduate interior design students at a university located in the south-western United States. Students ranked 15 slides that depicted the same computer classroom with 15 different wall colour applications. Results indicated that personality type did not impact colour preference for a computer classroom. The results suggested cool colours in the Master Palette Color System are preferred more for wall colour in a computer classroom.

Introduction

Computers are increasingly used in teaching and learning environments. According to a survey from the National Center of Educational Statistics (NCES), the trend of using computers for teaching and learning is steadily rising. In 2000, 77% of schools in the United States had Internet access [1]. Because students and faculty are highly satisfied with teaching and learning with computers, the demand for computers is still rising.

The setting for the computer classroom is as important as the traditional classroom environment. Colour, as one of the most important elements of the physical environment, has a significant impact on students' lives. Colour can impact state of mind, change moods, and uplift spirits. Colour may also change our perceptions of some physical qualities in our environment, such as thermal comfort. Researchers have found that colours have certain behavioural connotations, and when used in a resourceful and dynamic manner within the designed environment, can influence the users' mental and emotional balance [2]. Previous studies about computer classrooms were focused on ergonomics of furniture, acoustics and lighting. Studies about use of colour in computer classrooms are less prevalent.

Colour stimulates people on visual, physical and emotional levels. People are sensitive to colour. The human eye can distinguish approximately 2.5 million different colours. Greenman and Pile found walls finished with warm or dark colours advance or appear closer than they actually are and walls finished with cool colours recede or appear farther away [3,4]. Colour is also vital in setting objects apart from their backgrounds. Contrast in hue, brightness and saturation help the human eye define objects by distinguishing shapes and edges.

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Colour: Design & Creativity

Studies have explored the relationship between emotions and colour. Most research related to colour is focused on colour preferences [5]. The purpose of colour preference testing is to investigate persons' choice of colour to determine which colour they selected or found the most preferable. Colour preferences have been studies by researchers for many years [6–8]. These studies were based on the assumption that colours have certain characteristics and meaning to viewers as well as the ability to affect their performance.

Colour, form, space and light are the principal interactive components of the built environment, but colour is the element that affects the others most [9]. Because most people live in built environments, design professionals must pay greater attention to human psychological and physiological responses to their surroundings.

Previous colour studies in the field of interior design were focused on commercial, residential and hospital environments. Colour studies in school environments are scarce, especially for a computer classroom. How wall colours in a computer classroom affect students' attention and make them feel relaxed is relatively unknown.

In 2000, Beth Shapiro & Associates, a research firm based in Atlanta, surveyed 1050 public school teachers across the country. The results showed 88% of teachers believed that attractive colours, textures, and patterns for floors and walls had a very strong impact or somewhat strong impact on student learning and achievement. Seventy-nine percent believed it was important for students' attendance. Hence, if the interior environment of the classroom provides better physical and psychological comfort, students can have a positive school experience.

It has been strongly established that people are influenced and affected by their environment. Students exposed to the environmental conditions in school facilities are no exception [10]. Although researchers suggest that the home environment, natural surroundings, activities being undertaken and other factors may affect a student's performance, one important factor remains: a portion of the performance variable can be controlled by educators and design professionals alike through the built environment. Schools are special environments that exist for the objective of learning. In the United States there are about 120 000 schools providing for the educational needs of approximately 54 million students. Students spend an average of about 20% of their environmental exposure in schools.

For the classroom, the setting for teaching and learning environments can have a direct impact on motivation, concentration and performance by affecting comfort, control, attention, access and enjoyment. Therefore, in order to help students study in a learning environment, researchers and designers should know what types of physical settings are necessary and how to make the settings suitable for teaching and learning.

King has analysed previous research on the relationship between the behaviour of individuals and their educational environments [11]. Physical settings include acoustics, climate, colour and lighting. A learning environment can be improved by maintaining sanitation and good air quality, controlling noise, reducing light glare and using soothing colours. King concluded that climate (temperature, humidity and air circulation) and acoustics significantly affect academic achievement and task performance more so than the effects of light and colour, although they are also important. In 1988 Hathaway studied air quality, colour, light, noise and temperature and their physiological and psychological effects on humans. Hathaway indicated all of the factors have a closely coupled relationship to learning and human performance [12].

The learning environment in the computer classroom can now be defined as the place of connection between all the various media data, and other resources, and it can become something other than a traditional classroom space. Typically, students who use a computer classroom for course work (as opposed to those accustomed to a more traditional classroom setting) were found to spend significantly more time on class work. They were more likely to

prefer to use web pages to seek information when they needed it. Using computers to study subjects often involves long periods of time for research, analysis, design and writing.

