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Effective Environmental Factors on Designing Productive Learning Environments

Hamidreza Azemati[1*], Zinat Aminifar[2] and Somayeh Pourbagher[3]

[1] Professor of Architecture, School of Architecture and Urban Design, Shahid Rajaee Teacher Training University, Tehran, Iran.

[2] Ph.D. Student of Architecture, School of Architecture and Urban Design, Shahid Rajaee Teacher Training University, Tehran, Iran.

[3] Ph.D. Student of Architecture, School of Architecture and Urban Design, Shahid Rajaee Teacher Training University, Tehran, Iran.

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ABSTRACT: Educational spaces play an important role in enhancing learning productivity levels of society people as the most important places to human train. Considering the cost, time and energy spending on these spaces, trying to design efficient and optimized environment is a necessity. Achieving efficient environments requires changing environmental criteria so that they can have a positive impact on the activities and learning in users. Therefore, creating suitable conditions for promoting learning in users requires full utilization of the comprehensive knowledge of architecture and the design of the physical environment with respect to the environmental, social and aesthetic dimensions; Which will naturally increase the usefulness of people in space and make optimal use of the expenses spent on building schools and the time spent on education and training.The main aim of this study was to find physical variables affecting on increasing productivity in learning environments. This study is quantitative-qualitative and was done in two research methods: a) survey research methods (survey) b) correlation method. The samples were teachers and students in secondary schools' in Zahedan city, the sample size was 310 people. Variables were extracted using the literature review and deep interviews with professors and experts. The questionnaire was obtained using variables and it is used to collect the views of teachers and students. Cronbach's alpha coefficient was 0.89 which indicates that the information gathering tool is acceptable. The findings shows that there are four main physical factor as: 1. Physical comfort, 2. Space layouts, 3. Psychological factors and 4. Visual factors thet they are affecting positively on space productivity. Each of the environmental factors play an important role in improving the learning quality and increasing interest in attending learning environments; therefore, the desired environment improves the productivity of the educational spaces by improving the components of productivity.

Keywords: Space Productivity, Educational Space, Learning, Attendance.

INTRODUCTION

One of the effective factors in the process of modern education is how to define the physical criteria of the educational environment. In the other words, there is a positive relationship between the physical dimensions of the architectural space and productivity of the users. Physical conditions of the environment greatly affect the efficiency and effectiveness of individual and group learning.

During their studies, people spend a great deal of their time in educational spaces and schools; so providing physical and psychological comfort for users during school time is necessary. Lack of attention to users' needs in design of educational spaces will disrupt the growth and academic achievements; so, schools should be considered actively to achieve optimal performance. Achieving efficient environments, is the need to change the criteria, so users can have a positive impact on active participation and learning.

Environmental psychologists believe that physical factors have an undeniable impact on human thoughts and

* Corresponding Author Email: Azemati@srttu.edu

behavior. Creativity and innovation of architects has an impact on diversity of architectural spaces in schools, but there are many students that refuse to go to school or they don't want to spend hours in school. Users' satisfaction in the higher educational environment is critical for gaining self-confidence and flourishing their potential capabilities and also it has an effect on schools' efficiency (Azemati & Pourbagher, 2018).

Issues related to the physical environment has always been considered from the perspective of environmental psychology and referred to as a container that human behavior and interaction takes place and responses to users' mental and physical, psychological comfort- physical needs. Regardless of this, the space can cause major damages to human physiological and psychological needs (Lang, 2012). The architecture and physical education classes play an important role in the quality of students' educational activities and process. Designers and architects have turned to interdisciplinary approaches in order to identify the meanings and feelings the environment and to identify gaps in environmental design disciplines (Javan Forouzandeh & Motallebi, 2012).

Also considering the factors that increase the sense of vitality in educational environments and delivering practical solutions to enhance the feeling of vitality and subsequently improve the quality of the educational environment through architectural design is important. Structural factors, Environmental factors, Psychological factors and Social factors are the main factors in this field (Azemati et al., 2017).

