

Assessing the Role of the Visual Comfort Components in the Sense of Belonging to the Place of the Students; Case Study: Shahroud University of Technology*

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ABSTRACT

Attachment and sense of belonging are among the most fundamental human needs to interact with space. Emotional interaction with the place makes the place meaningful and improves the quality of experiencing the place. The academic spaces are among the places where the existence and improvement of the sense of belonging to the place can enhance educational quality. One of the significant physical variables in educational spaces is visual comfort. In this regard, the present study evaluated the role of the visual comfort components in the students' sense of place. Nine classrooms among three faculties of the Shahroud University of Technology were selected for evaluation. The main criteria included glare, brightness intensity, luminance intensity, and color rendering. A researcher-made questionnaire was filled by 385 students and analyzed using Spearman's Correlation coefficient in the SPSS20 software. The results show that out of 75 components related to visual comfort, 24 components significantly correlated with the sense of belonging to a place. Chair and its improper layout (-0.147) had the highest share in explaining the sense of belonging to a place, and light (0.086), window (-0.082), and non-physical factors (0.0287) ranked next. It indicates that although the building orientation seems effective at first glance, it ranks the last in the mental perception of the individuals, and the chair layout and the view to the board are of higher importance. The layout and importance of the chair are not only due to the view to the board, but it is more related to the difference in the light indicators in the different places of the classroom, affecting the individuals' mental perception.

Keywords: Sense of Belonging to Place, Visual Comfort, Mental Perception, Academic Space.

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1. INTRODUCTION

Attachment and belonging are among the fundamental human needs that have various aspects and manifestations. Environmental psychologists have considered the place, and the importance of the emotional, cognitive, and behavioral interaction between the human and the place has been studied (Salimi, 2009; Pirbabaei, Gharebaglou, & Alinam, 2015). Sense of belonging to a place has various aspects, one of which is the physical environment of the place. Light is one of the physical indicators of the place, and the human being receives the most information of the external world through eyesight and the light (Alfone, 2009, p. 255). The degree of light and its color is not always equal to their physical and measurable values, and various applications of the light with intensity, color, angle, etc., have a particular effect on the different individuals' perception of the place and its resulted behavior, which may not always be similar in the people. One of the criteria to study the quality of the light is Visual Comfort Perception (VCP). This index shows that what percentage of the people exposed to the light emitted from the lamp feel uncomfortable (Dehghan, 2008, p. 15). Observing the light comfort in the space is one of the requirements to achieve the excellent purposes of the lighting, and the audience of the place will feel positive effects of the space and architecture on his psyche and efficiency in doing tasks in case of having light comfort. Light comfort and the degree of the light received from the windows and openings of the building depend on the dimensions, shape, depth of the window, and glass stain (Alfone, 2009, p. 15). Increasing and creating a sense of belonging in the academic spaces leads to establishing a relationship and connecting the students to the proper academic space. The inappropriate usage of this light might cause issues, such as glare in performing visual tasks in the classrooms. The light must be studied in terms of the type of studying space. Indeed, various components (Mofidi Shemirani & Pournaseri, 2011, p. 31) affect the visual comfort of the students that, in turn, affect their sense of belonging to a place. In this regard, is there a significant relationship between the components of visual comfort and a sense of belonging to a place?

Furthermore, which components have the maximum effect on mental visual comfort? Are raised as the research questions. The effective indicators were extracted using the library studies to answer the research questions. Then, the mental perception of the students of the criteria of the light comfort and sense of belonging to a place in the study area using a questionnaire.

2. LITERATURE REVIEW

The present research is based on visual comfort and the sense of belonging to a place. In other words, visual comfort can be considered the sub-components of the

sense of belonging to a place.

