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Impact of Interior Physical Environment on Academicians' Productivity in Pakistan Higher Education Institutes Perspectives

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Abstract

This study empirically examines the impact of indoor physical environment on academicians' productivity in different higher education institutes of Khyber Pakhtoonkhawa (KPK) province of Pakistan. The study is based on primary data collected from one hundred and forty four educationists' of various institutes in Pakistan namely, COMSATS Abbottabad campus, Hazara University, Mansehra campus, UET campus, Abbottabad, Hazara University, Havelian campus, Comwave university, Abbottabad campus and University of Peshawar. A structured questionnaire was used for data collection. The data was analyzed using the techniques of rank correlation coefficient and multiple regression analysis. All the findings were tested at 0.01 and 0.05 level of significance. The finding of this study shows that office design is very important in terms of increasing employees's productivity. The study opines that comfortable and contented office design motivates and energizes the employees to increase their performance.

Keywords

Ergonomics, productivity, office design, higher education institutes, Pakistan.

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Introduction

Ergonomics is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities. The International Ergonomics Association (IEA, 2000, p.1) defines ergonomics as follows:

"Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance".

A general perception is that a better workplace environment produces better results. Most of the workplaces or offices are designed according to the nature of the job. In corporate level, productivity is affected by many factors such as workers, work environment health and safety moral and cultural aspects. To get more or better productivity, it is necessary to provide a better workplace.

Participatory ergonomics includes a large variety of approaches, and an interesting framework to classify the approaches which has been developed by Haines et al. (2002). Apart from the classification, it is interesting to know what factors influence the chance of being successful. Success factors have been described in various studies (e.g. Koningsveld et al., 2005; Looze et al. 2001; Vink et al., 2005). These are arranging direct workers' participation, arranging strong management support, carrying out a good inventory, using a step-by-step approach, arranging that a steering group is established with responsibilities, checking the effects, including side-effects. At an early stage, to focus only on health issues is not encouraged and to describe the cost such as benefit ratio in monetary terms and with non-quantitative measures is approved.

Figure 1 shows the summary of the success factors.

This paper does not include all dimensions and factors of the physical environment and employees' productivity but limited to the following variables:

