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Satisfaction Scale for Measuring Thermal Comfort and Illumination in Office

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ABSTRACT A suitable physical climate is needed if one wants to feel comfortable and efficient at work. The environment feels comfortable when you are barely aware of the climate conditions. It is only when temperature decreases and increases beyond ones' comfort limits that one becomes aware of discomfort. Artificial lighting is needed to provide task luminance and adequate visual environments to carry on the task when natural light is inadequate or not available. Good artificial illumination, prevent accidents, prospects health by minimizing eye strain and also contributes to the beauty in offices. Hence, presence study was undertaken with an objective to develop scale for measuring thermal comfort and illumination in office. As the scale was found to be reliable and valid, the developed scale will serve as a scientific tool for the measurement of thermal comfort and illumination in offices.

INTRODUCTION

A suitable physical climate is needed if one wants to feel comfortable and efficient at work. The environment feels comfortable when you are barely aware of the climatic conditions. It is only when temperature decreases and increases beyond ones' comfort limits that one becomes aware of discomfort (Jorn Toftum 2002). The comfort zone is about 20-22^{0}C for a clothed person in the winter and 20-24^{0}C in the summer. An increase in temperature above the comfort level may make one tired and sleepy. A decrease in temperature may make one restless and less attentive. People vary in their feelings about what is comfortable temperature and this depends on what they are doing and what they are wearing (Peter Hoppe 2003).

Light is effective when it corresponds to the visual needs of the worker. Morris defined good lighting as "the right kind and right amount of light at the right place". Sustainable lighting helps to avoid accidents, supports emotional and physical wellbeing and contributes to security. Knez and Enmarkar(1998), Galsiu and Veitch (2006) opined that artificial lighting is needed to provide task luminance and adequate visual environment to carry on the tasks when natural light is inadequate or not available. Good artificial illumination prevent accidents, prospects health by minimizing eye strain and also contributes to the beauty in offices. Hence, present study was undertaken with an objective to develop scale for measuring thermal comfort and illumination in offices.

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MATERIALS AND METHODS

The details of the steps followed in the construction of "scale to measure thermal comfort and illumination in office", have been discussed below.

Development of Self Rating Scale

Achievement of this study was measuring thermal comfort and illumination in office. The procedures for construction and standardization of the scale given by Edward (1969) were followed.

1. Collection of Statements

The major components and sub-components, which contribute to the thermal comfort and illumination were collected after reviewing of relevant literature and discussion with social scientists, environment engineers and metrology experts in the university.

The scale consists of two main heads. The first part deals with thermal comfort in office and second part deals with illumination in office. Hence, two main heads and 80 items were collected for the scale (Table 1).

Table 1: Details about items developed and finally retained in physical environment scale for office workers

S. No.	*Heads/Dimensions*	*Total number of items identified*	*No. of items retained after relevancy test*
1.	Thermal comfort in office	21	40
2.	Illumination in office	34	40
Total		55	80

2. Editing and Pre-selection of Items

Preliminary selection and editing of item were done as per the criteria suggested by Edward (1969). Two main components and 80 items were retained after preliminary screening.

3. Selection of Items

The inventory component was circulated among 20 panel members (10 experts and 10 subjects). They were asked to rate the appropriate statements and to add or delete them if they felt 50 on the basis of suggestions given and ratings of the panel members a modified list of statement was prepared.

The statements thus prepared were given to the same panel members for the relevance and face validity. The statements were rated for the response on a five point continuum viz. Highly satisfied (5), Satisfied (4), Neutral (3), Dissatisfied (2) and Highly dissatisfied (1).

The statements after being tested for the relevance and face validity and language were then given to 70 office workers. Exclusive of the final sample, the office workers were randomly selected from five offices, Administrative Office of Marathwada Agricultural University, Zilla Parishad Office, Collector Office, Municipal Office, District Welfare Office of Parbhani city. The office workers were requested to express their feelings of satisfaction with each statement on the five point continuum.

4. Item Analysis

The subjects were arranged in an ascending order based on the scores obtained by them, the top 25 per cent of the subject with higher scores (high groups) and 25 per cent subjects with lower scores (low groups) were used as criteria group. The middle 50 per cent respondents were deleted. The responses were analyzed to determine which of the items discriminate most clearly between high and low groups.

For evaluating the response of the high and low group to the individual statements, the 't' value was calculated by applying the following formula suggested by Edward (1969).

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\{\Sigma(X_H-\bar{X}_H)^2 + \Sigma(X_L-\bar{X}_L)^2\}.(1/n_1+1/n_2)}{(n_1+n_2-2)}}}$$

Where $\Sigma (X_H-\bar{X}_H)^2 = X_H^2 - \frac{(\bar{X}_H)^2}{n_1}$

and $\Sigma (X_L-\bar{X}_L)^2 = X_L^2 - \frac{(\bar{X}_L)^2}{n_2}$

The value 't' was a measure of the extent to which a given statement differentiates between the high and low group based on the 't' values, the statements with largest 't' values were selected for the scale.

