Classroom interior of high schools in Dharwad

■ J. MEENAKSHI AND P.R. SUMANGALA

See end of the paper for authors' affiliations

J. MEENAKSHI
Department of Family Resource
Management, College of Rural
Home Science, University of
Agricultural Sciences, DHARWAD
(KARNATAKA) INDIA
Email : meenasweety.meenakshi
@gmail.com

■**ABSTRACT :** School children workplace design and dimensions play a major role in influencing their learning performance. A total sample of six classrooms of high schools was selected purposively for the study. The existing physical interiors were recorded and compared with the BIS recommendation. The results revealed that classroom size, window size, illumination level on students desktop were found to be less than the recommended BIS standards. Also furniture dimensions such as bench height and desk height were found to be higher than the standard. It can be concluded that there is a need to redesign the interiors of the classroom for improved comfort of the users.

■**KEY WORDS:** Classroom interior, High school, Classroom furniture, Illumination

■ **HOW TO CITE THIS PAPER :** Meenakshi, J. and Sumangala, P.R. (2015). Classroom interior of high schools in Dharwad. *Asian J. Home Sci.,* **10** (1) : 221-226.

Children are the wealth of every country. A school is a place of work for children. Schools, being the ideal setting for promoting learning, stimulate positive change among children and subsequently, in turn, the community. Special attention should be paid to meet the needs of this group, constituting one fifth of our country's population (Khader, 1997).

A classroom is suitable for learning when it supports the acquisition of knowledge and skills and thus, has a positive influence upon the learning process. Teaching and learning are more effective in a well-designed environment, just as performance can be increased at well-designed workplaces. As at other workplaces, the familiar essential principles of ergonomic design should be applied at places of learning, *i.e.* in classrooms. An ergonomically well designed classroom improves learning and achievement. It also leads to improved performance and satisfaction of the students. The environment in which one teaches is just as important as the material being taught. The internal physical environment consists of variables like lighting, ventilation, temperature, noise, furniture, colour, humidity, shape and size which influence the learners comfort, their work performance and mental efficiency (Kumari, 2003). One of the important physical environment considerations in classroom is lighting which has long been overlooked by administrators as a secondary consideration in classroom design in terms of budget during the planning process. The design of suitable classroom furniture is complicated by the fact that classroom work involves a variety of tasks and postures but also by the diversity of students' body dimensions (Yeats, 1997). Anthropometric studies in schools have found that classroom furniture was mismatched with large numbers (sometimes as many as 80–100 %) of students and research has indicated that learning might be affected as a result (Parcells *et al.*, 1999 and Legg *et al.*, 2003). The application of anthropometric data in a conventional way (designing for the 95th percentile) is

not expected to meet the needs of the largest and smallest children. In practice, school furniture fits far fewer than 95 per cent of children (Karwowski, 2006). Also it is important for schools to have furniture that helps students to sit comfortably for longer periods, so they can concentrate on learning. Many studies (Grimes and Legg 2004; Corlett, 2006 and Trevelyan and Legg, 2006) indicated that there is a need for ergonomically designed interventions to make classrooms suitable places for long periods of sitting for study. The study conducted by Savanur *et al.* (2004) aimed at studying classroom interior environmental condition of a school in Mumbai, India. They found that mean area of classroom was 34.04 sq.m and the average class strength of 55 students which was much higher than the acceptable class strength. Also they found the mean illumination level of the classroom interiors as 157.5 lux. Winterbottom and Wilkins (2009) reported that mean illuminance of the classrooms were ranged from inadequate (38 lux) to excessive (in excess of 2500 lux – the upper limit of the meter) and also they found that in many classrooms, high illuminance levels in one area of the classroom were accompanied by much lower levels in another area, which itself could contribute to enhanced visual discomfort and/ or reduced task performance. Research studies highlighted that both natural daylight and appropriate artificial illumination are critical to the quality of student performance, lighting should be carefully addressed in new construction and modernization projects of classroom design. Hence, the available illumination on the student's workstation should be considered. Thus, the present study was aimed to study the existing classroom interior environment of the high schools of Dharwad.