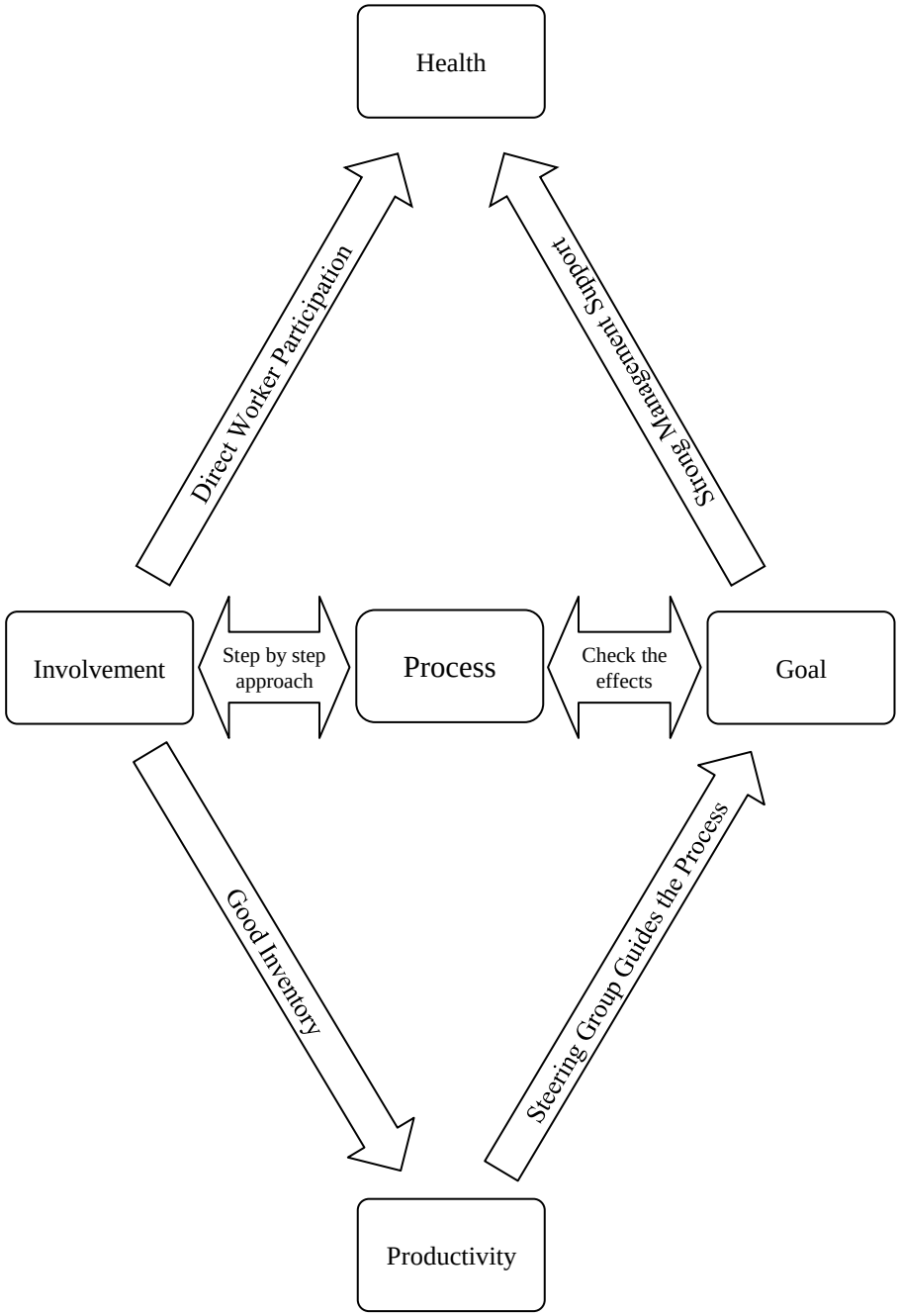

Figure 1. Summarize the Success Factors
Source: Adapted from Vink et al. (2006)

- **Employees' Productivity**: According to Hameed and Amjad (2009), productivity is a ratio to measure how well an organization (or individual, industry, country) converts input resources (labor, materials, machines, etc.) into goods and services. In this study, subjective productivity measurement method is used. The measures of this method are not based on quantitative operational information. Instead, they are based on personnel's subjective assessments. Wang and Gianakis (1999) have defined subjective performance measure as an indicator used to assess individuals' aggregated perceptions, attitudes or assessments toward an organizations product or service. Subjective productivity data is usually collected using survey questionnaires. Subjective data can also be descriptive or qualitative collected by interviews. Subjective productivity data is gathered from employees, supervisors, clients, customers and suppliers (Croome & Kaluarachchi, 2000).
- **Office Design**: Providing a workplace for employees that is equipped to make the most of a company's human resources is essential. Chiefly the layout of the office space and its system increase productivity specifying that half of all employees say they would put in an extra hour of work every day if they were supplied with an improved workplace. Present study used a number of factors which impacts on employees' productivity in higher education institutes perspectives in Khyber Pakhtoonkhawa (KPK) province of Pakistan such as furniture, temperature, noise, lighting and other arrangements.

  The more specific objectives are:

  1. To analyze the office design of different universities in Khyber Pakhtoonkhawa (KPK) province of Pakistan.
  2. To highlight the need of better workplace for improving productivity,
  3. To determine the effect of office design on physical environment
  4. To analyze the features which employees value in their workplace.

The paper is organized as follows: after introduction which is provided in Section 1 above, Section 2 describes literature review. Methodological framework is explained in Section 3. The estimation and interpretation of results is mentioned in Section 4. Section 5 concludes the paper.

Literature Review

Rowan and Wright (1995) highlight the importance of ergonomics in a workplace, as injuries and illnesses interface the employee and machine system. So, they opine the need for ergonomics in a workplace. They proposed that physical environmental factors like temperature, noise, flow of air, humidity, and furniture affects the employees' productivity. Therefore, ergonomics should be considered as part of the indoor environment. Regardless of these physical factors organizational laws, procedures and policies are undertaken by considering ergonomics (see, Figure 2).

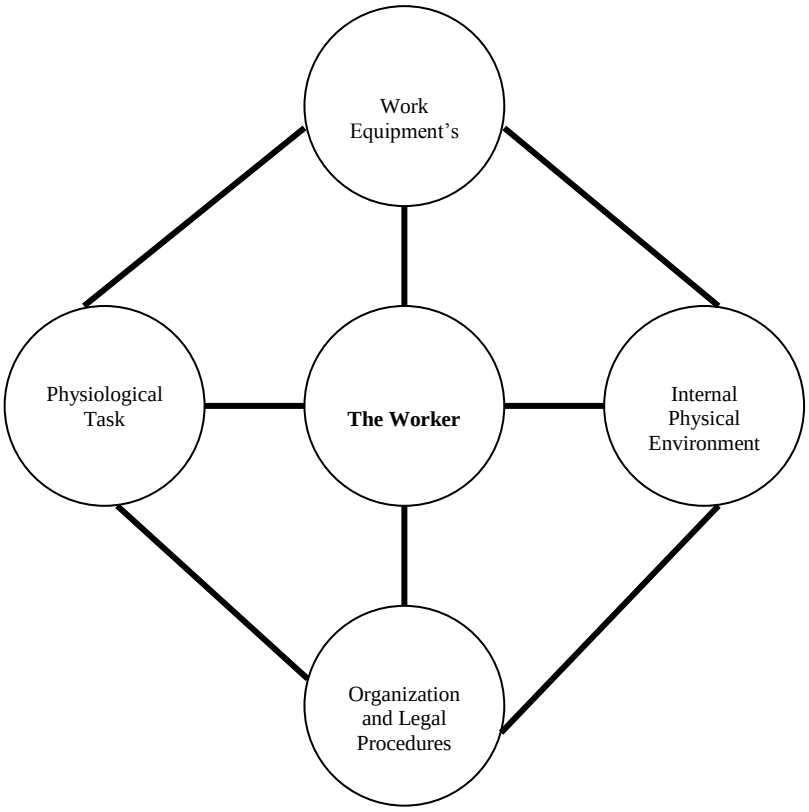

Figure 2. Ergonomics Job Considerations
Source: Adapted from Rowan and Wright (1995)

