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Effect of illumination and cross ventilation in the classroom on academic performance of the students

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ABSTRACT : Noise, humidity, illumination etc. are the environmental stressors; due to these factors human beings' task performance is decreased. In Krishna Engineering College (KEC), Ghaziabad, India students are also facing environmental problems in few classrooms, which exist particularly in the basement of the building. Due to these stressors students loose their concentration in the classrooms and this subsequently reduces their academic performance and ultimately the objective of the classroom teaching is lost. In the present study a particular classroom is selected. Faculty delivered the lecture in the specified position for a fixed duration. Through questionnaire, a feedback in the form of data is collected from the students. The statistical analysis (chi square test) has been carried out on the data. The results showed that illumination and cross ventilation adversely affects the students' academic performance in the classroom. On the basis of results and discussions, conclusions have been made in the light of previous researches in the field.

Keywords : Academic Performance, Equivalent Noise, Students, elimination

I. INTRODUCTION

In the era of Globalization and privatization in every field lot of opportunities are open for development of the society. The ultimate objective is to balance in every field between the demand and supply. One of the emerging fields is privatization of engineering colleges in India to cater for the future requirements of the engineers. In principle lot of rules and regulations are laid down to start any engineering college, but practically there are various factors such as location of the college, college building, air conditioning system, space limitation etc. affects the teaching-learning process in the classroom.

In KEC, Ghaziabad, India an effort is made to improve the classroom environment by reducing the environmental stressors such as noise, humidity, illumination, cross ventilation, etc. to enhance the academic performance of the students in the classroom. Besides this when the floor is in basement of the building its affects increases manifolds. As a consequence students have to pay more attention to listen to the teachers' voice to understand the lecture. But with the passage of time students feel uncomfortable and their performance is decreased.

Literature review reveals that environmental stressors such as noise, humidity, temperature, illumination etc. are adversely affects the human beings and increases strain and subsequently reduce the performances. Noise is notable among them. Significant differences in speech recognition performance between classrooms, with and without classroom amplification, and across the rows of each classroom when the classroom amplification system was not used [1]. It has been recommended to build schools in low-noise background locations, to reduce transmitted noise by proper city planning, traffic engineering and improved construction characteristics, and to properly select and maintain the air conditioning systems [2]. Noise has a significant impact on the quality of life, and in that sense, it is a health problem [3]. Low frequency noise annoyed the male operators and should be considered in the occupational exposure assessment [4]. Low frequency noise at 50 dBA could be perceived as annoying and adversely affecting mental performance (concentration and visual perception) of male operators [5]. It was also found that the noise impaired performance on the focused attention kind of tasks, Smith [6]. Khan *et. al.*, [7] found that males' and females' performance of a readability task was impaired in the presence of road traffic noise in a mobile driving environment.

Further, literature review showed that either no or few studies have been conducted in the past on the effect of environmental factors on engineering college students' listening performance in the classrooms particularly when the classrooms are in the basement. Keeping this in mind for the present study a questionnaire is formulated to explore the possible reasons of problem in the classroom;

Questionnaire

Q.1. Do you listen Teachers' Voice ?

S.No.	Response	Tick Mark
1.	Easily & Clearly	
2.	Partially Clearly	
3.	Not at all Clearly	

Q.2. Do you feel that fan produces disturbances during lecture ?

S.No.	Response	Tick Mark
1.	No	
2.	A Little Bit	
3.	Yes	

Q.3. I am unable to listen teacher's voice because :

S.No.	Response	Tick Mark
1.	The voice is not audible	
2.	I don't pay attention	
3.	Both of the above	

Q.4. I feel uncomfortable in class due to :

S.No.	Response	Tick Mark
1.	Noise	
2.	Humidity	
3.	Both of the above	

Q.5. I feel uncomfortable in class due to :

S.No.	Response	Tick Mark
1.	Insufficient Light	
2.	Insufficient Cross Ventilation	
3.	Both of the above	

Q.6. I feel uncomfortable in class due to :

S.No.	Response	Tick Mark
1.	Blackboard location	
2.	Teacher's Position	
3.	Both of the above	

And following null hypothesis is structured :

(*i*) Students and teacher's location is immaterial in the classroom from the point of view of listening.