2.1. Research Theoretical Framework

The current study deals with the sense of belonging to a place and visual comfort. A sense of belonging to a place is created following the sense of the place. Indeed, a sense of belonging to a place is a higher level of the sense of place that plays a determining role in human usage and constant presence (Falihat, 2006, p. 37). The sense of belonging to place links the person and the place, in which the human considers himself a part of the place and imagines a role for it in his mind based on his experiences of the signs, meanings, functions, and personality of the place, and respects it (Steele, 1981). Thus, a sense of belonging to a place is an intricate combination of the meanings, symbols, and environmental qualities perceived by the person consciously or unconsciously of a particular place. This concept, which is mainly based on the emotional relationship between the individual and the environment, is manifested as a physical manifestation in the design (Javan Forouzandeh & Motalebi, 2011, p. 33). Indeed, the first analytical level in studying the belonging of the perception is how sensory perception is added to a particular place by the individuals to create something, which is called a sense of belonging to a place (Antonich, 2010). In the recent two decades, the concepts of attachment and belonging of humans and place have been increasingly considered (Daneshpour, Sepehri Moghadam, & Charkhchian, 2009, p. 38). The physical aspect can include numerous variables based on the research subject and purpose. Light is one of the physical aspects of the place, creating various qualities. Visual comfort is of qualities that can affect the general spatial quality of a place and, in turn, affect the sense of belonging to a place. Jakubiec and Reinhart defined visual comfort as the lack of discomforts, such as glare, insufficient contrast, or the direct light of the sun (Jakubiec & Reinhart, 2013).

2.2. Research Background

Numerous studies have been conducted on a sense of belonging to a place due to its importance. These studies investigate the sense of belonging from the urban scale (Gorgul, Luo, Wei, & Pei, 2017; Hung Ng, Kwong Kam, & Pong, 2005) to the architectural spaces (Rezaei Sharif, Ghazi Tabatabaei, Hejazi, & Ejei, 2012). Some studies stated the physical factors of sense of belonging to place separately. The results of the research conducted by Javan Forouzandeh and Motalebi showed that the physical features, such as form (color, dimension, shape, and scale), and the interrelationships of the physical elements by providing and emphasizing the social activities of the environment play a significant and influential role in the formation of the sense of belonging. Maleki et al. indicated that the degree of sense of belonging to a place depends on the security in that place, physical characteristics, the effects of that place on the mental

perceptions, and the persistence of these imaginations that by the change of each of these factors, the sense of belonging to place of the individuals will vary (Maleki, Parsa, Vasigh, & Moradi, 2014). Bidikar et al. evaluated the visual comfort regarding the light in adjacency with the bed in the inpatient wards of the hospitals in India. A researcher-made questionnaire was used to assess 136 adult patients who visited at least three stated hospitals. 72% of the patients were satisfied with the daylight, and 68% expressed their satisfaction with the artificial light. Dissatisfaction was mainly related to the high intensity of light, glare caused by the brightness of the light resources and reflector plates, the point form of the light in specific places in the room, particularly close to the windows (Bidikar & Bidikar, 2013). Jakubiec and Reinhart, in their paper entitled “Predicting Visual Comfort Conditions in Large Daylight Space Based on Long-term Occupant Evaluations: A Field Study,” investigated three criteria of visual comfort, i.e., discomfort glare, the ratio of the contrast between the monitor and the direct sunlight.

The students were asked to determine their preferred chairs based on the visual comfort from a map in which the chairs were coded. The students classified their comfort into four groups for each interval (8 AM to 12 PM, 12-2 PM, and 2-6 PM): comfortable, perceptible discomfort, undesirable discomfort, unbearable discomfort (Jakubiec & Reinhart, 2013). Chao also studied the daylight and its effects on some classrooms in Beijing. The results showed that the issues of the selected samples were serious, and some samples were far from the state standards (Chao, 2006). In a paper entitled “Learning, Lighting, and Color: Lighting Design for Schools and Universities in the 21st Century”, Fielding studied the uniform brightness levels in the classrooms. The results showed that the concentrated light on the whiteboard creates a good feeling (Fielding, 2006). Although many studies have been conducted on a sense of belonging to place and visual comfort, some were presented in Table 1 to clarify the indicators and methods.