■ **RESEARCH METHODS**

The study was conducted in Dharwad city of Karnataka. The selection of High schools was based on purposive sampling. A total sample of six high schools (3 government schools and 3 private schools) was selected for the study. One classroom of 9th standard from each school was selected for taking the measurements of existing interior. For recording the existing classroom physical environment of the selected classrooms, a checklist was developed. The information on classroom interior components *viz.,* classroom size, clearance space between the furniture, furniture dimensions, clearance space available for students, chalkboard dimensions were recorded by using non-stretchable metallic measuring tape and illumination level was recorded by using digital lux meter (LX-101A). The lux meter was used for measuring both natural and artificial light in the selected classrooms at different time intervals *i.e.,* at 10 am, 1 pm and 4 pm. The data was collected during the month of June – July, 2014 and the general weather condition was found to be cloudy day with drizzling. Also a sample of 200 students was selected for further data collection regarding their opinion on classroom interiors.

■ **RESEARCH FINDINGS AND DISCUSSION**

The research findings obtained from the study have been discussed under the following sub-heads:

Existing physical interior of the classroom :

It is evident from Table 1 that majority of the selected classrooms were located in the ground floor (school 1 to 4). The area of the classrooms varied from 28 sq.m to 57.26 sq.m., with one school (school 2) fulfilled the BIS recommendation (50.37 sq.m) and the remaining schools were less than the standard. The ceiling height was found to be varied from 9 ft to 12 ft in the selected classrooms except in one classroom (school 1); it was 22 ft high, as the roof of the classroom was made of red clay tiles. The common classroom flooring was observed to be cement flooring, kadappa stones and mosaic tiles whereas the walls were made of cement plastered with white wash in most of the classrooms. Window floor area ratio in the selected schools (6.56 to 11.05 %) were found to be less than BIS recommendation of not less than 15 per cent of the floor area, except in school 4, it was found to be 15.78 per cent. The sill height varied from a minimum of 50 cm to 77.5 cm in the selected classrooms which was found to be within the recommended sill height of 80cm. In school 1 (95 cm) and school 4 (140 cm), the sill heights of the windows were found to be above the BIS recommended level which might prevent the natural daylight to fall on the work surface area of students. The door dimensions varied from 6 ft to 7 ft in length and 3 ft to 4 ft breadth in the selected classrooms. The doors of all the classrooms were made of wood except in school 3, it was metal.

Existing classroom furniture :

A combined unit of bench and desk (sled desk model) for three seaters was the common type of furniture in

Table 1 : Existing physical interiors of selected classrooms in government and private schools

Physical interiors		Government schools			Private schools			BIS recommendation (IS 8827:1978) (Selected schools – 6)
		School 1	School 2	School 3	School 4	School 5	School 6	
Classroom location		Ground floor	Ground floor	Ground floor	Ground floor	Second floor	First floor	--
Classroom size – L* B* H in ft (Area in sq.m)		20*18*22 (33.55 Sq.m)	44*14*9 (57.26 sq.m)	20*15*10 (28.06 sq.m)	22*20*11 (40.87 sq.m)	26*12*12 (29.23 sq.m)	25*20*12 (46.97 sq.m)	24'4"*23'*10' (50.37 sq.m)
Floor finish		Cement concrete	Cement concrete	Kadappa stone	Ceramic tiles	Kadappa stone	Ceramic tiles	--
Wall finish		White wash	White wash	brown distemper	yellow distemper	Blue distemper	White wash	--
Ceiling		Red clay tiles	RCC	RCC	RCC	RCC	RCC	--
Window	Dimensions and area	3'4"*3'6" (1.1)	4'*3' (1.00)	3'10"*2'10" (1.006)	4'1"*4' (1.62)	4'*3'5" (1.27)	4'*3'9" (1.39)	--
	Sill height	95.0	75.0	67.5	140.0	77.5	50.0	Not more than 80 cm from floor level
	No. of windows	2	6	3	4	2	3	--
	Window – floor area ratio (%)	6.56	10.48	11.05	15.78	8.69	8.90	Not less than 15 % of floor area
Door	Dimensions (L*B)	6'*3'	6'*3'	6'*3'	6'*42'	7'*32"	6'*4'	--
	Material	Wood	Wood	Metal	Wood	Wood	Wood	--