(*ii*) Fans' noise doesn't disturb the lecture to the students.

(*iii*) Faculty voice is audible and all students are interested in listening to the lecture in the classroom.

(*iv*) Noise and humidity does not affect the students listening performance.

(*v*) Insufficient light and cross ventilation doesn't affect the students' academic performance in the classroom.

(*vi*) Blackboard and faculty position in the classroom is immaterial.

II. METHODOLOGY

A. Subjects

Fifty students (35 males and 15 females) of MCA first year, from KEC, Ghaziabad, India, participated in the present study and they were not paid any remuneration to participate in the experiment. Their age ranged from 20 to 22 years.

B. Noise levels

A noise survey was carried out with the help of sound level meter (Model GA 214, Castle Group Limited, UK) to determine the levels of noise existing in the empty and with the students in classroom (Lower Ground Floor, LGF-10). The findings of the noise survey showed that the equivalent noise level (leq dBA) was ranging from 66.6 dBA to 80.4 dBA, when all fans were ON, and equivalent noise range was found from 71.0 dBA to 80.7 dBA when all fans were ON and all students were present in the classroom.

C. Task performance

All students were sitting in the classroom on their seats supporting their backs to the backrest. All fans were ON. Faculty delivered his lecture in normal pace for duration of 50 minutes in a specified position (Fig.1). After delivering the lecture a questionnaire was circulated among the students for taking feedback from the students.

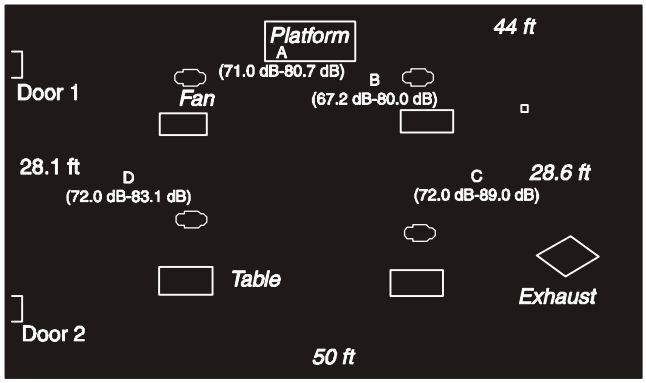


Fig.1. Faculty position during delivering lecture in the classroom.

D. Statistical analysis

After taking response from the students in the questionnaire (in specified faculty position) each question was analyzed through Chi-Square test. Further histograms are drawn in between;

(*i*) Response of the male students and number of students (male).

(*ii*) Response of the female students and number of students (female).

(*iii*) Response of the students (male and female) and number of students (male and female).

III. RESULTS

The data collected through questionnaire from the students were analyzed through Chi-Square test and followed by the histograms. The details of the faculty position (B) have been presented as follows :

Q.1. (I) Do you listen teacher's voice :

Table 7 : Response of Students.

Gender	Easily & Clearly	Partially clearly	Not at all clearly	Total
MALE	24	11	0	35
FEMALE	12	3	0	15
Total	36	14	0	50

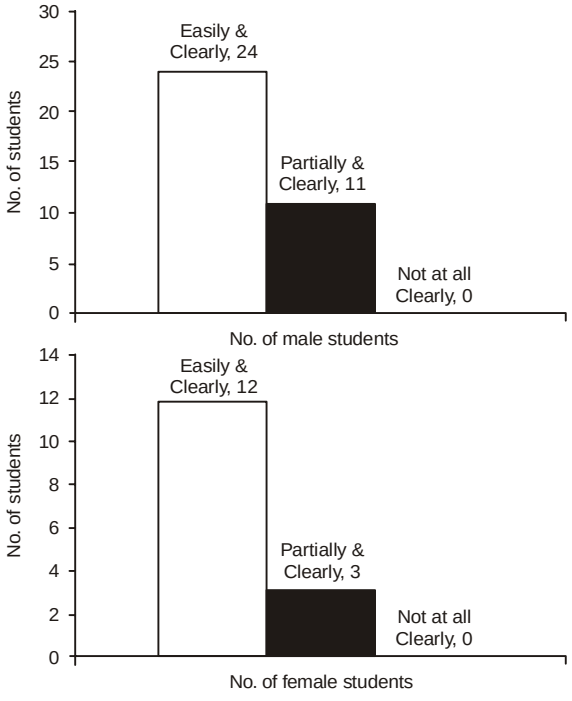
$E_{11} = (R_1 \times C_1)/T = (35 \times 36)/50 = 25.$
$E_{21} = (R_2 \times C_1)/T = (15 \times 36)/50 = 10.8$
$E_{12} = (R_1 \times C_2)/T = (35 \times 14)/50 = 9.8$
$E_{22} = (R_2 \times C_2)/T = (15 \times 14)/50 = 4.2$
$E_{13} = (R_1 \times C_3)/T = (35 \times 0)/50 = 0$
$E_{23} = (R_2 \times C_3)/T = (15 \times 0)/50 = 0$

