

Original Research

Effect of color of educational spaces on learning and students' satisfaction in Iran (Case study: Andish Negar Mehrgan educational complex in Isfahan)

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ABSTRACT:

Using appropriate combination of colors in educational spaces can have several advantages. People manifest different feelings and efficiency in spaces with different colors. The most important effect of color in educational spaces is refreshment and creation of enthusiasm and vibrancy during learning. These findings are investigated in a field called environmental psychology, and have a great influence on architecture and designers' decisions. Identifying different colors using descriptive-analytical method and reviewing the previous studies in the first step of this study. In the second step, a questionnaire in accordance with the objectives was designed using the knowledge and information collected. Finally, the data required was gathered using 21 to 27 years old people in a center of training software in Isfahan city. Randomly, 50 students were recruited for the study (50% male and 50% female). To determine internal consistency of data, a simple survey was carried out among 10 students; then, questions with scattered and irrational responses were eliminated. The research results shows that using color affects learning and increasing the enthusiasm of students in all sections of educational structures. The most important section to which the respondents were sensitive were entrance space, the space inside the classroom, and the communication space between classes. Describing suitable colors were done in the supplementary part of this study. The respondents recognized yellow, blue, green, purple, and amethystine as being more suitable, respectively. The results of this study can be used in different sections of higher education throughout the country.

Keywords:

Educational spaces, Color, Environmental psychology, Architectural design.

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INTRODUCTION

The researchers showed that the quality of educational facilities influence learning efficiency of the people. Four fundamental quality can be known as natural day light, thermal comfort, acoustic comfort, and ambient air quality. In a research-investigating these factors, it was found out that students' efficiency increases by 21% under suitable light. Moreover, it was found out that pleasant views, such as vegetation, human activities, and objects from a distance may lead to better learning in people (Mahone, 2003).

Color can play a significant role in all educational environments, and encourage students and create a feeling of honor in them (Kollie, 2004). Several ways have been identified for positive effect of color in educational spaces, some of which include removing eye strain, increasing efficiency and accuracy, helping to solve the problem, and supporting the processes leading to learning development and to name a few (Engelbrecht, 2003). Different effects of color makes it necessary to use different colors, depending on user's age and academic activities (Daggett *et al.*, 2008; Engelbrecht, 2003; Kollie, 2004). Researches indicated that light and warm colors attract younger students. By increasing age, these tendencies move from intense color to medium light colors, and gradually to dark colors (Daggett *et al.*, 2008).

As the most visual aspect of educational spaces, color can influence students' efficiency. Color is, in fact, and integrated component of architecture and has great effects on moral and behaviour of users in a given space. Controlling mental and emotional states of individuals, as well as the impact on information exchange between them, both visually and non-visually, can be considered as well. This study reviews previous researches and findings by a descriptive-analytical approach, which is a branch of the qualitative method, and then classifies the questions according to users' needs and requirements by designing a certain framework for

the study; then examines these questions in a suitable statistical population and discusses the influence of these factors.

Literature Review

Given their extensive role in human life, studying the colors and their effects on learning has different aspects. Importance and role of color in life reminds various concepts. Proposing a specific definition and a brief explanation not only doesn't cover the comprehensive and broad meaning of color, but also will be misleading in perceiving its broad dimensions. Color prevails in all aspects of life, so its meaning is as extensive as the meaning of life, or as Iten says, it is life itself (Hosseini-rad, 2005).

Ancient Iranian used a sort of color therapy illuminated radiation. Pythagoras, the Greek philosopher, in 500 BC believed that disease could be treated by music, poem, and color. At the beginning of the Christian era, Celsius practiced colour as a part of medicine as well. He used colour to treat diseases. He believed that a red colour poultice would sooner heal the wound. Old beliefs about the power of colour in treatment are very simple. People believed that colors are associated diseases, and disease creates color (Faber, 1961). Egyptians were the first civilization conducting researches on the effects of colors. They had built colorful corridors in their temples, namely as Karnak and Tabas, where they discovered the effect of color on treatment and recovery (Edge, 2003).