While traditional teaching methods and materials are very effective in science education, some skills are difficult to learn, such as the complex time-varying three-dimensional processes and skills of scientific reasoning. These problems may be facilitated by computer-based learning [13]. One pilot study conducted by Pitt and Guthrie indicated that students and faculty were highly satisfied with learning by computer, and the faculty's demand for additional technology classrooms was very high [14]. In one recent empirical study conducted by Schutte, 33 sociology students were randomly divided into a traditional classroom and a virtual classroom equipped with computer and Internet technology [15]. Students in a virtual classroom scored on average 20% higher than students in a traditional classroom. Glennan and Melmed found that specific applications of technology showed improvement in student performance, student motivation, teacher satisfaction and other educational outcomes [16].

Personality Type

Previous research has enlightened the relationship between the subjectivity of the human mind and the objectivity of the environment. Leighton's theory of personality formation emphasised the importance of environmental influences on peoples' lives [17]. Because we live in a built environment, the interior and exterior of buildings exert a direct and significant influence on our everyday experience and further stabilise or disrupt each individual personality. Moller claimed there was a dynamic reciprocal relationship between structural space and the psychological processes of individuals [18]. Perception is one of the most important aspects of this reciprocal relationship.

Perception in general is affected by the subjective reality of the environment. Baron and Byrne indicated the perception of the environment was a result of the combined impact of three factors: objective reality (the real things out there), personality characteristics (our needs, tastes and past experience) and the quality of the situation [19]. The built environment is exposed to interpretations and distortions exercised by human perception. These distortions and interpretations have no fixed character but are related to individual personalities. Therefore it is possible to say that the personality of each individual influences his/her experience of the built environment. Moreover, the built environment may be said to have a personality that is formed by the active relationship between physical, structural elements and its effect on the people who use it. This personality exists only in the image formed by the person who experiences the surrounding environment, which in turn affects his/her personality. Consequently, Moller concluded that architecture is best defined as the dynamic interaction of space and personality [18].

Allport claimed that personality traits are naturally connected to particular environments [20]. This assumption of systematic interconnection between traits and settings became a central dogma in the interactionist approach to personality, which supposed that a trait would be found only in situations that were relevant to its expression. In his work with vocational interest, Holland categorised people and occupations into six types (realistic, intellectual, social, conventional, enterprising and artistic) and argued that each types of person will seek an occupational environment that allows them to express himself or herself [21,22].

There is some evidence that personality differences are related to the preference of different visual forms. Janssens in Sweden first confirmed that the evaluation of buildings being seen as pleasant is related to its visual complexity [23]. He found that neurotics perceived tall and massive buildings as unpleasant. He also found that extroverts perceive buildings as more complex than

do introverts. In addition, some experimental studies showed there are a variety of linkages between personality and visual pattern preferences. For example, people who are competitive and dependable are said to prefer round shapes. People who are creative and organised like ovals, and people who are stubborn like squares [24]. In brief, the previous discussion supports the idea that personality traits have an impact on the perception of the environment.

Methodology

In the present study 45 colours with lighting reflectance values between 50 and 59% were selected for testing. The colours were selected from the ICI Master Palette Color System. The system consists of 1695 unique scientifically generated colours in chromatic sequence for both interior and exterior applications. Each colour is named and is also represented by a notation. This notation expresses the proportion of each three factors: hue, light reflectance value and chroma, which combine to create what the human eye sees as colour.

The 45 colours were evaluated by a panel of three interior design academicians for suitability in a learning environment. Following the evaluation, 30 colours were considered suitable. A simulated computer classroom was generated by AutoCAD2000 and AccuRender 3. The dimensions of the computer classroom were 11.0 x 10.4 m (36 x 34 feet) with a ceiling height of 2.4 m (8 feet). The classroom included four rows of tables and chairs with 24 computer stations. The simulated computer classroom had two walls of one colour and one accent wall of another colour. The colour for the two walls was grey and remained constant in the study. A panel of three professional interior designers reviewed the 30 images (the simulated computer classroom) to evaluate the content for defined visual attributes. Fifteen slides were selected and made into 35 mm slides for the Wall Color Preference Test (Figures 1–15).