The physical environment is designed in such a way that obstructs the learning process although researches have established a close correlation between the amount of work individual do and its physical environment. It stands to reason that a student sitting in an insufferably hot airless room listening to a lecture on cryogenics would not learn as much as he would in a cool comfortable space. Unfortunately, college buildings are designed to attract people from outside while they fail to provide a safe and comfortable internal atmosphere for students. There is a significant effect of classroom physical environment on the academic achievement scores of secondary school students. Well-equipped classroom with physical facilities has a significant positive effect on the academic achievement scores of secondary school students. If the students feel comfortable within classroom, then they will have much concentration on the lessons taught to them and that is why they will get more information from the teachers and thus they will obtain high scores (Suleman & Hussain, 2014, p. 80).

Considering the assessment of learning environments and classrooms in our country, what has often been neglected in these spaces is less paying attention to the needs of users in designing. Currently, most schools are out of shape.

In building of these schools, the impact of environmental factors, such as climate and socio-cultural factors are ignored, which in turn creates an inappropriate environment for learning.

Failure to achieve physical and psychological comfort in schools causes students to fatigue in the school environment and decreases the inclination rate of willingness to attend school. This issue has been affected on the helpful presence of users at school and disrupted the process of growth and academic achievement and finally results in wasting time and costs.

The purpose of this study is to find the physical variables that affect the productivity of educational spaces.

Main research questions:

• What are the physical criteria of a productive learning environment?

• Does the changing physical environment affect the student learning?

• Can changing the physical environment increases the duration of student attendance in the educational environment?

THEORETICAL FRAMEWORK OF RESEARCH

Environmental psychologists believe that physical factors have an undeniable impact on human thoughts and behavior. Architectural spaces together with other education factors have significant effects on the student's learning outcomes. Education administrators are always trying to find strategies to increase academic performance of students in the school settings, such as offering different curriculum options, different methods of teaching, better teachers, smaller classes, tutoring after school and so on. However, the physical environment factors are important and they play a main role on the quality of educational activities. According to the humanistic perspective, the environment in which a person is grown influences personality. A number of researches indicate that physical environment can dramatically influence the efficiency and effectiveness of individual and group learning (Azemati & Pourbagher, 2018, p. 2).

A desirable school with a healthy, safe and secure environment is able to maximize readiness and increase the role of students in promoting public culture and also

provides context to improve the efficiency of resource management in schools (Haji Babaei, 2012, p. 55).

Studies on the effect of the physical environment on training and learning have shown that the environment significantly affects students' academic achievement and their behavior.

Among the environmental factors affecting the productivity of universities, it is possible to highlight the quality of the classes in terms of heat, silence, illumination, furniture, facilities and cleanliness (Musavi, 2006, p. 103).

Earthman refers to seven physical factors of learning spaces that affect student achievement. These factors include temperature and thermal comfort, air quality and ventilation, lighting, sound control, science laboratories, capacity of elementary school students and high school students (Earthman, 2004, p. 10).

The relationship between the conditions of building and the success of students in rural high schools has been reviewed. Students' grades in academic achievement trials have dropped to 5 points in buildings with low quality ratings (Cash, 1993).

Students' academic achievement improves as the school building improves. Building conditions such as brightness, color, temperature, air quality, acoustics, school size and furniture have a significant impact on student behavior and outcomes.

Low light, health and performance of students and the color of attitude, behavior and learning, especially the range of attention and time feelings in students are influential (Fisher, 2000, p. 2).

In the above-mentioned studies productivity has been studied from the perspective of a device and measurement of efficiency scores of students.

A large number of studies indicated that there is a relationship between noise pollution and problems with reading, weakness in skills before reading and most perceptual weaknesses (Higgins et al., 2005). The quality of ambient light affects students' learning. "Another important factor in learning is the proper equipment for heat and cold production, which can lead to a decrease in learning" (Moinpour et al., 2004, p. 4).