The key factors that affect employees' productivity and performance fall into two categories:

1. Those that are driven by procedures, protocols and management requirements (work environment);
2. The factors that arise from premises, office or factory design (office design);

3. These key factors are depicted in Figure 3.

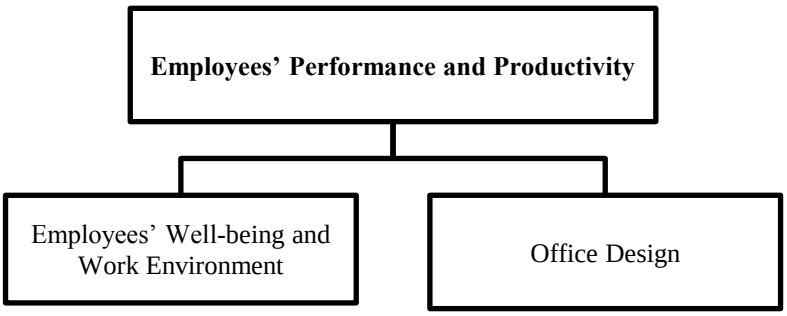

Figure 3. Employees' Well-being and Work Environment
Source: Self Extract

The office environment in which employees work and undertake most of their activities can impact on their productivity. The quality and quantity of work generated by employees are influenced by the office environment (Keeling and Kallaus, 1996), while Quible (2000) points out those poor environmental conditions can cause inefficient workers' productivity as well as reduce their job satisfaction, which in turn will impact on the financial well-being of the organization. On the basis of the above discussion, the present study testifies the hypothesis:

H1: There is a direct relationship between office design and employees' productivity.

Most people spend approximately 60% of their lives within indoor environment which greatly influence their moral behavior, actions, abilities and performance (Sundastrom et al., 1994). One of the fundamental human requirements is a working environment that allows people to perform their work optimally under comfortable conditions (Roelofsen, 2002).Workplace environment affects the attitude of employees. Different organizations have different office designs. Flexible and adjustable furniture, adequate lighting, required temperature, less noise and other special arrangements make work environment comfortable and desirable for carrying out occupational duties. Maintaining comfortable office conditions are important because a small deviation in temperature comfort level may lead to reduced job performance and impaired safety awareness. On the basis of the above discussion, the present study testifies the hypothesis:

H1a: There is a direct relationship between furniture and employees' performance.

The number of work pertains to the study of multiple offices and office buildings indicated that the factors such as dissatisfaction, cluttered workplaces and physical environment are playing a major role in the loss or employees productivity. Huges (2007) surveyed two thousand employees pertain to various organizations and industries in multiple levels. The results of this survey show that a better workplace affects attitude of employees and enhance their productivity. Employees in different organizations have different office designs. Every office has unique furniture and spatial arrangements, lightening and heating arrangements and different level of noise. On the basis of above discussion, the preset study testify the hypothesis i.e.,

H1b: There is a direct relationship between lighting and employees' performance.

A physical feature of the work environment affects psychologically and could become part of success and failure of the organization. In service sector, physical settings of the office or department help to communicate and influence both the teachers and students. Mentally relaxed and satisfied work environment plays an important role in productivity. The most significant indoor environmental parameter is room temperature. Heating and air conditioning system directly affect on employees' productivity. Employees should give opinions regarding their workplace so that they feel comfort and concentrate on their work and fulfill the desired level of productivity (Roelofsen, 2002). On the basis of the above discussion, the present study testifies the hypothesis:

H1c: There is an indirect relationship between noise, room temperature and employees' performance.

Human perspective cannot be ignored while determining the productivity aspect. While considering productivity cost, it is not given value against satisfying human element. The "Leveraging approach" reveals that small increase in workers' productivity causes decrease in real estate costs. Considering the preferences of human element in workplace, productivity improvements are to be made (Haynes, 2007). On the basis of the above discussion, the present study testifies the hypothesis:

H1d: There is a direct relationship between spatial arrangements and employees' performance.

The above discussion confirms the strong relationship between physical environment and employees' productivity. In order to find this

impact, the present study analyzes the impact of the office design factors on employees' productivity in higher education institutes of Khyber Pakhtoonkhawa (KPK) province of Pakistan.