Figure 1 Foliage 30GY 50/195

Figure 2 Green Tambourine 90YY 58/532

Figure 3 Desert Sand 00YY 52/119

Figure 4 Viola 42BB 53/176

Figure 5 Sailing Blue 50BG 55/150

Figure 6 Spring Field 10GY 56/184

Figure 7 Moon Shade 70BB 55/044

Figure 8 River Birch 45YY 58/094

Figure 9 Coastal Beige 90YR 51/109

Figure 10 Appletree 10GY 52/362

Figure 11 Orange Cantaloupe 90YR 54/440

Figure 12 Colonnade 70GY 51/283

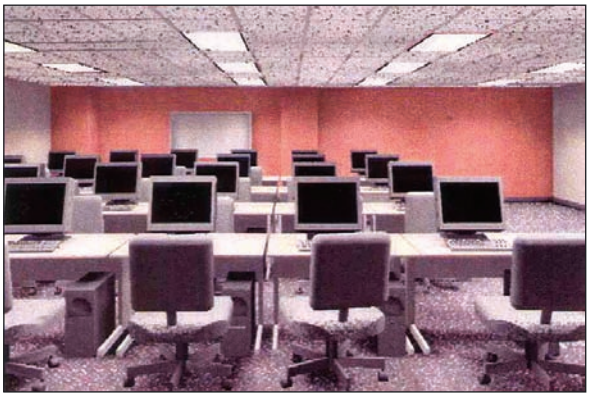

Figure 13 Christmas Cactus 58YR 53/342

Figure 14 Dusky Lilac 48BB 56/162

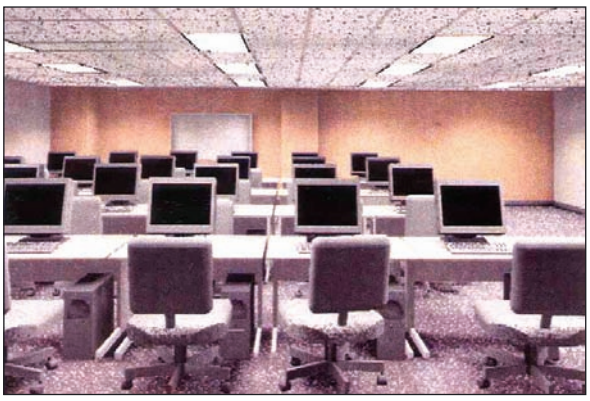

Figure 15 Fairhaven Peach 90YR 58/202

In the Wall Color Preference Test, eight descriptive adjective pairs were adapted from Kasmar [26] and used in the questionnaire. The pairs were scored on a seven-point semantic differential rating scale. The eight word pairs were:

- Comfortable/uncomfortable
- Attractive/unattractive
- Cheerful/gloomy
- Appealing/unappealing
- Bright/dull
- Impressive/unimpressive
- Clean/dirty
- Pleasant/unpleasant.

The second instrument, the MBTI Form G Self-Scorable, which included 126 questions, was used to determine influences of personality on environmental preference. The MBTI measures student preferences on four scales:

1. Extrovert (E) or introvert (I)
2. Sensing (S) or intuition (N)
3. Thinking (T) or feeling (F)
4. Judging (J) or perceiving (P).

Data Collection

In spring 2003 145 undergraduate students majoring in interior design at a university located in the south-western United States were asked to participate in the study. At the beginning of the session, the researcher stated the objective of the study and distributed questionnaires. This was followed by showing the 15 slides with students responding to the Wall Color Preference Test. Then students were asked to complete the MBTI. At the conclusion of the 45 minutes, the questionnaires were collected and the students were thanked for their participation.

Pilot Study

In order to identify any problems with the organisation and structure of the questionnaire

and with the selected procedure to collect data, a pilot study was conducted. Ten students participated in the study and answered the Wall Color Preference Test. The procedure of the pilot study was the same as that described above in data collection. The validity and reliability of the study were determined by Cronbach's coefficient (α), which is a measure of internal consistency. Data showed that the α values of most images were above 0.7. The method to test the colour preference for the 15 images was therefore valid and reliable.

Results and Discussion

The population of the study consisted of 145 (143 female and 2 male) undergraduate students majoring in interior design. Due to 99% of the students being female, differences in wall colour preference based on gender were not examined.

Data from this study indicated that interior design students have colour preferences for the walls in a computer classroom. Colour preference was measured by a seven-point scale semantic test using the eight adjective pairs mentioned above. Results indicated that the 15 images were significant predictors of colour preference. Using a multiple comparison technique, the Bonferroni HSD, as a *post-hoc* test of data patterns, significant differences were found among the 15 images [27]. Table 1 illustrates the most and least preferred wall colours by mean ratings, colour numbers and colour notations. Table 1 indicates that there no significant differences in preference for Figure 7 (ρ = 0.776) and Figure 10 (ρ = 0.093). Correlation coefficients for Figures 7 and 10 were greater than 0.05, signifying that the preference for neither was significantly different from the mean of the 15 images. The correlation coefficients for the other 13 images were all lower than 0.05, which means they were significantly different from the mean of the 15 images (3.88).

Student classification (freshman, sophomore, junior or senior) was insignificant with 12 of the images (all except for Figures 2, 6, and 12). Students with a higher classification (junior or senior level) did not prefer the colour used in Figures 2 or 12; the colour used in Figure 6 was more preferred by students at the junior and senior level. The more courses that students had completed in the program was correlated with a preference for the colour used in Figure 6 and less preference for the colours used in Figures 2 and 12.

Table 2 reports the personality types for the respondents. The results indicated most students could be classified as Extrovert, Intuition, Feeling and Judging. The results presented in Table 2 show that the predominant personality type of these interior design students was ENFJ.

