

Effects of Furniture Ergonomics on Student's Satisfaction in a Library Facility

Dodo Mansir

Department of Building, Faculty of Environmental Design, Ahmadu Bello University, Zaria 810107, Nigeria

Abstract: Building occupants are not immune to ill-health as a result of time they spend in a building. This paper seeks to examine the effects furniture ergonomics have on student's satisfaction in the library of Universiti Teknologi Malaysia. A pilot survey was initially conducted in the library through a one-to-one interaction with students to fetch their opinions on the general effects of the furniture. An observation through several walkthroughs was also conducted by the researchers to compare and validate responses obtained. Two hundred and sixty-five students that come from fifteen nationalities are surveyed. A structured questionnaire is used to collect data on the respondents' opinions on the size, shape, arrangement and comfort of the furniture. Eta cross tabulation, Spearman's rho and Kendall's Tau-b are used to establish relationships. Results show that amongst the effects studied, there are significant positive relationships between students' satisfaction of furniture ergonomics as against back-strain and lack of concentration. This implies that the more the furniture arrangements, size and shape are perceived unsatisfactory, the more their effects on back-strain and lack of concentration towards the students. This paper further recommends that library management should see to designing IEQ (Indoor Environmental Quality) guidelines that will mitigate the effects of furniture ergonomics thus improving student's satisfaction.

Key words: Ergonomics, furniture, library, satisfaction, students.

1. Introduction

According to Andrew and Michael [1], a healthy working environment is that environment which is free from negative health contaminants thus contributing to an occupant's feeling of well-being. As such, the condition of a space enables building users to work productively and effectively [2]. Edwin et al. [3] assert that a building's indoor comfort can affect productivity when building occupiers are not physically comfortable in an indoor environment. This implies that humans cannot perform well and be satisfied in "less-than-ideal" environments.

Indoor environmental conditions of a building such as IAQ (indoor air quality), lighting, acoustics, and furniture ergonomics have gained attention as part of the growth in interest for occupant's satisfaction. As such, users of libraries are not immune to ill health because a

range of such indoor environmental factors have been found to cause problems amongst building occupants. As a result of the impacts of these parameters, a significant relationship between a building occupant's comfort level and his/her performance has been realized [4].

As stated by Croome et al. [5], poor furniture ergonomics in buildings can cause a reduction in performance. This signifies that the more uncomfortable the furniture of a building is, the more prone for a drastic drop in human performance to result. Researches conducted on furniture ergonomics are predominantly those related to office buildings (like works of Morris and Dennison [6]; David [7]). As for school libraries, researches of such are predominantly carried out on library staff (like works of James [8]; Reginald [9]) whereas there is not much on students. As such, this study seeks to bridge such gap.

Corresponding author: Dodo Mansir, lecturer, research fields: building information modelling.

2. Literature Build-Up

2.1 Evolution and Definitions of Ergonomics

Research like works of Ertugrul et al. [2] shows that documented interests in the relationship of people and their working environment started during the post-World War I era. Working behaviors/practices relative to working environments were studied and as a result of all such researches, the International Ergonomics Association was formed in 1959. From the research, areas covered in detail regarding furniture ergonomics were posture, the physique of working men and women, rest pauses, lighting, heating, and ventilation [8].

Ergonomics are defined as the study of how a workplace can best be designed for comfort, efficiency, safety and productivity. Ergonomics is thus a range of concepts that assists in maximizing the design of the interaction of the human beings with systems, working methods and environments [10]. For optimal efficiency and productivity level to a building occupant, a harmony must exist between the occupant's anatomy and the furniture. As such, a designer must take into account the safety, physical and mental capacity and productive potential of human beings.

2.2 Library Furniture

In order to satisfy the increasing demands on the effect of furniture ergonomics on IEQ (indoor environmental quality), researches are undertaken in different types of buildings. Audrey and Stan [11] opined that the focus on library furniture should not only be in the design, but also in the arrangement for practical use. As reported by James [8], the furniture items to consider in regards to the ergonomics for a library set-up are:

(1) Chairs

Periods of use of chairs may range from few minutes to several hours. The correct mixture of chair and desk height is essential to alleviate back strain. No seat or chair can meet the height requirements of all users, but consideration can be given to the width and

depth of a seat. A narrow seat can be uncomfortable to many users. Ideally, a seat width should be 400 mm minimum. This is essential to support the lower lumbar region. An adjustable backrest to support the lumbar regions should have a height of 170 mm to 250 mm with the height of the rest being 100 mm minimum. The depth of seats, the distance from the back to the front of the seat is sometimes so small that users feel uncomfortable. A seat depth of 380 mm to 470 mm is the ideal measurement. An important, but often neglected, aspect of chair design is the kind of material used on seat covering. PVC (polyvinyl chloride) may be easy to clean but a cloth covering, especially on computer chairs, enables the body to breathe and is more comfortable. Ideally, seats should be adjustable from a minimum height of 420 mm to a maximum of 500 mm, the adjustability being achieved by the use of a lift device found on the side of chairs. The addition of an armrest can alleviate pressure on the spine by giving support to the upper body. Ideally these chairs should be supported by a four-legged base.

(2) Desks

Desks available to students in libraries carry out several functions. There are general purpose desks for reading and taking notes. There are desks meant for online catalogue terminals and some other desks serve as workstations. Sometimes, desks available to students in many academic libraries are mainly of one type though having to carry out a number of functions. Students may find desks uncomfortable if they are too low or too high when using them. In library chairs and desks, footrests are often overlooked. They aid in relieving pressure on a person's leg especially for the shorter user and as such, can be very relaxing. Some desk dimensions in a library are: 600 × 1,200 × 750 mm high and 750 × 1,500 × 750 mm high.

(3) Shelving

Shelving is amongst the most significant feature of any library. As Cynthia and Megan [12] assert, shelving layout and design must be central to ease the accessibility of available materials. A convenient

height to shelving is crucial for the effective use of the library. Shelf aisles in university libraries should encourage students including the disabled to maneuver easily. It should also be designed to enable book transport using book trolleys. A minimum width of 1,000 mm should be allowed between shelf aisles. Trolley areas can have five to six shelf levels with a maximum shelf unit reaching height of between 1,500 to 1,800 mm. Shelves must be practical, long-lasting and pleasing to the eye. Convenient height of shelving is crucial for effective use of the library: too often top and bottom shelves are difficult to use for many users. A minimum distance between stacks of 914 mm prevents the aisles from appearing oppressively narrow and provides acceptable clearance for wheelchair users and book trolleys; also, the use of lower shelves will not be impaired by poor light. There are a number of other types of shelving. Face displays of periodicals, although wasteful of space, are popular with users who

are drawn to the items on display, often finding publications which they may not have been aware of. Spinners are more space-saving and consequently used in many libraries and shopping outlets to save space.

Furniture used in a library should be comfortable to use for short and long periods of time [13]. An understanding of the human body posture when using furniture is essential for designers. As such, furniture design and arrangements in relation to the human body should alleviate all effects arising from uncomfortable posture.

2.3 Frameworks for Furniture Ergonomics

The adopted parameter to study in this research is as shown in Fig. 1.

Relationship/association will be established between furniture ergonomics (relative to size, arrangement and comfort) and its effect on student's satisfaction as is depicted in Fig. 2.

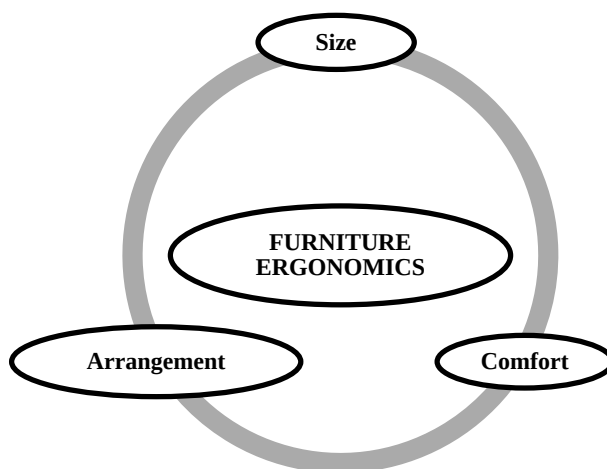


Fig. 1 Furniture ergonomics parameters.

Source: Researchers (2010).



Fig. 2 Relationships/associations to establish.

Source: Researchers (2010).