Research Methodology

This study has been conducted at individual level that is who are directly involved in the academics at university level. Performance / productivity are taken as dependent variable while furniture, room temperature, noise, lighting and other arrangements are taken as independent variables. Dependent and independent variables were measured by the feedback from the educationists of different universities of KPK province of Pakistan through the questionnaire. The framework of the study is given in Figure 4.

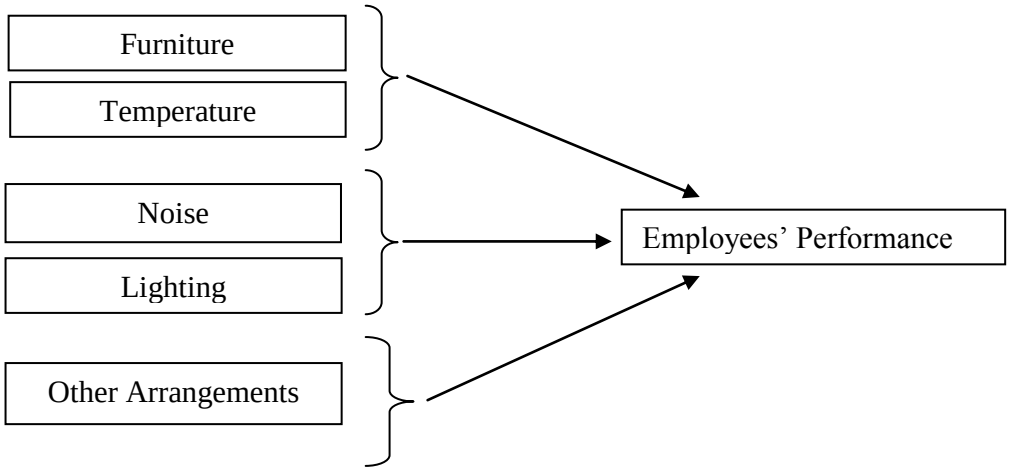

Figure 4. Research Framework
Source: Self construct

Data Collection

Questionnaire was used for data collection. Prior to the distribution of the actual survey, a pilot study involving a sample of eleven academicians were conducted to validate the content of the questionnaire in terms of relevance, accuracy, and wording. Appropriate changes were made in the final questionnaire. Five point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) and in other form i.e., 1 (Not at all) to 5 (Always) was used to measure responses. The respondents' scores for each construct were obtained by summing all the item scores of the individual variables. The hypothesized relationships among the study variables depicted in the model were tested using multiple regressions.

Sampling

Total two hundred questionnaires were randomly distributed among the academicians of different higher education institutes in Khyber Pakhtoonkhawa province of Pakistan, namely, COMSATS Abbottabad campus, Hazara University, Mansehra campus, UET campus, Abbottabad, Hazara University, Havelian campus, Comwave university, Abbottabad campus and University of Peshawar. One hundred and forty four questionnaires were returned. Thus, the response rate was 72%.

The Cronbach's Alpha reliability coefficients for the sample are given in Table 1 below:

Table 1. Cronbach's Alpha Reliability Coefficients

Items	Cronbach's Alfa (r)
Furniture	0.73
Temperature	0.91
Noise	0.64
Lighting	0.89
Other arrangement	0.77

Results and Discussion

Demographic Data Analysis

Table 2 shows the frequency distribution on the basis of age, gender, education and total experience in higher education institutes. The demographic data shows that thirty seven respondents were between 25 to 35 years of age, sixty three people were between 36 to 46 years which is the largest pool of respondents. Twenty five respondents were between 47 to 57 years while nineteen people were 57 and above. There were ninety seven males and forty seven female respondents. The qualification category shows that twenty one people were having 16 years of education, the qualification of ninety seven respondents were 18 while twenty six respondents have Ph.D. degree in their relevant subject. Sixty seven people were having teaching experience less than 2 years, fifty four people were having experience between 2 to 5 years and twenty three people had 5 or more than 5 years of teaching experience.

Table 2. Frequency Distribution of Demographic Variables

Variables	Frequency	Percentage
Age		
25-35	37	25.69
36-46	63	43.75
47-57	25	17.36
57 and above	19	13.19
Gender		
Males	97	67.36
Females	47	32.64
Education		
Masters	21	14.58
M.Phil	97	67.36
PhD	26	18.05
Total Experience		
Less than 2 years	67	46.52
2-5 years	54	37.5
More than 5 years	23	15.97

The respondents were asked the following questions regarding furniture, temperature, noise, lighting, other arrangements and its impact on employees' performance in different higher education institutes of KPK province of Pakistan and evaluate the responses in terms of frequency distribution. There are four main questions asked from the academicians regarding office furniture in their universities which are shown in Table 3.