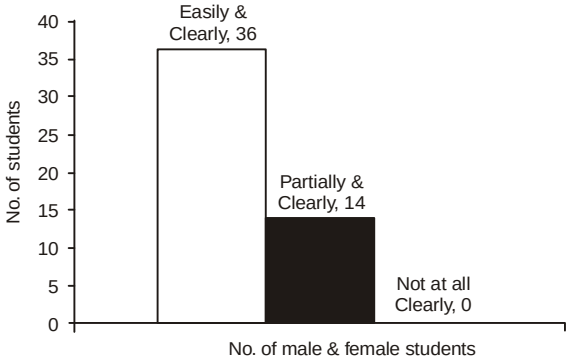
Arranging the observed and calculated frequencies :

Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$(O - E)^2/E$
24	25.2	– 1.2	1.44	.0571
11	9.8	1.2	1.44	0.1469
0	0	0	0	0
12	10.8	1.2	1.44	0.1333
3	4.2	– 1.2	1.44	0.3429
0	0	0	0	0
				0.6802

d.o.f = 2, $\alpha = 0.1$, $\chi2_T = 4.61$, $\chi2_C = 0.6802$, $\because \chi2_T > \chi2_C$

$\because$ Insignificant





Q.2. Do you feel that the fans produce disturbance during lecture :

Table 8 : Response of Students.

Gender	No	A little bit	Yes	Total
MALE	6	20	9	35
FEMALE	5	7	3	15
Total	**11**	**27**	**12**	**50**

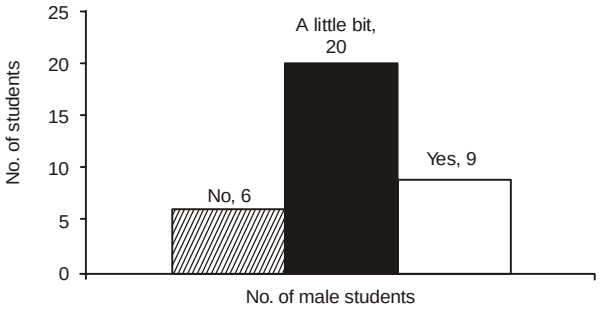
$E_{11} = (R_1 \times C_1)/T = (35 \times 11)/50 = 7.7$
$E_{21} = (R_2 \times C_1)/T = (15 \times 11)/50 = 3.3$
$E_{12} = (R_1 \times C_2)/T = (35 \times 27)/50 = 18.9$
$E_{22} = (R_2 \times C_2)/T = (15 \times 27)/50 = 8.1$
$E_{13} = (R_1 \times C_3)/T = (35 \times 12)/50 = 8.4$
$E_{23} = (R_2 \times C_3)/T = (15 \times 12)/50 = 3.6$

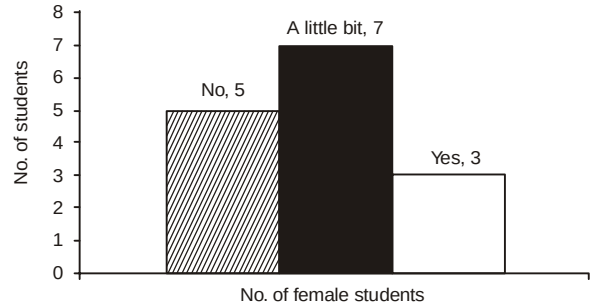
Arranging the observed and calculated frequencies :