3. Methodology

3.1 Pilot Study

Initially, a pilot survey was conducted to fetch information on the general state of the furniture in the library of Universiti Teknologi Malaysia. Opinions of students regarding the corresponding effects of the libraries furniture's shape, size and arrangement were sought for through a one-to-one conversation. Also, a physical walkthrough was undertaken by the researchers to validate such opinions. Results from such revealed to the researchers that there was some form of imbalance between students' satisfaction and the furniture ergonomics.

3.2 Sample Size/Sampling Population

Data obtained from the library management show that a total of 1,324 students used the library (the case study building) on 12th April, 2010. This constitutes a peak use thus it is adopted as the targeted population of this research. As a means to relate the works of Thad [14] who used 20 percent of the targeted population, Nyuk and Wy [15] who used 16.6 percent of the targeted population and Ertugrul et al. [2] who used 20 percent of the targeted population, the researchers will thus adopt 20 percent (265) of this number (1,324) which will constitute the sampling frame of this research. Of the 265 questionnaires that were sent out however, a total of 203 (76.60 percent) were returned. This return rate is justifiable when compared with the return rate in the works of Ertugrul et al. [2] whose return rate was 73 percent and that of Cynthia and Megan [12] whose return rate was 75 percent.

3.3 Method of Data Collection

The research tool for this work was a structured questionnaire (refer to Appendix A). With the permission of library management, a random distribution of the questionnaire was done to the students. Some were filled and collected instantly while some were returned at a later time. Interviews were also conducted with

library management.

4. Data Analysis, Presentation and Discussion

4.1 Scales Adopted

To assess the effects of the furniture ergonomics in the questionnaire, the scale used was: (1) Unsatisfactory; (2) Somehow satisfactory; (3) Manageable; (4) Satisfactory; and (5) Excellent.

4.2 Data Reliability

Works of Zinbarg et al. [1] have indicated a minimum Cronbach's Alpha value of 0.7 to be an acceptable reliability coefficient. Results of this research gave a Cronbach's Alpha reliability value of 0.86 which depicts an excellent result.

4.3 General Comments from Pilot Study

Comments from the pilot survey on the furniture are as shown in Table 1.

It must be stated here that these results are pulled together from both the pilot survey and the physical walkthroughs conducted. Kindly refer to Appendix B for pictures of the furniture.

4.4 Personal Details of Respondents

Information on the personal details of respondents relating to their nationality and the approximate duration to which they use the library is fetched and is shown in the sub-sections to come.

Table 1 General comments on furniture ergonomics.

General comments
Uncomfortable size and shape of reading chair and desk for students over 6 feet tall;
No leg rests so chairs and tables are uncomfortable for long use;
Reflection from reading table;
Creaking noise of some reading tables;
Perspiration from using "leather seats";
Not enough "mount-ons" to get book on higher part of bookshelf;
Arrangement is somehow satisfactory.

Source: Field survey (2010).

4.4.1 Nationality of Respondents

Results obtained reveal that 58 percent (135 respondents) of the respondents surveyed are Malaysians while 42 percent (99 respondents) are international students (from more than 15 countries). Fig. 3 shows the proportion of coverage of nationalities for the respondents of this research.

It is a fact that the population of Malaysian students far outnumbers international students but this research however tries to achieve some uniformity by fetching as much data as possible from the international students as well. This is evident from the not so high difference (16 percent) in margin of local students to international students covered in this study.

4.4.2 Duration of Respondents Stay

Fifty-one percent of respondents stay in the library for less than 2 h, 45 percent stay between 3-6 h and 4 percent stay for over six h. Fig. 4 depicts the duration of respondents' stay.

Considering the fact that more than half (51 percent)

of the respondents use the library stay in it for less than 2 h (the proportion is unappealing), it seems obvious that there may be a cause. One major cause of such could be attributed to dissatisfaction of the indoor environmental condition.

4.5 Effects from Furniture Use

Results from Fig. 5 reveal that 2 percent of the respondents feel furniture arrangement is unsatisfactory, 11 percent feel it is somehow satisfactory, 22 percent opine it is manageable, 44 percent feel it is satisfactory and 21 percent consider it excellent. Also regarding the size of furniture, 5 percent consider such unsatisfactory, 11 percent say it is somehow satisfactory, 22 percent feel it is manageable, 40 percent believe it is satisfactory and 20 percent feel it is excellent. As for furniture comfort, 6 percent of the respondents consider it unsatisfactory, 9 percent opine it is somehow satisfactory, 21 percent feel it is manageable, 44 percent are of the opinion that it is satisfactory and 20 percent consider it excellent.