Table 3. Furniture

Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My furniture is flexible to adjust, rearrange or recognize my workspace.	21	23	15	20	65
My furniture is comfortable enough so that I can work without getting tired till 5pm.	19	25	21	59	20
The physical condition at work influences my productivity.	12	28	18	62	24
Adequate and comfortable furniture will affect my productivity positively.	0	13	11	56	64

In Table 3, out of one hundred and forty four respondents, 45.13 percent of academicians strongly agree that their furniture is flexible and recognize their workspace. Similarly, academicians rate the second

question and 40.9 percent of them agree that they are enjoying a sound and comfortable place to sit, as their furniture is comfortable. Regarding physical condition at workplace, almost 43.0 percent of academicians agree on the argument that their physical condition affects their productivity in a positive sense. For the last question almost 44.4 percent (strongly agree) and 38.8 percent (agree) of academicians admit the fact that comfortable furniture influence their productivity positively. They feel relaxed and concentrate on their work or lectures more properly.

Next question asked from the academicians was about noise at workplace. The responses are summarized in Table 4.

Table 4. Noise

Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My work environment is quiet.	26	64	21	19	14
I am able to have quiet and undisturbed time alone.	25	55	11	33	20

In Table 4, the question which is related for quiet working environment shows that 64 academicians are disagreeing with the statement that their work environment is quiet which leads to decrease their productivity. Respondents do not agree with the statement that they are having a quiet and undisturbed workplace. 55 respondents disagree; 25 strongly disagree while 33 respondents agree and 20 strongly agree with this statement. The major respondents fall in the region of disagreement which shows that their workplace is not quiet and calm, and it may lead to decrease their productivity.

Next questions were related to the room temperature in their offices. The results are presented in Table 5.

In Table 5, 54 respondents answer that if the temperature of the office is normal then it has a good effect on productivity, while 35 respondents choose a normal effect on their productivity. However, only two academicians say that temperature does not influence as much on their productivity. The temperature of offices in winter is slightly warm in majority of responses which is 69. However, 24, 13 and 24 respondents' offices are cold, cool and pleasant in winters. Subsequently, in summer the temperature is pleasant. 61 respondents answer that there rooms are pleasant while 14 report that their rooms are slightly warm in summer. Similarly, room temperature is sometimes cannot be controlled by the employees working in it and sometimes it is under their control. 59 respondents are neutral with the statement that the flow of air can be controlled in their offices and windows and proper ventilation system is

available and they can open or shut them. Heating and cooling system is under their control or not.

Next questions were related to the lightings in the offices shown in Table 6.

Table 5. Temperature

Statements	No effect	Positive effect	Normal effect	Quite good effect	Bad effect
To what extent your room temperature affects your normal level of productivity.	2	33	35	54	20
Statements	Cold	Cool	Pleasant	Slightly Warm	Warm
The overall temperature of my workspace in winters is	24	13	24	69	14
The overall temperature of my workspace in summers is	20	38	61	11	14
Statements	No effect	Positive effect	Normal effect	Quite good effect	Bad effect
I am able to control temperature or airflow in my office.	12	21	59	31	21

Table 6. Lighting

Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My workspace is provided with efficient lighting so that I can work easily without strain on my eyes.	18	13	13	61	39
Do you have control over the lighting on your desk (i.e., adjustable desk light on desk)?	32	48	25	15	24
Ample amount of natural light comes into my office.	13	21	20	61	29
Number of windows in my work area complete my fresh air and light need.	11	69	19	31	14

In Table 6, 61 respondents agree with the statement that in their office they have enough light so that they can do their work easily and 18 disagree with this statement. Similarly, 32 strongly disagree and 48 disagree with the statement that they have the facility of adjustable lighting over their desk or table because dim light cause many problems and discomfort. Next question is related to the sound and enough amount of light in their workplace. In response to this question, 61 respondents agree and 29 strongly agree out of 144 samples. With the higher percentage of

42.3% of respondents agree that light in their office place is enough for their daily tasks. Flow of light and air in the office is enough to some extent. Out of 144 respondents, 69 employees disagree with this statement. Only 31 and 14 respondents agree and strongly agree with the statement while 19 respondents are neutral. After that, some questions are related to the other necessary arrangements in their office design (see Table 7).

Table 7. Other Arrangements

Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My office/branch is open enough to see my colleagues working.	10	14	20	63	37
My work area is sufficiently equipped for my typical needs (normal storage, movements, etc.)	27	63	19	21	14
I am satisfied with the amount of space for storage and displaying important materials.	16	24	31	61	12
My workspace serves multipurpose functions for informal and instant meetings.	15	25	20	61	23

In Table 7, it is reported that at their workplace employees usually want to become aware of the outside environment, so that their productivity may influence. Out of 144 respondents, 63 agreed with this statement and 37 strongly agreed. In other spatial arrangements, employees required certain necessary materials to keep them fresh and energetic i.e., freezer for cold drinks, fast food storage. So, 63 respondents don't have any facility in their workplace. However, only 21 and 14 respondents have such facility in their workplaces. Employees need enough space for the storage of their confidential files (question papers, etc.). 61 agreed with this statement while 24 disagreed. Sometimes office is used for informal meetings, gatherings, therefore, respondents may ask the question regarding some meeting spaces available at their workplace. 61 respondents said that their office is also used for that purpose and they have freedom of spending relaxed time while 25 respondents disagreed with this statement.