The presence of plants in the classroom can improve students' performance and can be used even as an educational tool (Daly, 2010).

Movement and circulation in space, daylight and optimal visibility affects the success of students (Tanner, 2009, p. 381)

Traditional classrooms with tables arranged in several rows disconnects students from having the diverse and flexible groupings that they need (Stone, 2001). So, for improve efficiency in educational environments attention to the environmental conditions, the social-psychological factors, spatial and cognitive factors are more important factors compared with other factors (Azemati & Pourbagher, 2017).

PRODUCTIVITY

Nowadays productivity goes beyond the scope of economic activities and industrial production, and it is inconceivable in other political, social and cultural fields.

"Productivity in the word means production power and fertility and productiveness" (Bahramian, 2011, p. 40).

Productivity is a multi-dimensional term that the meaning of it can be vary depending on the area in which it is used.

Productivity is a kind of way of thinking that every person can do his duties each day better than the previous day (Alwani & Ahmadi, 2001, p. 2).

Productivity in terms of Iran's Productivity Center: A culture, a rational attitude to work that aims to make activities smarter to achieve a better and more active life (Yousefy, 2012).

An educational organization is more effective when it has the right and proper goals to choose and can be achieved; and this organization is efficient when it can use the various sources properly (Mousavi, 2005, p. 44).

Therefore, before examining the productivity of physical education, it is necessary to define the inside data, the process, and outsourcing in the educational spaces. Internal factors include students, teachers, educational tools and most importantly time; and external factors include the ability, learning and performance of students.

School productivity is measured mainly by school spending money (facilities, space, and people) and students' academic achievement.

"School with High-productivity is a school that for every dollar spent on it the success of its students becomes greater "(Hoxby, 2002).

RESEARCH METHODOLOGY

The present research is a fundamental research and is a quantitative-qualitative research. In this study correlation methods have been used, to understand the relationships between variables. The statistical population of the study included all the teachers and students who worked in the academic year of 1394-1393 in Zahedan city.

The sampling method is random, and the sample size is 310 people. Due to the lack of a standard questionnaire, a researcher-made questionnaire was used.

In order to investigate the validity, three methods of formal validity, content validity and validity of the structure of tool has been used.

Formal validity is designated by qualified experts and professors.

For content validity the table of target - content has been used and the instrumental validity was also studied using factor analysis method.

Cronbach's alpha coefficient was 0.89 which indicates that the information gathering tool is acceptable.

FINDINGS

In order to investigate the hypotheses of the research, multiple regression methods have been used in step by step method.

To test the first and second hypotheses standard or simultaneous regression was used. In this method, the effect of a set of environmental variables on the components of productivity has been examined. The environment variable contains the following four groups:

• **Environmental comfort:** Natural light, window, temperature, air quality, acoustic.

• **Visual factors:** Color, scale, visual appearance, materials, visual communication between spaces and nature.

• **Space order:** Circulation, accessibility, flexibility, user interference in space formation, communication between inside and outside space, furniture, open space and roof space, open plan and space layout.

• **Psychological factors:** Safe and relaxed places, environment attractiveness, readability of environment, private space, social environment.

• **The first hypothesis:** Designing educational spaces with respect to the physical environment of the environment can affect the learning of users.

Table 1. Coefficient Regression Results - the Impact of the Environment Variable on Learning

The Significance Level	p	F	t	2 R	R	BETA	b	A	Predictive Variable
0.00	0.01	39.48	6.51	0.11	0.33	0.33	0.10	11.77	Influence of the Environment on Learning

According to the table, the analysis shows that the four environmental factors can predict eleven percent (%11) of the variance of learning.

Achieved value (B = 0.33) is significant on a level of p = 0/01.

Therefore, with 99.9% confidence, environmental factors can predict learning positively.