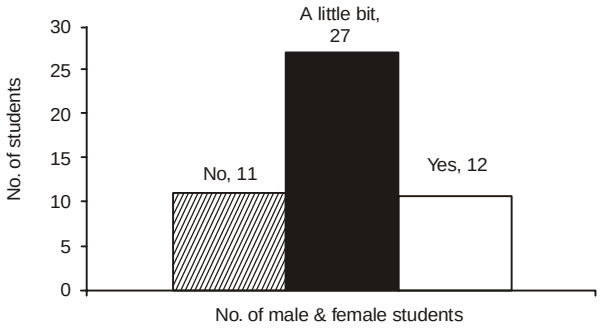
Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$(O - E)^2/E$
6	7.7	– 1.7	2.89	0.3753
20	18.9	1.1	1.21	0.0640
9	8.4	0.6	0.36	0.0714
5	3.3	1.7	2.89	0.8758
7	8.1	– 1.1	1.21	0.1494
3	3.6	– 0.6	0.36	0.1
				1.6359

d.o.f = 2, $\alpha = 0.1$, $\chi2_T = 4.61$, $\chi2_C = 1.6359$, $\because \chi2_T > \chi2_C$

$\because$ Insignificant







Q.3. (I) am unable to listen teacher's voice because :

Table 9 : Response of students.

Gender	The voice is not audible	I don't pay attention	Both of the above	Total
Male	22	3	10	35
Female	13	0	2	15
Total	**35**	**3**	**12**	**50**

$E_{11} = (R_1 \times C_1)/T = (35 \times 35)/50 = 24.5$

$E_{21} = (R_2 \times C_1)/T = (15 \times 35)/50 = 10.5$

$E_{12} = (R_1 \times C_3)/T = (35 \times 3)/50 = 2.1$

$E_{22} = (R_2 \times C_2)/T = (15 \times 3)/50 = 0.9$

$E_{13} = (R_1 \times C_3)/T = (35 \times 12)/50 = 8.4$

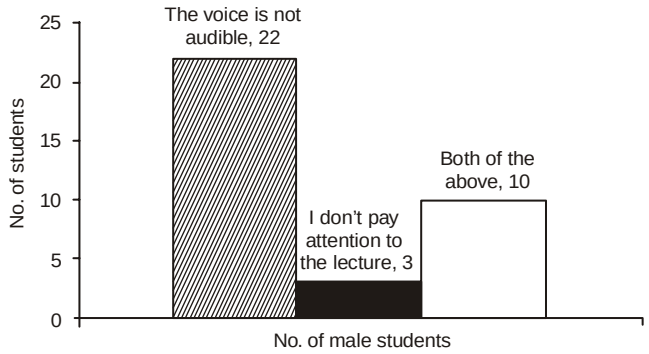
$E_{23} = (R_2 \times C_3)/T = (15 \times 12)/50 = 3.6$

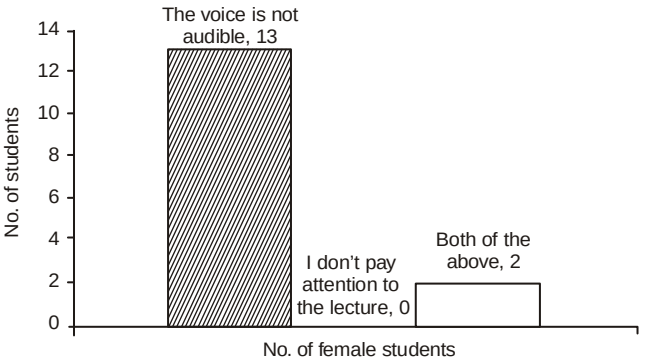
Arranging the observed and calculated frequencies :