Table 8. Employees' Productivity

Statements	No Effect	Increase by 20%	Increase by 30%	Increase by 40%	Increase by 50% or more
Favorable environmental conditions (less noise, suitable temperature etc) in the office building will increase my productivity at work.	1	11	18	71	43
	Not at all	To some extent	Often	Mostly	Always
Due to overall office environment can you complete your daily tasks easily?	38	52	25	14	15
	No change	10%	20%	30%	40% or more
By what percentage your overall productivity would increase if the related office environment problems are solved.	1	3	7	26	67

As it is the matter of fact that **s**uitable environmental condition in workplace like less noise, flexible furniture, and suitable temperature increased the energy level of employees and they do their job more effectively and efficiently. Out of 144 respondents, 71 respondents rate this question up to 40 percent that shows the increase of productivity in workplace. While 43 respondents argue that their productivity increases more than 50 percent. Also, 52 respondents reported that they could finish their task daily to some extent, however, 38 respondents doe not complete their task efficiently. When the problem of workplace is solved then 67 employees of the universities productivity enhances by up to 40% or more. While, 26 employees have done their work efficiently up to 30 percent or more. The descriptive statistics of all major variables i.e., furniture, temperature, noise, lighting, spatial arrangements and productivity are reported in Table 9 for reference.

Table 9 shows the central tendency and measures of dispersions of the study variables. As indicated, means of all variables are greater than 3.5 values except noise which means that respondents disagreed that noise has no impact on productivity. The central tendency of the study variables shows that except noise all of the remaining variables are very close to their mean and they have very low tendency to fluctuate the responses. Noise factors cause discomfort, deviate the attention from lecture and effects on moods of employees. Noise may cause headaches

and irritability. Preparation of lectures requires more concentration and quiet environment. Due to discomfort, there is a decrease in employees' performance and level of productivity decreases. So that we may conclude that there may be an inverse relationship between employees' productivity and noise.

Then, the multiple correlation coefficients have been examined in Table 10, to find the intensity, magnitude and signs of the variables over productivity.

Table 9. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Furniture	144	2.00	4.50	3.8134	.5695
Noise	144	1.50	5.00	2.9871	.9548
Temperature	144	2.00	4.25	3.9965	.5338
Lighting	144	1.00	5.00	4.0119	.7797
Spatial Arrangement	144	1.50	4.25	3.1262	.6130
Productivity	144	2.33	5.00	3.9604	.6382

Table 10. Correlation Matrix

	Furniture	Noise	Temperature	Lighting	Spatial Arrangement	Productivity
Furniture	1.000					
Noise	-0.577	1.000				
Temperature	0.250	.011	1.000			
Lighting	0.498	.058	.218	1.000		
Spatial Arrangement	0.654	-.272	-.045	.138	1.000	
Productivity	0.564	-0.301	-0.208	0.544	0.166	1.000

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (1-tailed). N denotes the sample size.

The results reveal that there is a strong correlation between furniture, lighting over productivity, as correlation coefficient indicates, r =0.564 and r = 0.544 respectively. On the other hand, there is a medium and negative correlation between noise, temperature over productivity as coefficient values indicate, r = -0.301 and r= -0.208 respectively. Spatial arrangements have a small and positive relationship with the productivity. Finally, the present study finds the stepwise regression to find the impact of physical environment on employees' productivity in higher education institutes (see Table 11).

The empirical results given in Table 11, appear to be very good in terms of the usual diagnostic statistics. The value of R^2 adjusted, Column 1, indicates that 71.2% variation in dependent variable has been explained by variations in independent variables. F-value is higher than its critical value suggesting a good overall significance of the estimated

model. Therefore, fitness of the model is acceptable empirically. The result suggests that all variables have a correlation proving the hypothesis. Coefficients of temperature and spatial arrangement have a significant and positive impact on employees' productivity, as it is significant at 90 percent significant level. However, Noise and room temperature has a significant and negative impact on employees' productivity in the higher education institutes. Lighting and office furniture both are reported as having insignificant impact on employees' productivity over the sample period.

Table 11. Incremental Regression Dependent Variable: Employee's Productivity

Variables	OLS1	OLS2	OLS3	OLS4	OLS5
Constant	3.347*	4.281*	0.824	2.584***	1.021
Furniture	0.124	_	0.240***	0.188	0.131
Noise	-0.237**	-0.287*	_	0.364*	0.180*
Temperature	-0.033***	-0.219***	-0.295***	_	0.220***
Lighting	0.087	0.095	0.228***	0.129***	_
Spatial Arrangement	0.173***	0.246***	0.396**	0.268	0.128***
R square	0.712	0.682	0.329	.428	0.489
F-value	3.451*	4.096*	2.086***	3.817*	4.281*
D-W	1.773	1.8 99	1.611	1.653	1.889

*, ** and *** indicates significance at 1, 5 and 10% significance level.