Y = 11.77+0.10 MY

Second hypothesis: Designing educational spaces with respect to the physical factors can affect on presence in space.

Table 2. Results of Simultaneous Regression Impact of the Environment Variable on Presence in the Space

The Significance Level	p	F	t	2 R	R	BETA	b	A	Predictive Variable
0.00	0.01	55.48	7.51	0.15	0.39	0.39	0.13	10.77	Influence of the Environment on Learning

According to the table, the analysis shows that the environmental factors can predict 0.16 of the variance of presence. (B = 0.40) is significant on a level of p = 0/01.

Therefore, with 99.9% confidence, environmental factors can predict presence in the space positively.

Third hypothesis: Designing educational spaces to improve the level of user learning improves the productivity of space.

The main hypothesis: Designing educational spaces with respect to the physical factors of the environment can affect the productivity of space.

Among the predictive variables, the effect of the environment on learning that has the components of psychological factors, spatial layout, visual factors, and environmental comfort is introduced into the equation as a predictor variable in several steps and were introduced the effect of learning on productivity as a criterion variable.

Table 3. Results of Regression Analysis (Step-by-Step) - Environment Predictor Variables and Learning on Productivity

Second Stage					First Stage					Predictive Variable
The Significance Level	T	BETA	B	A	The Significance Level	T	BETA	B	A	
0.00	4.34	0.29	0.26	6.91	0.00	3.91	0.21	0.19	6.48	Psychological Factors of Presence
0.00	-1.97	-0.13	-0.07							Space Layout Presence
0.24					0.21					Correlation Coefficient -R
0.06					0.04					Multiplying Coefficient- R^2
9.68					15.32					F Value
0.00					0.00					The Significance Level

The table 3 shows the results of regression analysis of the variable environmental factors (spatial layout and environmental comfort) on user learning and then the effect of the two obtained variables on the productivity variable.

During the regression analysis of the set of predicate variables, it is clear that these two variables can predict productivity on learning as the best set of variables.

According to the above results, the strongest predictor of productivity is the environmental comfort variable ($p < 0.01$; $t = 4.4$; $B = 0.29$)

This variable significantly explains about 0.04% of the variance of learning scores on productivity.

The second variable entered into the analysis is the spatial arrangement of learning) $p < 0.00$; $t = -1.97$; $B = -0.13$). The input of this variable to the analysis increases the coefficient of explanation by 0.06%.

Fourth hypothesis: The design of educational spaces by improving the level of space presence in the space improves the productivity of space.

The main hypothesis: Designing educational spaces with respect to the physical factors of the environment can affect the productivity of space.

Table 4. Results of Regression Analysis (Step-by-Step) - Environment Predictor Variables and Presence in the Space on Productivity

Second Stage					First Stage					Predictive Variable
The Significance Level	T	BETA	B	A	The Significance Level	T	BETA	B	A	
0.00	4.09	0.15	0.10	5.18	0.00	6.4	0.34	0.24	6.12	Psychological Factors of Presence
0.00	2.21	0.28	0.13							Space Layout Presence
0.40					0.34					Correlation Coefficient -R
0.16					0.11					Multiplying Coefficient- R^2
29.93					40.99					F Value
0.00					0.00					The Significance Level

Table 5. Results of Regression Analysis (Step-by-Step)- Environment Predictor Variables and Presence in the Space on Productivity

Third Level					Predictive Variable
The Significance Level	T	BETA	B	A	
0.00	2.51	0.15	0.07		Space Layout - presence
0.00	2.51	0.15	0.35	4.14	Environmental Comfort - presence
0.50					Correlation Coefficient -R
0.25					Multiplying Coefficient- R^2
52.38					F Value
0.00					The Significance Level

The table 5 shows the results of regression analysis of the variables of environmental factors (psychological factors, spatial layout and environmental comfort) on attendance and then the effect of the three achieved variables on the productivity variable. The strongest predictor of productivity is the effect of psychological factors on the presence in the space ($p < 0.01$; $t = 6.4$; $B = 0.34$). This variable alone explains about 11% of variance in productivity scores. The second variable entered into the analysis is the effect of spatial layout on presence in the space ($p < 0.00$; $t = 2.21$; $B = 0.28$). The input of this variable to the analysis increases the coefficient of explanation by 0.16%. The third variable entered into the analysis is the effect of environmental comfort on the presence in the space ($p < 0.00$; $t = 4.34$; $B = 0.29$). Whose entry increases the 0.9 coefficient of explanation.