Table 1. Concluding Various Researchers’ Opinions

Area	Researcher	Subject	Methods, Tools, Indicators
Sense of Belonging to a Place	(Peters, Sodolska, & Horolets, 2016)	Role of the natural environments in increasing the sense of belonging	Method: in-depth interviews- Content analysis of data Indicators: sub-indicators of the memorability and meaning
	(Gorgul et al., 2017)	Sense of belonging Concluding Various Researchers’ Opinions to a place in urban spaces	Method: Descriptive, Phenomenology Case study
	(Javan Forouzandeh & Motallebi, 2011)	Concept of sense of belonging to the place and its constituent factors	Method: Cognitive Research Indicators: Physical Criteria of form, Including Color, Dimension, Shape, and Scale
	(Saraei et al., 2016)	The sense of belonging to place of the residents of the old texture	Method: A Descriptive-analytical Field Study Tool: Questionnaire Indicators: Satisfaction with the Facilities, Environmental Features, and Social Characteristics
	(Maleki et al., 2014)	Sense of belonging to place: an approach to the gender differences	Method: Documentary, Field Study Tool: Questionnaire Indicators: A Sense of Security, Physical Characteristics, Meaning Stability
	(Heidari et al., 2014)	Sense of belonging to a place in the traditional houses and residential complexes	Method: Descriptive-analytical Indicators: Texture and Decorations, Shape and Size, Relations and LLayout
	(Hung Ng et al., 2005)	People Living in Ageing Buildings: Their Quality of Life and Sense of Belonging in China	Tool: 5-100 Point Scale Questionnaire Indicators: Mechanic Belonging, Degree of Belonging, Individual Identification, and Pride as a Citizen from Hong Kong
	(Sarmast & Motavaslli, 2010)	The role of place scale in the sense of belonging to a place	Tool: Semantic Differential Scale Indicators: People’s Satisfaction, People’s Perception of the Different Elements of a Place
	(Rezaei Sharif et al., 2012)	School-students link	Method: Interview Components of belonging: Organizational attachment, attachment to the teachers, Attachment to the school staff, Occupation in the school, Belief in the school, and Commitment to the school

Area	Researcher	Subject	Methods, Tools, Indicators
Visual Comfort	(Bidikar & Bidikar, 2013)	Visual comfort In the inpatient ward of a hospital	Method: Qualitative quantitative Tool: Questionnaire, Simulation of daylight, and Photometer device Subjective indicators: Satisfaction with daylight and artificial light Objective indicators: Light intensity (lux)
	(Jakubiec & Reinhart, 2013)	Predicting Visual Comfort Conditions in Large Daylight Space	Method: Quantitative and qualitative analyses Tool: Questionnaire, Daylight simulation of Radiance Subjective indicators: Discomfort glare, the Ratio of contrast, and Direct sunlight Objective indicators: Luminous Intensity
	(Aries, 2005)	Lighting in the commercial buildings in the Netherlands	Method: Evaluating the light that the retina receives, Questionnaire Indicators: The Degree of brightness
Educational Spaces	(Mofidi Shemirani & PourNaseri, 2011)	The effect of the physical variables of the window on the optimal usage of the daylight	Tool: Researcher-made Questionnaire
	(Winterbottom & Wilkins, 2008)	The light and lack of comfort in the classrooms of England	Indicators: The landscape and its effects, Glare, The quality of lighting, and non-visual effects of window
	(Fielding, 2006)	Lighting design for schools and universities	Tools: Photometer and questionnaire
	(Chao, 2006)	Daylight in the classrooms	Indicators: Optical discomfort, Glare, The luminance ratio

3. RESEARCH METHODOLOGY

Three faculties of the Shahroud University of Technology were selected as case studies to evaluate the effect of the indicators of visual comfort on the sense of belonging to the place of the students. The reason for selecting three faculties was the type of classrooms and the amount of time that the students spend in them. The faculties were selected to minimize the effect of the irrelevant factors with the light indicators, and the student has spent the maximum amount of the time in that due to the educational reason. The considered spaces of the classrooms of the three faculties were selected considering the stated characteristics. The statistical population included all the students in the various faculties of the Shahroud