The effect of color on people at different situations might also be harmful. For example, blood pressure changes during an adverse psychological state, which might be harmful. Red color stimulates and invigorates the body (Venolia, 1988). It accelerated muscle activities and processes. It also affects blood pressure, breathing, nervous tensions, heart rate, and changes in hormone levels.

Colors and their effects on social behaviors and people's psychological states are one of the important

Table 1. Definitions proposed for environmental psychology by different scientists (Emamgholi et al. 2012)

S. No	Researcher	Year	Definitions on Environmental Psychology
1	Craik and Levy	1970	Psychological study of people's behavior, so that it would be related to their daily life in the physical environment.
2	Graumann	1976	Environmental psychology is complementary to general psychology lacking environment.
3	Canter and Craik	1981	A branch of psychology focusing on studying and analyzing interaction, experiences, and actions of people with different aspects of social and physical environment.
4	Russell and Ward	1982	A branch of psychology focusing on providing a systematic relationship between people and environment.
5	Holahan	1982	Environmental psychology addresses common issues between the physical environment and people's behavior and experience.
6	Proshansky	1990	Environmental psychology deals with the interactions and relationships between people and environment.
7	Gifford	2002	Environmental psychology is a crosscheck between the individual and his physical stand.

subjects in terms of understanding them for using in spaces. According to its essence, each color has a psychological effect in people, which is not irrelevant to their social and psychological behavior. Visual, electromagnetic, and chemical processes in eye and brain are always associated with the processes of the psychological world. Such reflections from color experience may diffuse into innermost centers and affect emotional and intellectual perceptions as a result.

Based on the researches conducted, there are various interfering factors in achieving a successful study, which must be assumed under control. Factors such as age, sex, feelings, color, ambient lighting, color saturation, light sources, adjacent colors, texture, and cultural factors also have a significant effect (Park, 2009).

Various definitions have been proposed for environmental psychology. This knowledge is considered as a part of behavioral sciences, and deals with studying people's behavior regarding their residence or the physical environment surrounding. Different definitions and applications of this science are summarized in Table 1. People's perception of the environment is the main issue of environmental psychology and the process of information acquisition from the environment (Lang, 2002). It can be argued that human perception is at the center

of any environmental behavior, and is the source of all environmental information (McAndrew, 2008). Environmental perception is a process based on a combination of emotional information and experience-based expectations, through which people select the data required according to their needs from the surrounding environment. This process is purposive and depends on the culture, attitude, and value governing one's thought. In fact, environmental perception results from the interaction between emotional perception and cognition experience in one's mind. During this process, the role of environment, as a fundamental factor in growth, development, and learning, is considered (Matlabi, 2001). Since color has a significant effect on receiving information *via* eyesight, understanding this effect can have a desirable influence on the results of this study.

Due to their specific limitations, educational spaces have a great tendency to become lifeless and defunct. But efforts have to be made to prevent this. Paying attention to educational spaces and meeting the related principals and standards in designing these centers resulted in the creation of an environment in accordance with psychological requirements of students and the society (Hosseini-Pourian, 2011). Several factors, such as light, ventilation, noise pollution, and most importantly, color, influence students' learning and en-

Table 2. Effect of using different colors in educational spaces (Schultz, 2011)