The incremental regression is performed by removing individual independent variables from the model and by checking the effect on the value of R-squared. Among all the variables removed, noise has altered the value of R-squared to a highest degree which is 31.6% decreases in the portion of the dependent variable explained by independent variables as the value for the R-squared changes from 71.2% to 39.6%. This importance is also highlighted in the regression result as the value of coefficient of the variable is the highest among all the variables in their five models respectively. The result is presented in Table 12.

Table 12. Results of Incremental Regression removing Noise

Models	Values
R-squared (original)	0.712
R-squared (after the removal)	0.396

The VIF and Tolerance test suggests that there is no problem of multi-collinearity in the stated model as VIF values are less than the value of 10 (see Table 13).

Table 13. Collinearity Statistics

Tolerance	VIF
.912	1.096
.888	1.126
.946	1.057
.876	1.141
.894	1.118

a. Dependent Variable: Productivity

Discussion

The results reveal that the office design has a substantial impact on the productivity of employees. The results are consistent with the previous study of Hameed and Amjad (2009) in which they reveal that office design of banks in Pakistan are very vital in terms of increasing employees' productivity. The overall impact of noise and temperature badly affects the productivity of employees. The results are consistent with the previous researches of Lan et al. (2010) and Niemela et al. (2002) which revealed that temperature has an effect as long as the task concerned lasts at least 60 minutes. In one experiment, Lan et al. (2010) investigated the impact of three different indoor temperatures (17°C, 21°C and 28°C) on productivity. They found that employees felt slightly uncomfortable in both the coolest and warmest of these climates, that they were less motivated and that they experienced their workload as more onerous, with a consequent decline in productivity. These results tie in with those from a study by Niemela et al. (2002), which found that a temperature higher than 25°C adversely affects productivity.

Factor Analysis

Factor analysis is a statistical method used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called factors. In other words, it is possible that variations in three or four observed variables mainly reflect the variations in such fewer unobserved variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables is used later to reduce the set of variables in a dataset.

The result of Principal Component Analysis shows that there are eight factors whose Eigen-values exceed 1. The factor's Eigen-value shows the amount of total variance explained by that factor. The eight factors explained 67.10% of the total variance, shown in Table 14. The first, second, third, fourth, fifth, sixth, seventh and eighth factor explained

16.2%, 11.1%, 9.45%, 7.83%, 6.50%, 5.91%, 5.22% and 4.87% of this variance respectively.

Table 14. Total Variance Explained

	Initial Eigenvalue			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.404	16.210	16.210	3.404	16.210	16.210
2	2.328	11.087	27.297	2.328	11.087	27.297
3	1.985	9.452	36.749	1.985	9.452	36.749
4	1.646	7.836	44.585	1.646	7.836	44.585
5	1.366	6.507	51.092	1.366	6.507	51.092
6	1.243	5.918	57.011	1.243	5.918	57.011
7	1.097	5.225	62.236	1.097	5.225	62.236
8	1.023	4.871	67.106	1.023	4.871	67.106
9	.958	4.564	71.670	-	-	-
10	.846	4.030	75.701	-	-	-
11	.749	3.568	79.268	-	-	-
12	.699	3.328	82.596	-	-	-
13	.667	3.174	85.771	-	-	-
14	.577	2.747	88.517	-	-	-
15	.485	2.310	90.828	-	-	-
16	.469	2.235	93.063	-	-	-
17	.365	1.739	94.802	-	-	-
18	.316	1.504	96.305	-	-	-
19	.291	1.388	97.693	-	-	-
20	.270	1.287	98.980	-	-	-
21	.214	1.020	100.000	-	-	-

Extraction Method: Principal Component Analysis.

The component matrix is shown in Table 15. First factor “Employee well-being”, is constructed by four scale items and accounted for largest proportion, which is, 16.21% of total explained variance. The second factor, “Employee commitment”, is constructed by three scale items and accounted for 11.08% of variance. The third factor, “Employee health”, is constructed by three scale items and accounted for 9.45% of total variance. The forth factor, “Employee safety”, is constructed by two scale items and accounted for 7.83% of total variance. The fifth factor, “Employee assurance”, is constructed by three scale items and accounted for 6.50% of total variance. The sixth factor, “Employee binder”, is constructed by two scale items and accounted for 5.91% of total variance. The seventh factor, “Employee protection”, is constructed by two scale items and accounted for 5.22% of total variance. The last and eighth factor, “Employee obligation”, is constructed by two scale items and

accounted for 4.87% of total variance.