University of Technology. There are currently 7721 students in this university, among which 364 students were selected as case studies based on Morgan's table. The questionnaire was used to evaluate the individuals' perceptions. This questionnaire was the researcher-made and consisted of three main parts. The first part evaluated the sense of belonging to the place of the totality of the space. The second part assessed the criteria of visual comfort. The components and sub-criteria studied in the previous research presented in Table 1 were extracted, and the influential factors in the criteria were explained in detail using architectural analysis by the researchers. The main criteria of visual comfort are glare, luminance intensity, brightness intensity, and color rendering.

Table 2. Concluding Various Researchers' Opinions

Components of Sense of Belonging to A Place	Sub-Criteria		Influential Factors
Sense of Belonging as The Students of Shahroud University of Technology	Feeling Proud		The Individual and Collective Pride
	Sense of Belonging to the Place		Tendency to Be Present in the Place and Interest in the Place
	Collective and Individual Identification		Recognizing Oneself by the Space and Attributing Oneself to a Particular Social Group
Physical Factors	The Desirability of the Physical Factors	Window	The Height of the Window from the Ground, The Dimensions of the Window, The Layout of the Window and Skylights, Being Vertical or Horizontal, The Ratio of the Window to the Surface, The Type of Glass, The Transparency of the Glass, The Connection between Window and the Board, Being Anti-Light
		Room	The Depth of the Room, The Radiation Barriers, Such as Curtain, Type, and Brightness of the Floor, The Motifs of the Floor, The Proportions of the Space, The Distance of the Chairs from The Board, The Height of the Room, and the Materials of the Walls

Components of Sense of Belonging to A Place	Sub-Criteria	Influential Factors
	Board	Orientation of the Board, The Height of the Board from the Ground, The Color of the Board
	The Possibility to Perform Various Activities	Chair
	(Moving in the Spaces, Reading, Sitting, Seeing the Board, Working with Computer, Manual Design)	Light
	Non-Physical Factors	Facilities (Heating and Cooling), Audio and Visual Facilities, Different Seasons, Heating of the Space in the Summer, and Coldness of the Space in the Winter.

4. FINDINGS

The results obtained from the questionnaire were analyzed and studied in several sections. In the first step, the validity test was performed for all items to investigate the significance of the research items. Then, the correlation test was applied according to the significance and type of normal or non-normal distribution.

4.1. Validity and Reliability of the Questionnaire

Cronbach's alpha test was used to study the validity of the questionnaire. According to Table 3, it was revealed that the Cronbach's alpha value among the items was 0.867, indicating acceptable validity of the questionnaire. Bartlett's test and KMO coefficient were also used to study the data's reliability and sufficiency.

Table 3. The Coefficients of Bartlett's Test and KMO to Determine the Reliability of the Questionnaire

The Kaiser-Meyer-Olkin test	0.807	
Bartlett's test of sphericity	Approx, Chi-square	8298.581
	Df	1653
	Sig	0.000

According to Table 3, KMO equals 0.897 at the significance level of sig=0.00, indicating the relatively good values of the data suitability (higher than 0.6). KMO coefficient was higher than 0.4 for all the items, indicating that all the items enjoyed the minimum suitability for the reliability of the questionnaire.

4.2. Normality Test of Variables

The common way to test the normality of the quantitative and rank data distribution is the Kolmogorov-Smirnov test. If the null hypothesis's significance test (error percentage lower than 0.05) (assuming the normal distribution of the data) is rejected, the distribution will not be normal. The results showed that the distribution

is not normal.

4.3. Correlation Test of the Variables

Since the studied variables enjoyed the non-normal distribution, Spearman's correlation coefficient was applied to analyze. Given that the current study aimed to investigate the relationship between the dependent variable (sense of belonging to place) and independent variables (criteria of visual comfort), the correlation between these two variables has been only studied. According to Table 4, a few indicators were significant at the significance level of 0.05 and 0.01, as presented in Table 5.