Table 2 : Existing furniture dimensions in the selected schools

Existing furniture dimensions (cm)		Category of school						BIS recommendation (IS 4837: 1990)	Remarks
		Government schools			Private schools				
		School 1	School 2	School 3	School 4	School 5	School 6		
Bench	Height	47.5	45.0	45.0	50.0	40.0	45.0	38.3	Higher than the BIS standard
	Depth	30.0	25.0	30.0	25.0	22.5	25.0	35-37	Narrow
	Length (3 seaters)	120.0	105.0	105.0	120.0	150.0	112.5	38 / one seater	Sufficient
	Backrest height	-	-	-	-	-	-	31-33	--
	Backrest width	-	-	-	-	-	-	28	--
Desk	Height	77.5	75.0	72.5	30.0	65.0	77.5	64.3	Higher than the standard
	Length/number of students	120.0/3	105.0/3	105.0/3	120.0/3	150.0/3	112.5/3	45.0/1 ; 105.0/2	Sufficient
	Depth	35.0	32.5	32.5	37.5	35.0	32.5	45.0	Narrow
	Underneath of the desk height	50.0	55.0	55.0	50.0	45.0	62.5	58.0	--
	Footrest height	-	7.5	12.5	7.5	7.5	7.5	Nil	--
	Desk slope (in degree)	10	2	5	6	5	10	16	Less slope
Space between bench and desk		24.0	25.0	24.0	17.5	24.0	24.0	Nil	--

all the selected classrooms. Majority of the classroom furniture in the selected classrooms was found to be made of wood. There was a distinct variation in the dimensions of classroom furniture (Table 2). Regarding the existing bench height (40–50 cm), it was found to be higher than the BIS recommended seat height (38.3 cm) which would result in the underside of the thigh muscles being compressed and causing discomfort and restriction in blood circulation. The existing bench depth (22.5 to 30 cm) was narrower than the BIS recommended seat depth of 35–37 cm; the bench length (105 to 150 cm) was found to be sufficient for seating arrangement of 3 students according to BIS standard (38 cm per student). None of the classroom benches had backrest for back support.

Desk height (65 cm to 80 cm) was found to be higher than the recommended height (64.3 cm) in majority of the selected schools except in school 5, which might results in the working arm to be raised and to compensate this, the shoulders had to be raised or abducted placing a stress on the deeper posterior neck musculature to provide stabilization of the head posture. The measurements of existing desk length and desk depth were found to be lower than the BIS standards. Also underneath of the desk height from the floor was found to be lower than the BIS standard (58 cm) for 50 per cent of selected schools while, it was found to be high in the remaining 50 per cent of schools. The provision of footrest under the desk was found and its height varied from 7.5 cm to 12.5 cm. The slope of the desk (2^0 to 10^0) was less in all the classroom desk against the recommended slope (16^0). The space between bench and desk was fixed and its distance ranged from 17.5 cm to 25 cm. Thus, both the existing bench and desk measurements of the selected schools were not in conformance with the BIS recommendation, this could results in the students to adopt awkward posture and cause discomfort in the form of pain in various body parts.

Existing illumination level on students desktop :

Table 3 presents the existing illumination level in the selected schools of Dharwad. The data presented in the table discloses that only school 1 under government management and school 5 and 6 under private management had combination of natural day light and artificial light. In school 1, the existing mean illumination level in the morning (57 lux) was comparatively more than afternoon (28 lux) and in the evening (37 lux). The daylight on the student's desktop in the classroom of school 1 comparatively was more in the morning than in afternoon and in the evening. However, mean daylight was found to be 41 lux which was comparatively below than the BIS recommended illumination level (150 - 300 lux). However, when artificial lighting was considered along with daylight, the mean illumination level was increased to the extent of 69 lux in the morning, 35 lux in the afternoon and 44 lux in the evening.

In school 2, the mean illumination level was found to be more in the afternoon (285 lux) than in the morning (232 lux) and evening (167 lux). Overall, the mean illumination (228 lux) on the students desktop was found to be within the recommended lighting level. However, window floor area ratio (10.48 %) was found to be less than the recommended ratio (not less than 15 % of floor area), but the mean illumination level (228 lux) was found to be within the recommended level. In school 3, the illumination level in the morning (258 lux) and afternoon (365 lux) was more and within the recommended level but it was less in the evening (67 lux). Overall, mean

Table 3 : Existing illumination level on students' desktop in selected schools of Dharwad						
Schools	Source of lighting	Illumination level (lux)				
		Morning	Afternoon	Evening	Mean	BIS standard (IS 8827:1978)
School 1	Natural light alone	57	28	37	41	150 - 300 lux on students desktop
	Combination of natural and artificial lighting	69	35	44	49	
School 2	Natural light alone	232	285	167	228	
School 3	Natural light alone	258	365	67	230	
School 4	Natural light alone	259	380	98	246	
School 5	Natural light alone	91	260	69	140	
	Combination of natural and artificial lighting	109	284	206	200	
School 6	Natural light alone	84	146	45	91	
	Combination of natural and artificial lighting	90	154	67	104	

illumination level (230 lux) was within the recommended range even though the window floor area ratio (11.05 %) was found to be less than the recommended ratio. In school 4, except in the evening (98 lux), the illumination was found to be sufficient during morning and afternoon. In general, the illumination level (246 lux) on the students desktop was found to be within the recommended level with the window floor area ratio (15.78 %) of more than the recommended ratio.