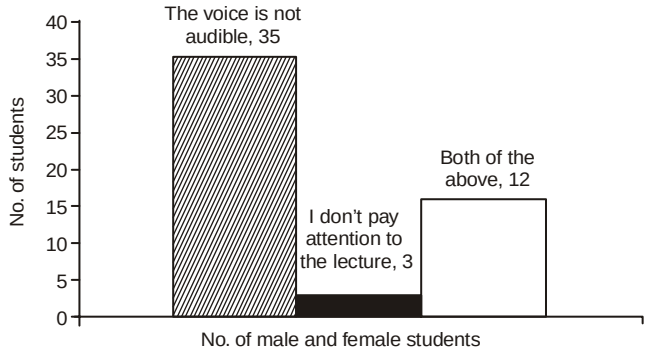
Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$(O - E)^2/E$
22	24.5	– 2.5	6.25	0.2551
3	2.1	0.9	0.81	0.3857
10	8.4	1.6	2.56	0.3048
13	10.5	2.5	6.25	0.5952
0	0.9	– 0.9	0.81	0.9
2	3.6	– 1.6	2.56	0.7111
				3.1519

d.o.f = 2, $\alpha = 0.1$, $\chi 2_T = 4.61$, $\chi 2_C = 3.1519$, $\chi 2_T > \chi 2_C$

∴ Insignificant







Q.4. I feel uncomfortable in class due to :

Table 10 : Response of students.

Gender	Noise	Humidity	Both of the above	Total
MALE	12	15	8	35
FEMALE	4	10	1	15
Total	**16**	**25**	**9**	**50**

$E_{11} = (R_1 \times C_1)/T = (35 \times 16)/50 = 11.2$

$E_{21} = (R_2 \times C_1)/T = (15 \times 16)/50 = 4.8$

$E_{12} = (R_1 \times C_2)/T = (35 \times 25)/50 = 17.5$

$E_{22} = (R_2 \times C_2)/T = (15 \times 25)/50 = 7.5$

$E_{13} = (R_1 \times C_3)/T = (35 \times 9)/50 = 6.3$

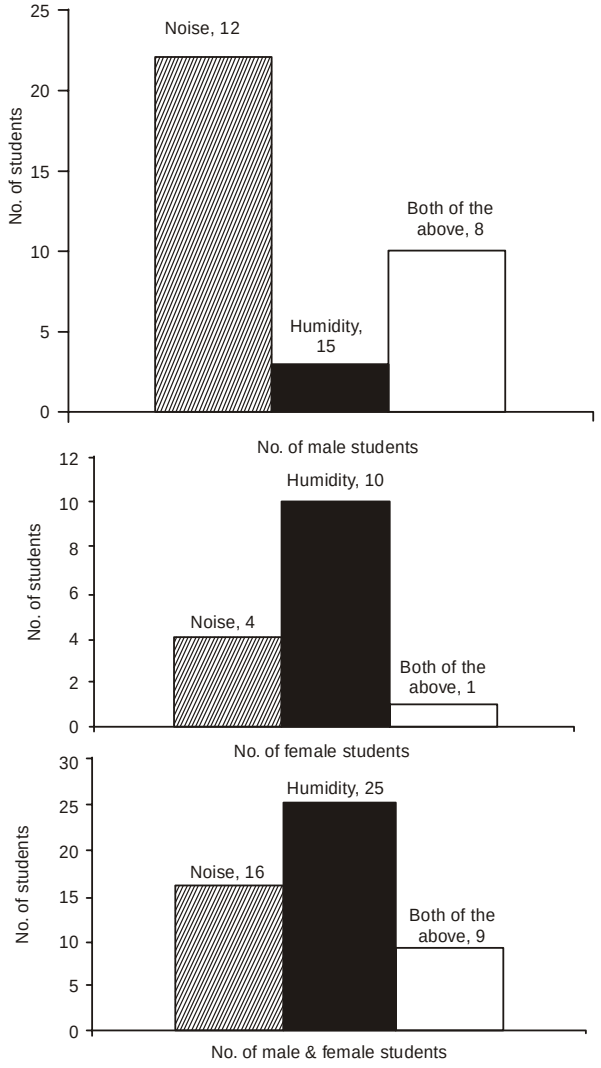
$E_{23} = (R_2 \times C_3)/T = (15 \times 9)/50 = 32.7$

Arranging the observed and calculated frequencies :

Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$(O - E)^2/E$
12	11.2	0.8	0.64	0.0571
15	17.5	– 2.5	6.25	0.3571
8	6.3	1.7	2.89	0.4587
4	4.8	– 0.8	0.64	0.1333
10	7.5	2.5	6.25	0.8333
1	2.7	– 1.7	2.89	1.0703
				2.9098

d.o.f = 2, $\alpha = 0.1$, $\chi 2_T = 4.61$, $\chi 2_C = 2.9098$ ∵ $\chi 2_T > \chi 2_C$

∴ Insignificant



Q.5. I feel uncomfortable in class due :

Table 11 : Response of students.