Table 4. Correlation Coefficients of the Independent Variables of Visual Comfort and the Dependent Variable of Sense of Belonging to a Place

Significance (2-Tailed)	Correlation Coefficient	Spearman	Significance (2-Tailed)	Correlation Coefficient	Spearman
0.006	-0.164**	Q34	0.000	0.323**	Q4
0.348	-0.056	Q35	0.000	-0.231**	Q5
0.432	-0.047	Q36	0.126	-0.091	Q6
0.584	-0.033	Q37	0.001	-0.205**	Q7
0.640	-0.028	Q38	0.000	0.239**	Q8
0.000	-0.254**	Q39	0.004	-0.172**	Q9
0.001	-0.192**	Q40	0.000	-0.232**	Q10

Significance (2-Tailed)	Correlation Coefficient	Spearman	Significance (2-Tailed)	Correlation Coefficient	Spearman
0.021	0.137*	Q41	0.001	*0.198**	Q11
0.013	-0.147*	Q42	0.00	-0.243**	Q12
0.800	-0.015	Q43	0.397	-0.050	Q13
0.790	-0.016	Q44	0.279	0.064	Q14
0.196	-0.077	Q45	0.716	-0.022	Q15
0.000	0.220**	Q46	0.068	-0.108	Q16
0.751	-0.019	Q47	0.03	0.177**	Q17
0.217	-0.073	Q48	0.183	-0.079	Q18
0.890	0.008	Q49	0.000	-0.243**	Q19
0.916	-0.06	Q50	0.341	-0.056	Q20
0.000	0.222**	Q51	0.041	0.121*	Q21
0.486	0.041	Q52	0.001	-0.198**	Q22
0.934	0.005	Q53	0.939	-0.005	Q23
0.441	-0.046	Q54	0.794	-0.016	Q24
0.002	0.186**	Q55	0.636	0.028	Q25
0.001	0.202**	Q56	0.236	0.070	Q26
0.000	-0.218**	Q57	0.426	0.047	Q27
0.984	-0.001	Q58	0.103	0.097	Q28
0.274	0.065	Q59	0.315	-0.084	Q29
0.000	0.308**	Q60	0.394	-0.051	Q30
			0.137	-0.088	Q31
			0.749	-0.019	Q32
			0.001	-0.201**	Q33

*Correlation is Significant at the 0.05 Level (2-Tailed)

** Correlation is Significant at the 0.01 Level (2-Tailed)

Table 5. Correlated Indicators at the Significance Level of 0.05 and 0.01

Indicator	Correlation Coefficient	Significance Level
Reducing the Glare by the Proper Color of the Curtain and Sense of Belonging to a Place	0.121	0.05
The View to the Board Due to the Proper Height	0.137	0.05
The Lack of View to the Board Due to the Chair Layout	-0.147	0.05
The Lighting Due to the Proper Height of the Window	0.323	0.01
Glare Due to the Height of the Window	-0.231	0.01
Glare Due to the Dimensions of the Window	-0.205	0.01
The Sufficient Lighting to the Window Layout	0.239	0.01
The High Glare Due to the Window Layout	-0.172	0.01
The High Luminance Due to the Window Layout	-0.232	0.01
The Window to Inner Surface Ratio and Sense of Belonging to a Place	0.198	0.01
The High Luminance Due to the High Window to Inner Surface Ratio	-0.243	0.01
The Proper Depth of the Room to the Placement of the Windows	0.177	0.01
Creating Glare Due to Improper Depth of the Room to the Placement of the Windows	-0.243	0.01
Luminance Due to the Material of the Curtain	-0.198	0.01
Luminance Due to the Height of the Room	-0.201	0.01
Discomfort Light or Low Light Due to the Building Orientation	-0.164	0.01
Luminance Due to the Building Orientation	-0.254	0.01
Light Reflection Due to the Improper Location of the Board	-0.192	0.01
Proper Lighting of the Lamps Due to the Light of The Lamps	0.22	0.01