5. Testing the Validity and Reliability of the Scale

The validity of test or of any measuring instrument depends upon fidelity with which it measures what it purports to measure. A test is valid when the performance which measures corresponds to the same performance as otherwise independently measured or objectively defined. Validity is a relative term (Garrett 1981).

Kerlinger (1978) defined reliability as accuracy or precision of a measuring instrument. A scale can be said to be reliable only when it will consistently produce the same result when applied to the sample any number of times. Reliability of the scale was assessed by split half method.

The split half method is employed when it is not feasible to construct parallel forms of the test nor advisable to repeat the test itself. One of its main advantages is the fact that all data for computing reliability are obtained upon one occasion, so that variation brought about by differences between the two testing situations are eliminated (Garrett 1981).

For calculating the reliability, the scores for the 55 statements finally selected for the scale were given to 70 office workers, who were randomly selected. The scores thus obtained were split up as statements with even numbers and statements with odd numbers. Spearman Brown prophecy formula for estimating reliability from two comparable halves of the test (Garrett 1981).

Hence, the reliability coefficient of half test for part A (thermal comfort) at the scale was 0.80 and the reliability coefficient of the whole test for this part was 0.88. Thus, it was found to be positively significant and the reliability coefficient of half test of part B (Illumination) at the scale was 0.76 and the reliability coefficient at the whole test for this part was 0.86 this also found to be positively significant.

Self Rating Scale of Office Workers

The mean score of each item was calculated by multiplying frequency of response with the weightage and dividing the number of respondents. Based on the scores obtained following classification was made.

Category	*Marks*
Highly satisfied	2.50-3.00
Satisfied	3.01-3.50
Neutral	3.51-4.00
Dissatisfied	4.01-4.50
Highly dissatisfied	4.51-5.00

Self Rating Scale for Thermal Comfort and Illumination in Office

The scale consists of two main heads. The first part deals with thermal comfort in office and second part deals with illumination in office. Office workers have to rate their performance by ticking against each statement under given five point continuum. (Highly satisfied -5, Satisfied -4, Neutral -3, Dissatisfied -2, Highly dissatisfied -1).

CONCLUSION

As the scale was found to be reliable and valid, the developed scale will serve as a scientific tool for the measurement of thermal comfort and illumination in offices.

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APPENDIX

DEVELOPED SCALE

S. No.	*Statements*	*1*	*2*	*3*	*4*	*5*
I Thermal Comfort in Office:How Much Satisfied Are You About:						
1.1	Temperature in office?					
1.2	Humidity in office?					
1.3	Provision of fan?					
1.4	The ventilation?					
1.5	The placement of workstation?					
1.6	The temperature during morning?					
1.7	The temperature during afternoon?					
1.8	The temperature during evening?					
1.9	The location of fan?					
1.10	The provision of curtains?					
1.11	The provision of cooler / AC?					
1.12	The windows?					
1.13	The size of office?					
1.14	The air flow at workstation?					
1.15	The location of workspace?					
1.16	The cushion of chair?					
1.17	Weared clothing?					
1.18	Plants near the windows?					
1.19	Drought in office?					
1.20	Placement of workstation?					
1.21	Exhaust fan?					
II Illumination in Office How Much Satisfied Are You About:						
2.1	Light fixtures?					
2.2	Type of light provided?					
2.3	Direction of light?					
2.4	The wattage of tubes?					
2.5	Natural light?					
2.6	Artificial light?					
2.7	Control safety?					
2.8	The type of wiring?					
2.9	Placement of light?					
2.10	The shielding provided for light?					
2.11	The workplace light?					
2.12	The intensity of light?					
2.13	The table cloths?					
2.14	The color of walls?					
2.15	The carpet color?					
2.16	Illumination in office for reducing risk of theOccupational accidents?					
2.17	Illumination in office for reducing risk of the Health problems?					
2.18	Better concentration & accuracy of work?					
2.19	Improved work performance?					
2.20	Better visibility?					
2.21	Increased Work speed due to available light in office?					
2.22	Position of light sources?					
2.23	The height, width & position of windows?					
2.24	Placement of light fixtures?					
2.25	Location of workplace?					
2.26	Ceiling & wall colors?					
2.27	Trees around the office due to prevent or diminishDirect glare from the sun?					
2.28	General light?					
2.29	Work station light?					
2.30	Curtains for avoiding glare?					
2.31	Appropriate Colors are used for workstation background?					
2.32	Wattage of lamp/Tub?					
2.33	Regarding to the safety of light fixtures?					
2.34	Reflector for light					