Table 15. Component Matrix

	Employee well-being	Employee commitment	Employee health	Employee safety	Employee assurance	Employee binder	Employee protection	Employee obligation
Furniture								
Flexibility	0.44	-0.09	0.31	0.02	-0.26	0.27	0.45	-0.11
Contended	0.11	-0.03	0.05	0.09	-0.01	0.03	0.85	0.11
Physical Condition	-0.14	0.19	0.07	-0.01	0.02	-0.08	0.10	0.79
Comfortably	0.03	0.47	0.07	-0.44	-0.04	0.44	-0.19	0.35
Noise								
Noiseless	-0.74	-0.08	0.19	-0.25	0.08	0.02	-0.02	0.09
Calm	-0.68	-0.17	0.23	0.04	0.11	-0.26	0.09	0.07
Temperature								
Temperature	0.03	-0.04	0.31	0.09	-0.49	0.13	-0.44	0.23
Winter	0.38	-0.35	-0.23	0.11	0.06	-0.07	-0.13	0.42
Summer	-0.32	-0.01	0.57	-0.49	-0.11	-0.11	-0.15	-0.02
Control	0.08	0.11	0.03	0.78	0.01	0.24	0.02	0.10
Lighting								
Lighting	0.20	0.06	0.24	0.69	-0.15	-0.04	0.02	-0.07
Lighting Control	-0.06	-0.03	0.16	0.19	0.20	0.82	-0.02	-0.15
Natural Light	-0.22	-0.06	0.68	0.05	0.00	0.18	0.16	0.08
Windows	0.06	0.12	0.80	0.21	0.08	0.00	-0.03	-0.04
Other Arrangements								
Openness	0.17	0.15	0.08	-0.13	0.67	0.06	0.09	-0.09
Equipment's	0.73	-0.03	0.00	0.09	0.11	0.11	0.17	0.04
Space	0.35	0.08	-0.03	0.07	-0.26	0.59	0.16	0.02
Multi-purpose	-0.08	-0.15	-0.01	0.07	0.77	0.02	-0.22	0.24
Productivity								
Favorable Environment	0.15	0.83	0.15	0.18	-0.03	0.02	0.11	-0.03
Friendly Environment	0.65	-0.06	0.14	0.12	0.37	-0.24	0.12	-0.03
Efficiency	-0.05	0.85	-0.13	0.03	0.08	0.00	-0.14	0.16

The component plot is shown below for ready reference in Figure 5.

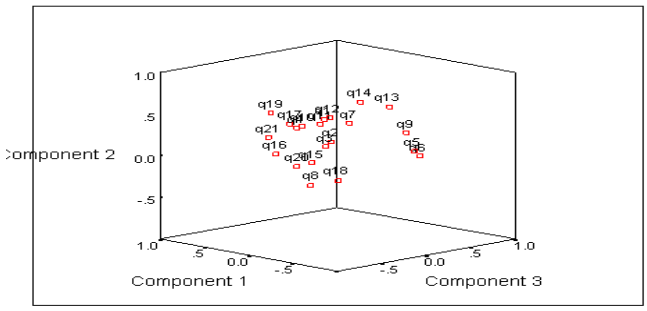

Figure 5. Components Plot

Conclusion

The objective of the study is to examine the impact of physical environment on employees' productivity in higher education institutes of Khyber Pakhtoonkhawa (KPK) province of Pakistan. The results reveal that there is a positive relationship between spatial arrangements and productivity. However, there is a negative and significant impact of noise and temperature on academicians' productivity of higher education institutes of KPK province of Pakistan. Furniture and lighting have an insignificant impact on employees' productivity, which show that sample is not large enough to explain this relationship significantly. The results are quite robust in terms of usual diagnostics tests on the coefficient estimates. The future research area would emphasis on large sample sets and wide geographical areas of Pakistan.

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بهره‌وری مجامع علمی در پاکستان: چشم‌انداز مراکز آموزش عالی

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چکیده

این مطالعه به‌طور تجربی تأثیر محیط فیزیکی داخلی را بر بهره‌وری مراکز علمی در مراکز مختلف آموزش عالی ایالت (KPK) پاکستان بررسی می‌کند. این مطالعه مبتنی بر داده‌های اولیه جمع‌آوری شده از ۱۴۴ دانشجو مراکز مختلف در پاکستان، پردیس COMSATS Abbottabad، دانشگاه Hazra، دانشگاه Mansehra، پردیس UET، پردیس Havelian، دانشگاه Comwav، دانشگاه پیشاور می‌باشد. پرسشنامه ساختار یافته‌ای برای جمع‌آوری داده‌ها استفاده شد. داده‌ها با استفاده از آزمون‌های ضریب همبستگی رتبه‌ای و تحلیل رگرسیون چندگانه، تجزیه و تحلیل شد. تمام این یافته‌ها در سطح اطمینان ۰/۰۵ و ۰/۰۱ آزمایش شد. یافته‌های این مطالعه نشان می‌دهد که طراحی دفتر در رابطه با افزایش بهره‌وری کارمندان بسیار حایز اهمیت می‌باشد. این بررسی بیان می‌کند که طراحی مناسب و رضایت‌بخش دفتر، کارکنان را برمی‌انگیزد و به آنها انرژی می‌دهد تا عملکرد خود را بهبود بخشد.

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