Indicator	Correlation Coefficient	Significance Level
The Proper Lighting Due to the Number of the Lamps	0.222	0.01
Sitting Beside the Window in Summer Due to the Warmth of the Sun	0.186	0.01
Sitting Beside the Window at the Winter	0.202	0.01
Creating Glare Due to the Color and Materials of the Wall	-0.218	0.01
Real Color Visibility	0.308	0.01

5. DISCUSSION

The current research aimed to analyze the influential factors on visual comfort in the students' sense of belonging to a place. In this regard, the optical and non-optical indicators and components affecting visual comfort were determined. Then, using a researcher-made questionnaire, the students' mental perception was investigated. In terms of the studied optical criteria, the current research was relatively similar to the study conducted by Jacubiec et al. (2013), Mofidi Shemirani and Pournasari (2011, Winterbuttom and Wilkins (2008). However, what distinguishes the current research from other conducted studies is the classification of the optical indicators regarding the

physical and non-physical factors of the place and evaluating the effect of these factors on creating or enhancing the sense of belonging to a place, which has been less studied in the previous research. Two main questions of the research were raised. The first question was whether there is a significant relationship between the components of visual comfort and a sense of belonging to a place. Out of 57 components of visual comfort, 24 components had a significant correlation with the sense of belonging to a place, as presented in Table 5. Given that each sub-indicator belonged to a group of factors, the significant indicators at the level of 0.01 and 0.05 were placed and studied in their related class. The correlation average for these indicators was calculated and presented in Table 6.

Table 6. The Average of the Correlation Coefficients of the Visual Comfort at the Spatial Classes

Component	Window	Room	Building	Board	Chair	Light	Non-Physical Factors
The Average Value of Correlation	-0.082	-0.01	-0.0148	-0.005	-0.147	0.086	0.0287

However, to answer the second question that what criteria have the most impact on the sense of belonging, given Table 6, inappropriate chair and its layout (-0.147) had the highest share in explaining the sense of belonging to a place, and light (0.086), window (-0.082), and physical factors (0.0287) ranked next, respectively. It indicates that although the building orientation seems to play a determining role at first glance, it is considered the last at the mental perception of the individuals, and chair layout and view to the board are of higher importance. Indeed, Jakubiec and Reinhart (2013) also studied the role of the location and selection of the preferred chair and analyzed three criteria of the discomfort glare, the ratio of the monitor contrast, and direct light. According to their research and comparing that with the result of the present study, it can be understood that the location and importance of the chair are not because of the view to the board. However, it is primarily due to the difference in the quality of the visual indicators in different classes affecting the individuals' mental perception. It seems that if the layout of the chairs were based on the required visual comfort, the mental satisfaction and sense of belonging to the place would have been increased. The lights and the artificial lighting ranked second, and the change in the qualities of the artificial lighting can affect the sense of belonging to a place. The window also ranked third.

6. CONCLUSION

The present research aimed to assess the role of the components of visual comfort in the students' sense of belonging to a place. The results of analyses showed a significant relationship between the indicators of visual comfort and a sense of belonging to a place. The optical conditions at any part of the room are affected by various factors, such as the number and luminance of the lights, the lighting from the window, the location in the room, etc. The findings indicated that one of the user's priorities to select the proper visual conditions is the location of the chair as the individuals cannot change the visual conditions; Since it is only possible to adjust the lighting from the window by the curtain and the number and the luminance of the lights are fixed. The following important factor was the light. It indicates that the more students are free to change and set the visual factors, the more their sense of belonging to a place. Considering that the lighting from the window and its shading is manual and mechanical in the studied area, it has had a more mental and perceptual load on the audience. The importance of the window may be lower, and the mental and perceptual load will be less if there is the possibility for the electronic and remote control of the lighting and shading of the window. How the mechanical or electronic settings of the lighting and shading affect the sense of belonging to a place can be the research subject for future studies.

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