In school 5, the mean illumination level in the morning (91 lux) was less and it increased to 260 lux in the afternoon and then decreased to 69 lux in the evening. The mean natural illumination was found to be 140 lux which was almost nearer to the recommended lighting level. When artificial lighting was adopted, lighting level in afternoon (284 lux) and evening (206 lux) was found to reach the recommended range but it was less in morning (109 lux). In school 6, the mean illumination level in the morning (84 lux) was less when compared to afternoon (146 lux) and lesser in the evening (45 lux). In combination with artificial lighting, the mean illumination level was increased. The overall mean natural illumination level on the student's desktop was less (91 lux) and it was 104 lux in combined illumination. Both the illumination level was found to be less than the recommended illumination level. The window floor area ratio (8.90 %) was also found to be less than the recommended ratio.

Conclusion :

The results of the study revealed that considerable variation between the BIS recommendation and the existing physical interior parameters *viz.,* classroom size, window size, furniture dimensions and illumination level. Especially furniture dimensions such as bench height and desk height were found to be higher than the standard. This could lead to problems like fatigue, muscular stress and pain discomfort in different body parts also could results in students adopting poor posture while performing their classroom activities. The poorly illuminated classrooms could result in visual fatigue and discomfort for the students. It can be concluded that there is a need to redesign the interiors of the classroom for improved comfort of the users.

Acknowledgement :

Authors' affiliations:
P.R. SUMANGALA, Department of Family Resource Management, College of Rural Home Science, University of Agricultural Sciences, DHARWAD (KARNATAKA) INDIA
Email : sumangalpatre@yahoo.com

■ REFERENCES

BIS (2006). Recommendations for basic requirements of school buildings (IS 8827 : 1978), Reaffirmed, 2006.

Bureau of Indian Standards (1990). School furniture, classroom chairs and tables – Recommendations for 5 -17 years of age schoolchildren (IS - 4837: 2nd revision).

Corlett, E.N. (2006). Background to sitting at work: research-based requirements for the design of work seats. *Ergonomics,* **49** (14) : 1538 – 1546.

Grimes, P. and Legg, S.J. (2004). Musculoskeletal disorders (MSD) in school students as a risk factor for adult MSD: a review of the multiple factors affecting posture, comfort and health in classroom environments. *J. Human Environ. Syst.,* **7** (1) : 1 -9.

Karwowski, W. (2006). *International encyclopedia of ergonomics and human factors*, Taylor and Francis Group Publishers, London. 3728 pp. ISBN–9780415304306.

Khader, V. (1997). Anthropometric dimensions of primary school children (6-10 years) in Vallabah Vidyanagar, Gujarat. *Indian J. Nutr. & Diete.*, **34** : 15-19.

Kumari, D.R. (2003). Assessment of illumination and noise levels in classroom environment. Ph.D. Thesis, A.N.G. Ranga Agricultutal University, Hyderabad, A.P. (INDIA).

Legg, S.J., Pajo, K., Sullman, M. and Martell-Jones, M. (2003). Mismatch between classroom furniture dimensions and student anthropometric characteristics in three New- Zealand secondary schools, proceedings of the 15th congress of the international Ergonomics Association, Ergonomics for Children in Educational Environments Symposium, Seoul Korea. 395 – 397pp.

Parcells, C., Stommel, M. and Hubbard, R.P. (1999). Mismatch of classroom furniture and student body dimensions, *J. Adolescent Health*, **24** (4) : 265–273.

Savanur, C.S., Ghosh, S., Dhar, U. and De, A. (2004). An Ergonomic study of comparison between school classroom furniture and student's anthropometry. In: Proceedings of the National Conference on Humanizing Work and the Work Environment (2004). National Institute of Industrial Engineering, Mumbai 22–24 April; 2004. 41–48pp.

Trevelyan, F.C. and Legg, S.J. (2006). Back pain in school children – where to from here? *Appl. Ergon. Special Issue Fundamen. Rev.*, **37** (1) : 45 – 54.

Winterbottom, M. and Wilkins, A. (2009). Lighting and discomfort in the classroom. *J. Environ. Psychol.,***29** (1):63-75.

Yeats, B. (1997). Factors influence the postural health of school children. *Occupat. Health & Indust.Med.*, **37**(4):156- 157.

10th Year
★★★★★ of Excellence ★★★★★