Due to the minority of students with personality types such as ESTP, ISFP, INTJ, etc., the number of subjects in each type was too small to test the effect of personality type on wall colour preference. Hence, four dimensions (EI, SN, TF, and JP) were used as the independent variables in examining the relationship between students' personality types and their colour preference for walls of a computer classroom. Repeated analysis of variance (ANOVA) revealed that all personality types have no significant main effect or interaction effects on wall colour preference for a computer classroom. The analysis of their preferences is presented in Table 3.Comparison of the results from the present work with those obtained in an earlier study were informative: in both the catalyst type (NF) accounted for about 40% of the interior design students.

Table 1 Ratings for wall colour preferences (145 subjects)

Rank	Figure no	Colour name	Master Palette reference	Swatch	Student rating				
					Min.	Max.	Mean[a]	σ [b]	ρ [c]
1	Figure 14	Dusky Lilac	48BB 56/162		2.75	7.00	5.30	1.078	0.000
2	Figure 5	Sailing Blue	50BG 55/150		2.00	7.00	4.77	1.130	0.000
3	Figure 4	Viola	42BB 53/176		1.00	7.00	4.66	1.130	0.000
4	Figure 6	Spring Field	10GY 56/184		1.00	7.00	4.43	1.267	0.000
5	Figure 12	Colonnade	70GY 51/283		1.38	7.00	4.29	1.132	0.000
6	Figure 1	Foliage	30GY 50/195		1.25	6.88	4.20	1.205	0.001
7	Figure 10	Appletree	10GY 52/362		1.00	7.00	4.04	1.176	0.093
8	Figure 7	Moon Shade	70BB 55/044		1.00	7.00	3.91	1.445	0.776
9	Figure 3	Desert Sand	00YY 52/119		1.00	6.25	3.47	1.322	0.000
10	Figure 15	Fairhaven Peach	90YR 58/202		1.00	7.00	3.32	1.929	0.000
11	Figure 2	Green Tambourine	90YY 58/532		1.00	6.63	3.19	1.137	0.000
12	Figure 13	Christmas Cactus	58YR 53/342		1.00	7.00	3.17	1.246	0.000
13	Figure 11	Orange Cantaloupe	90YR 54/440		1.00	7.00	3.17	1.424	0.000
14	Figure 8	River Birch	45YY 58/094		1.00	6.75	3.16	1.434	0.000
15	Figure 9	Coastal Beige	90YR 51/109		1.00	6.63	3.12	1.362	0.000

a Mean of 15 images = 3.88
b Standard deviation
c Correlation coefficient

Table 2 MBTI personality types of interior design students (145 subjects)

Personality type[a]	No of subjects[b]
ESTJ	13
ESTP	2
ESFJ	17
ESFP	6
ENTJ	9
ENTP	6
ENFJ	23
ENFP	22
ISTJ	6
ISTP	2
ISFJ	12
ISFP	7
INTJ	1
INTP	3
INFJ	5
INFP	11

a For key see text
b Extrovert 66.1%
Introvert 33.9%
Sensing 43.4%
Intuitive 56.7%
Thinking 27.6%
Feeling 72.4%
Judging 58.6%
Perceiving 41.4%

Table 3 Personality types in the present study (145 subjects) compared with those from previous work [25]

Personality type[a]	Verbal description	Present study		Fraction in previous study (%)
		No	Fraction (%)	
NF	Catalyst	61	42.1	40.2
SP	Troubleshooter	17	11.7	21.4
SJ	Traditional	48	33.1	16.2
NT	Visionary	19	13.1	22.1

a For key see text

Conclusions

The study found that bluish colours were more favored than greenish colours: Figures 4, 5 and 14 show the top three colour choices from the total sample survey, regardless of gender, classification level, or personality. These findings suggest that 'cool' colours were more preferred than 'warm' colours. Among the 15 colours tested, the orange colour (Figure 9) was the least preferred colour for a computer classroom.

Results indicated that the higher the students' classification (in terms of the range freshman to senior) or the more courses they completed, the more the colour in Figure 6 was preferred and less preference for colour in Figures 2 and 12. The colour in Figure 2 is a bright stimulating yellowish-green colour; one reason for less preference of this colour could be that junior or senior level students were taught that a bright and stimulating colour is not traditionally suitable for a computer classroom.

Additional research is recommended to expand the sample to include a larger distribution of male students. Gender differences could be studied to determine if gender preferences for wall colour in a computer classroom are different. The results of the study indicated that interior design students' personality types had no impact on wall colour preference in a computer classroom. Subjects were not equally distributed among the personality types. ENFJ and ENFP were the two dominant personality types in the sample. Therefore research related to colour preference in personality type needs to address more diverse sample populations from other majors than just interior design.

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