Gender	Insufficient Light	Insufficient Cross Ventilation	Both of the above	Total
MALE	12	13	10	35
FEMALE	1	11	3	15
Total	**13**	**24**	**13**	**50**

$E_{11} = (R_1 \times C_1)/T = (35 \times 13)/50 = 9.1$

$E_{21} = (R_2 \times C_1)/T = (15 \times 13)/50 = 3.9$

$E_{12} = (R_1 \times C_2)/T = (35 \times 24)/50 = 16.8$

$E_{22} = (R_2 \times C_2)/T = (15 \times 24)/50 = 7.2$

$E_{13} = (R_1 \times C_3)/T = (35 \times 13)/50 = 9.1$

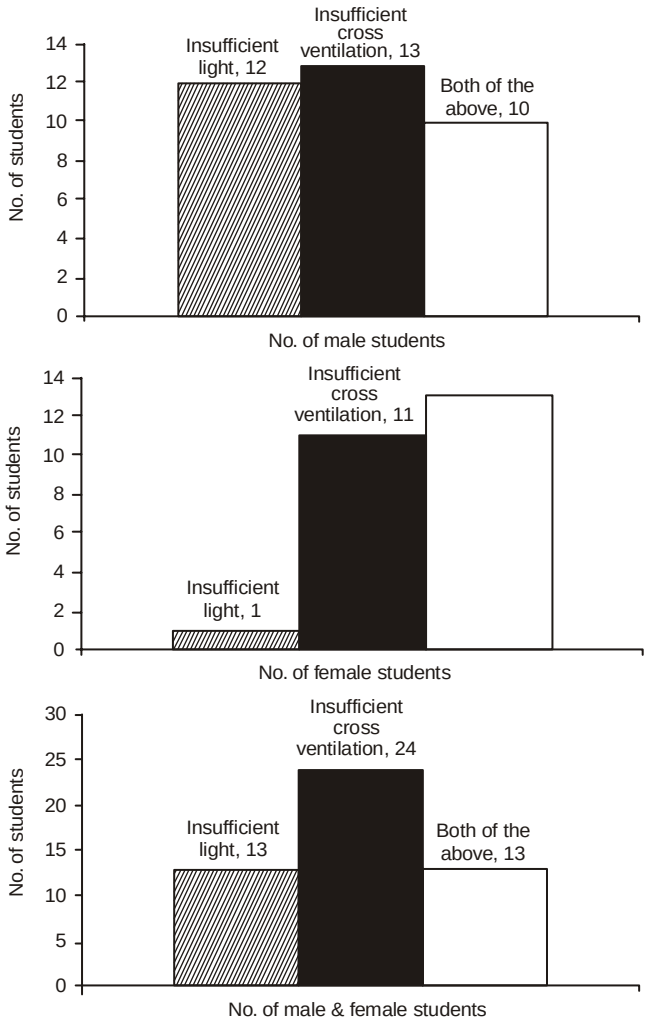
$E_{23} = (R_2 \times C_3)/T = (15 \times 13)/50 = 3.9$

Arranging the observed and calculated frequencies :

Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$(O - E)^2/E$
12	9.1	2.9	8.41	0.9242
13	16.8	– 3.8	14.44	0.8595
10	9.1	0.9	0.81	0.0890
1	3.9	– 2.9	8.41	2.1564
11	7.2	3.8	14.44	2.0056
13	3.9	– 0.9	0.81	0.2077
				6.2424

d.o.f = 2, $\alpha = 0.1$, $\chi 2_T = 4.61$, $\chi 2_C = 6.2424$, ∵ $\chi 2_T > \chi 2_C$

∴ Significant



Q.6. I Feel uncomfortable in class due due to :

Table 12 : Response of students.