S. No	Color	Effect and Recommendation
1	Red	It is not recommended for classrooms architecture as it makes people anxious and grumpy, and prevents people's concentration due to its excitement nature. It is better to be used in sport environments.
2	Yellow	Evokes mental activity and strengthens intelligence and curiosity. Therefore, it is related to the speed symbol, especially speed of thinking and decision making, and it increases concentration.
3	Orange	It is live and strong, and it is better to be combined with creamy and/or yellow colors to prevent tension in the environment. It make people lively, warm, and pacifist, and decreases drowsiness and apathy in early morning.
4	Blue	It has a cold and official quality and calms the environment. But it avoids friendly and warm atmosphere, so it is better to be used in combination with other colors in educational spaces.
5	Bluish Purple	It is the color of perfectionism, humanism, and strengthening of philosophical thought. Students who prefer this color are passionate and brainy and have a strong sixth sense. This color is related to decision making with thinking and logic.
6	Purple	It is a combination of red and blue. It creates a special warmth and coldness in the environment, which is the result of these two colors. Being in a space with this color for a long time causes depression since tires the mind and it is not suggested alone. It is better to be used in combination with white, green, and lilac colors.
7	Green	It is the result of combining two opposite colors of yellow and blue. It is a mild color, it helps mental relaxation and peace of mind, and creates a relaxing environment. It is the most pleasant color among the students since eye doesn't need to adjust sight muscles in order to concentrate on it.
8	Gray	It is neutral and a sign of ambivalence. It brings a sense of uncommitted, non-participation, laxity, laziness, and depression. Tendency of students to this color is a sign of physical and mental fatigue and crisis. Happy colors should be used to bring them back from this situation.

thusiasm. The effect of using different colors in educational spaces is presented in Table 2.

Psychologists believe that the color of objects, environment, and people's clothes has a direct effect on communicating with them. Therefore, as long as the students cannot match themselves with the color of classroom environment, the objects within it, professor's clothes, etc., they wouldn't be able to enjoy being in class and feel it comfortable (Mortazavi, 1997). Color has significant effects on the moral and behaviour of users of the spaces and highly affects their psychological and emotional states (Lusher, 2010). A color creating joy and mirth in the students can create a sense of belonging to the environment as well (Piaget and Inhelder, 1992). According to the literature, physiological effects of inappropriate colours might cause muscle cramps, rapid breathing, increased heart rate and blood pressure, and disturb mental activities. Decreased reac-

tion and disturbance in actions may occur in case of using incongruent combination of colors (Mortazavi, 1997).

Research Methodology

This study is primarily conducted using descriptive-analytical method. First, the research path was specifies by analyzing literature content. Then, systematic search in library studies and valid internet databases were used to collect data. Extracting the requirements and needs precisely defined the study, following which the variables were quantitatively investigated using a 16-question questionnaire in Likert scale. The results indicated significant effect of using different colors in educational spaces. The questionnaire was developed by using information obtained in the study; then, the questionnaire was initially distributed among 10 students to determine internal consistency of data and eliminate inappropriate questions. The final questionnaire con-

Table 3. Details of demographics data

Variables	Frequency	Frequency percentage (%)
Gender		
Male	25	50
Female	25	50
Age		
20-25	20	40
26-30	14	28
Upper Than 31	16	32
Education		
Diploma	17	34
Bachelor	29	58
Master	4	8

tained 16 questions. Next, samples were recruited among 1500 students of Andish Negar Mehrgan Software Training Center, Isfahan. Randomly, 50 students (50% male and 50% female) were recruited and questionnaire was distributed among them. Samples are all students of architecture and have sufficient information on quality of space and environment. Finally, frequency of responses and colors considered by students were used to analyze and classify the best colors and their composition for training centers. The data was collected in one set. This study is Cross-sectional research. The data was collected in one set. This study is Cross-sectional research. Cross-sectional research studies are based on observations that take place at one time. This means there is no experimental procedure, so no variables are manipulated by the researcher. Instead of performing an experiment, we would simply record the information that you observe in the groups you are examining. Because of this, a cross-sectional research study can be used to describe the characteristics that exist in our statistical population. Moreover for the normality testing of the data Shapiro-Wilk test and Kolmogorov-Smirnov test is used. The p-values of these two tests aren't significant in 0.05 level. Thus, we can conclude that the data comes from a normal distribution.

RESULTS

The study findings showed that 50% of respondents were women and 50% men. The study findings showed that 34% had diploma, 58% bachelor, and 8% had master. The study findings showed that those 20-25 years were 40%, 26-30 years 28% and upper than 31 years 32% of study population (Table 3).