DISCUSSION AND CONCLUSION

The results of this study indicate that there is a significant relationship between the physical environment and the productivity of schools.

On the other hand, there is a positive relationship between the physical dimensions of the architectural space and the productivity and productivity of the users; Therefore achieving efficient environments requires changing environmental criteria so that they can have a positive impact on the activities and learning of users.

Therefore, creating suitable conditions for promoting the learning of users requires full utilization of the comprehensive knowledge of architecture and the design of the physical environment with respect to the environmental, social and aesthetic dimensions; which will naturally increase the usefulness of people in space and will make optimal use of the expenses spent on building schools and the time spent on education and training.

Improving productivity in schools has led to increased productivity in education and training, and this also contributes to national productivity growth.

The two factors of space availability and user learning are the factors that affect productivity in educational spaces. On the other hand, the characteristics of the physical environment have a positive effect on the quality of these two components of productivity. The characteristics of the physical environment are categorized into four categories (environmental comfort, visual factors, environment layout, and psychological factors), the sub factors of are listed in table 6.

What matters in terms of environmental comfort is the use of natural light, the fitting of a suitable window, temperature control, air quality and acoustic.

Moreover, the components that affect visual factors are such as: Color, scale, visual appearance, materials, visual communication between spaces and nature.

Sub- factors that affect the layout of the environment include: Circulation, access, flexibility, using the users' idea in shaping space, the relationship between inside and outside space, furniture, close space and open space, open plan and space layouts; and psychological factors are influenced by sub-criteria such as: Safe and relaxed places, ambience attractiveness, environment readability, private space and social environment. Therefore, in designing the educational spaces, it is recommended to consider the factors that are extracted in the research.

Table 6. Environmental Factors Affecting Space Productivity

Effective Environmental Factors	Factors Affecting Space Productivity
The Use of Natural Light, The Fitting of a Suitable Window, Temperature Control, Air Quality and Acoustic	Environmental Comfort
Color, Scale, Visual Appearance, Materials, Visual Connection between Spaces and Nature	Visual Factors
Circulation, Accessibility, Flexibility, User Involvement in Space Design, Connection between inside and outside Space, Furniture, Open Space and Plan Layout	Layout of Environment
Secure Space, Environment Readability, Private Space, Social Environment	Psychological Factors

Each of the environmental factors play an important role in improving the learning quality and increasing interest in attending learning environments; therefore, the desired environment improves the productivity of the educational spaces by improving the components of productivity.

The findings of this study are in line with the the findings of Mousavi (2005), Fischer (1997) and

Earthman (1998) about impact of the environment on the productivity of educational spaces and the success and academic achievement of users.

Regarding the impact of the environment on learning, what has been studied in the previous research, each one considers the impact of one or a few limited environmental factors on learning; the obtained results in this study are in line with previous findings.

In most of the previous studies, the impact of the environment on learning has generally been studied on success and academic achievement, but the impacts of space factor has not been addressed.

Also, the productivity of educational spaces is measured by amount of money spent and the grades of students score but environmental factors have not received much in attention.

Also, in Iranian universities, there are few applied research and studies aimed at improving the efficiency of educational spaces, except for a few very limited cases, and even the concept of productivity in the field of educational spaces has not been comprehensively defined.

Considering the relationship between the environment and other school productivity measures can be a great topic for future studies.

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