Gender	Blackboard location	Teacher's position	Both of the above	Total
Male	14	10	11	35
Female	7	6	2	15
Total	**21**	**16**	**13**	**50**

$E_{11} = (R_1 \times C_1)/T = (35 \times 21)/50 = 14.7$

$E_{21} = (R_2 \times C_1)/T = (15 \times 21)/50 = 11.2$

$E_{12} = (R_1 \times C_2)/T = (35 \times 16)/50 = 11.2$

$E_{22} = (R_2 \times C_2)/T = (15 \times 16)/50 = 4.8$

$E_{13} = (R_1 \times C_3)/T = (35 \times 13)/50 = 9.1$

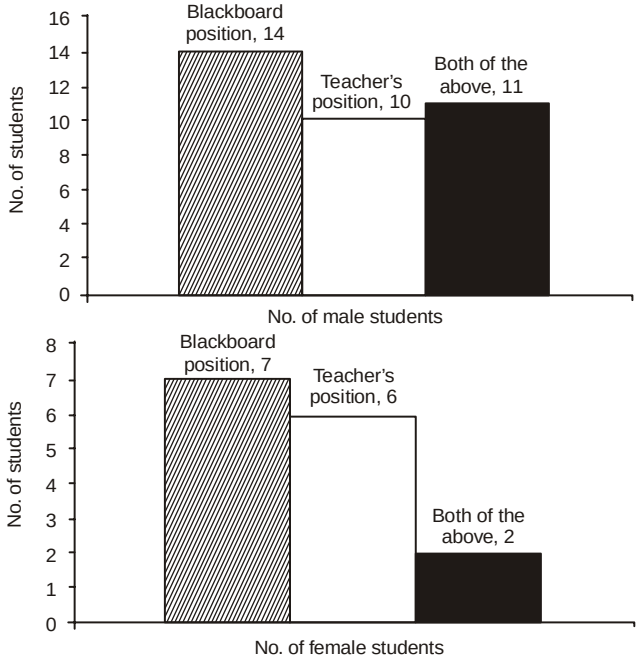
$E_{23} = (R_2 \times C_3)/T = (15 \times 13)/50 = 3.9$

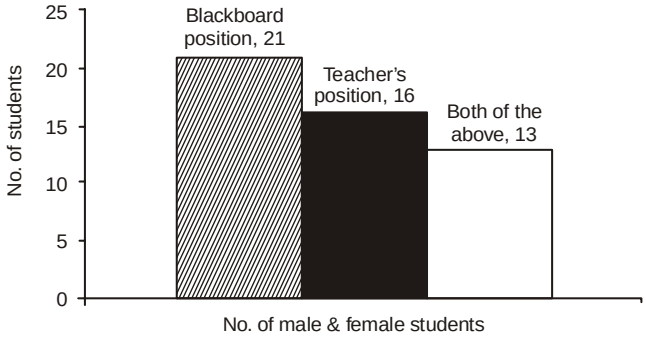
Arranging the observed and calculated frequencies :

Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$(O - E)^2/E$
14	14.7	– 0.7	0.49	0.0333
10	11.2	– 1.2	1.44	0.1286
11	9.1	1.9	3.61	0.3967
7	6.3	0.7	0.49	0.0778
6	4.8	1.2	1.44	0.3
2	3.9	– 1.9	3.61	0.9256
				1.8620

d.o.f = 2, $\alpha = 0.1$, $\chi 2_T = 4.61$, $\chi 2_C = 1.8620$, $\therefore \chi 2_T > \chi 2_C$