A five-item Likert scale questionnaire was designed to achieve reliable results in this study using the information and data of previous studies. The study was performed in a software training with center (Andish Negar Mehrgan) in Isfahan City. This complex is located in the neighborhood of Si-o-seh pol, and is the second great center of software training across the country. Using this questionnaire, questions were asked from the students under study regarding the accordance and implementation of color in spaces. From their perspective, using colors were not sufficiently influenced in accordance with the whole complex. Therefore, complementary questions about using appropriate colors for the space were added to the end of the questionnaire. The results of this survey are shown in Table 4.

76% of students believed that the colors used in the outer space of classes has a proper combination. Using a combination of white, yellow, orange, and creamy in this environment increased illumination and creates a desirable feeling after learning.

80% of the respondents believed that the colors used in the complex represents its application. It suggested two different approaches. Firstly, the structure of the complex, defined in accordance with an educational structure with middle communication space, helped this feedback. Secondly, using light colors in all spaces, caused dynamism and liveliness among the people. It seemed that this level of results wouldn't have been achieved if the spaces and arrangements were not in its present form and if change of use of residential spaces would have been was used for educational applications.

All respondents believed that some of the colors

Table 4. Questions used in Likert scale and the obtained results

S. No.	Likert scale questions	Totally agree	Agree	No idea	Disagree	Totally disagree
1	The colors used for outer space of the classrooms has a proper combination.	0	38	2	10	0
2	The colors used in the complex represent their application and objectives.	10	30	0	5	5
3	Some colors shouldn't have been used.	40	10	0	0	0
4	More colors should have been used.	50	0	0	0	0
5	You feel more excited after entering the complex.	0	0	0	40	10
6	The colors used in the complex and its surrounding environment create a sense of belonging.	0	0	0	0	50
7	The color of the campus is warm and welcoming.	20	30	0	0	0
8	The color used in cafeteria is warm and causes delight when eating snack.	35	15	0	0	0
9	The color used in the communication space increases excitement.	0	10	10	30	0
10	The color of the interior space is selected in accordance with objectives of the institute.	0	0	0	25	25
11	You will always remember the events happened inside the classrooms.	0	0	0	30	20
12	Combination of yellow and white colors is suitable for the class.	35	5	0	3	2
13	Combination of purple and white colors is suitable for the class.	25	10	0	5	0
14	Using green color is suitable for the class.	30	20	0	0	0
15	Using bluish purple color is suitable for the class.	10	10	5	15	10
16	Using blue combined with another color is suitable for the class.	33	12	0	3	2

used in the complex are totally unacceptable. This issue can be considered in complementary investigations. Although all colors had a specific and suitable range, finally some locations didn't have a desirable color and was partially unacceptable.

All respondents believed that more colors should be used in the complex. It showed that despite the relative satisfaction from the colors used, they still do not meet the dynamic behavior of the students and there is a need for more drivers.

All respondents believed that they don't feel excited when entering the complex. Given the objectives defined as the center of training specialized in software engineering at Isfahan city (Iran), it might be unacceptable to induce a sense of dynamism and excitement in the students, but the approach of using colors can be a

little changed in the publication section due to the tumultuous atmosphere prevailing and different activities performed in it.

All people believed that the color used in the campus and cafeteria has been selected in accordance with its application, and gave a good grade to it. According to the application of this space, the only factor that can be considered limiting is that the space specified doesn't have enough capacity for students and visitors, and it could have been changed to some extent.

Questions 9, 10, and 11, defined about the color used in the interior space and communication spaces between the classes, indicated that there are some problems in defining these spaces. These problems are so that they prevent students to have a sense of excitement

Table 5. Evaluation of the level of desirability and undesirability of questions

S. No.	questions	Ttest	DF	Sig	status
1	The colors used for outer space of the classrooms has a proper combination.	4.83	49	0.001	Desirable
2	The colors used in the complex represent their application and objectives.	6.93	49	0.001	Desirable
3	Some colors shouldn't have been used.	5.96	49	0.001	Desirable
4	More colors should have been used.	6.52	49	0.001	Desirable
5	You feel more excited after entering the complex.	-7.11	49	0.001	Undesirable
6	The colors used in the complex and its surrounding environment create a sense of belonging.	-8.32	49	0.001	Undesirable
7	The color of the campus is warm and welcoming.	4.02	49	0.001	Desirable
8	The color used in cafeteria is warm and causes delight when eating snack.	3.96	49	0.001	Desirable
9	The color used in the communication space increases excitement.	-6.41	49	0.001	Undesirable
10	The color of the interior space is selected in accordance with objectives of the institute.	-12.65	49	0.001	Undesirable
11	You will always remember the events happened inside the classrooms.	-4.38	49	0.001	Undesirable
12	Combination of yellow and white colors is suitable for the class.	5.68	49	0.001	Desirable
13	Combination of purple and white colors is suitable for the class.	5.23	49	0.001	Desirable
14	Using green color is suitable for the class.	4.74	49	0.001	Desirable
15	Using bluish purple color is suitable for the class.	2.23	49	0.96	Equal to average
16	Using blue combined with another color is suitable for the class.	5.63	49	0.001	Desirable

and dynamism by being in the environment. Therefore, complementary investigations were allocated to suitable colors for the spaces. In this regard, the appropriate colors extracted from the literature were investigated to be used in the spaces. The results indicated that using yellow combined with white, green and its spectrum, blue combined with another color, and a combination of purple and white is more suitable for educational objectives of the complex, and can be suggested for using it in the future building. One sample T test has been used for evaluating the status of questionnaires in this study (Table 5). The results of the analyzed data showed that colors used for outer space of the classrooms has a proper combination and colors used in the complex represent their application and objectives. Moreover, the results showed that color of the campus is warm and welcoming and the color used in cafeteria is warm and causes

delight when eating snacks. Also, combination of yellow with white and purple with white colors is suitable for the class.

DISCUSSION

Analyzing the questions used indicated that the colors used in the complex are relatively acceptable. However, considerable dissatisfaction of students in different sections cannot be neglected. The goal of an educational structure must be evident from its outer space as well, a point that no proper planning has been made for it in this complex. The students believed that the number of colors used are not suitable, and they suggested that the number of colors should increase depending on different and specifies objectives and requirements.

Analyzing research questions is as important as

direct observation and understanding the information resulted. Using red color at the entrance and campus can initially attract attention. This color represents entertainment and excitement. The studies conducted by indicated that the color exiting and provocative (Kwallek, 1998). Using warm colors, such as red and yellow, have also been suggested by other researches for increasing they suggested that dynamism. These that color can boost the five senses in human beings by five percent (Spence et al., 2006).

The sixth question implied induced dissatisfaction to the users from the color of the outer environment as an attractive and memorable color. Different researchers believed that outer environment must simultaneously have the changes in color, saturation, and brightness. In this regard, using cold and warm colors in succession, together with a filling color, could solve this problem to a great extent (Mahnke, 1996).

Although the results of this study examined many theories and findings of previous researches and emphasized on them, it showed that psychological characteristics and effects of color on people's behavior are significant.

Recommendations:-

The following recommendations can be made based on the findings of this study and its results:

1. The need for balance, complexity, and unity in educational spaces are one of the main concerns of designers. Using attractive colors and making color contrasts in the outer space, and the need for joyful colors in the inner spaces should always be considered. This approach can differ from designed outer spaces and implementing various paintings in them to simple and immaculate spaces, in which only white color is used.
2. Inner surface with simple colors used in the complex have to be modified, and the color recommendation have to be implemented in them.
3. The need to understand the effect of colors on each of them provided for the users and students are criti-

cal for a successful architecture. In most cases, using common colors and combining them with colors in accordance with the environment can enhance the performance of that space.

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