$\therefore$ Insignificant





IV. DISCUSSIONS

Important finding in faculty position (B) is that students feel uncomfortable in the classroom due to insufficient light or cross ventilation or both as shown in above Figures. The male students' performance is decreased due to insufficient light and female students got affected due to improper cross ventilation. And jointly they affect the students listening performance in the classroom. It might be possible when male students could not recognize a word on the blackboard or on their notebooks and they loose their concentration and their learning is adversely affected. On other hand female students might be feeling uncomfortable due to suffocation and their performance is decreased. This findings get support from previous researches e.g. In order to ensure a certain minimum level of ergonomic performance it was important to measure, control and reduce reflections of ambient light sources from the visual display screen, Menozzi and Kriiger [8]. Gavhed [9] while conducting a study on working conditions in a call centre emphasized the need to follow the directives and recommendations related to visual ergonomics to prevent discomfort as the various sources of ambient illumination such as windows, bright walls, ceiling luminaries, light bulbs, etc. might be reflected by display screen thus reducing the contrast of the displayed information leading to visual discomfort or sometimes disabling visual information recognition, Becker [10]. According to Menozzi and Kriiger [8] the refocusing of the operators' eyes between the information on the screen and the images of various light sources caused visual stress and fatigue. Ambient illumination was an important factor in VDU workplace design and many recommendations existed regarding ambient illumination. An ambient lighting in the range of 200 to 450 lx (ANSI/HFS 100-1988, 1988) has been recommended for better working, Ostberg [11]. The study further showed that lower ambient illumination (200lx) and the normal office ambient illumination (450 lx) were appropriate for VDT work with regard to both visual recognition and subjective preference. Lin and Huang [12] showed that ambient illumination did not significantly affect character identification performance at normal office lighting levels.

V. CONCLUSIONS

Now on the basis of the findings and subsequent discussions the following conclusions can be drawn :

(*i*) In faculty position 'B' the students' performance was decreased due to insufficient light or cross ventilation or by both factors.

On the basis of conclusions, the following recommendations for improvement of the environment of the classroom are given below:

1. Proper illumination should be provided in the classroom
2. Adequate cross ventilation should be provided in the classroom.
3. By roof ceiling listening performance of the students may be increased.
4. By installing air conditioning system in the classroom.

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REFERENCES

[1] Larsen, JB,Vega, A, and Ribera, JE. The effect of room acoustics and sound-field amplification on word recognition performance in young adult listeners in suboptimal listening conditions. *Am Journal Audiol*, **17**(1)**:** 50-59(2008).

[2] Noweir MH, and Ikhwan MA. Study of noise pollution in Jeddah School. *J. Egypt health Association*, **69**(3-4)**:** 149-162(1994).

[3] Suter HA. Noise and its effects. http./www.noise.org/library/suter/suter.htm, (1991).

[4] Pawlaczyk-Luszczynska M, Dudarewicz A, Waszkowska M, and Sliwinska-Kowalska, M. Assessment of annoyance from low frequency and broad band noise. *Int. J. Occup. Med. Environ. Health*, **16**(4)**:** 337-43(2003).

[5] Pawlaczyk-Luszczynska M, Dudarewicz A, Waszkowska M, Szmczak W, Kamedula M, and Sliwinska-Kowalska M. The effect of low frequency noise on human mental performance Med Pr, **55**(1)**:** 63-74(2004).

[6] Smith, AP. Noise and aspects of attention. *B. Journal of Psychology*, **82:** 313-324(1991).

[7] I.A. Khan, Z. Mallick and Z.A. Khan. A study on the combined effect of noise and vibration on operators. Performance of the Readability task in a Mobile Driving Environment. JOSE, **13**(2)**:** 127-136(2007).

[8] M. Menozzi and H. Kriiger. Reflexionen am Bildschirm-Beurteilung der berfliicheneigenschaften, *Zeitschrift fiir Arbeitswissenschaft,* **44:** 240(1990) (inGerman).

[9] Gavhed, and Toomingas A. Observed physical working conditions in a sample of call centres in Sweden and their relations to directives, recommendations and operators comfort and symptoms. *International Journal of Industrial Ergo*., **37:** 790-800(2007).

[10] Becker ME. Eva. and Characterization of display reflectance. *Displays,* **19:** 35-54(1998).

[11] Ostberg O. Accommodation and visual fatigue in display work, In: E.Grandjean and E. Vigliani (Eds.) *Ergonomics Aspects of Video Display Terminals, Proceedings of the International Workshop*, Taylor and Francis, London, 41-52(1980).

[12] C.C. Lin and K.C. Huang. Effects of ambient illumination and screen luminance combination on character identification performance of desktop TFT-LCD monitors. *International Journal of Industrial Ergonomics*, **36:** 211-218(2006).