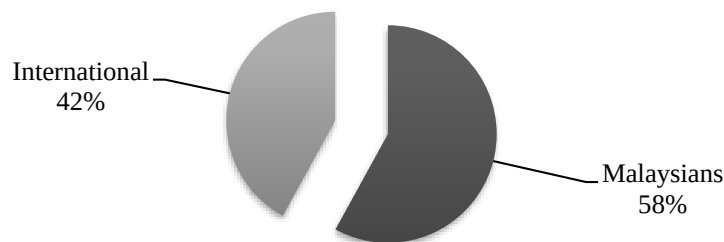


Fig. 3 Nationality of respondents.

Source: Field survey (2010).

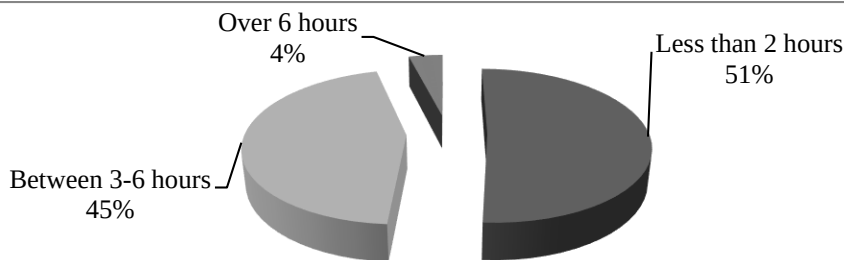


Fig. 4 Duration of respondents stay in library.

Source: Field survey (2010).

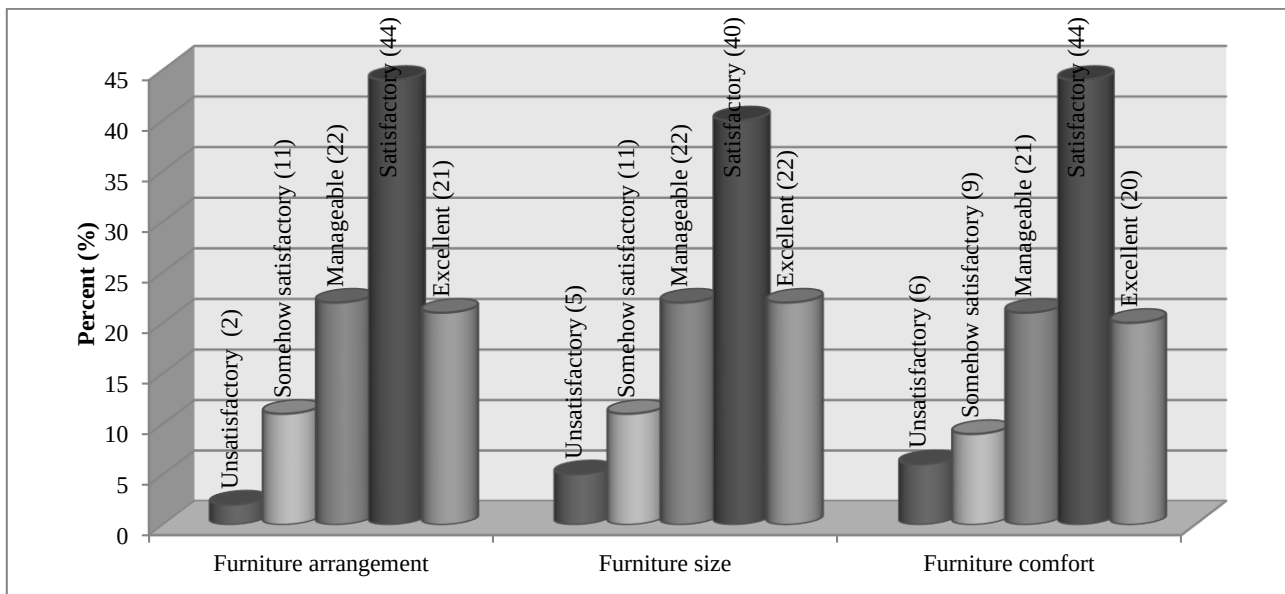


Fig. 5 Ratings of furniture arrangement, size and comfort.

Source: Field survey (2010).

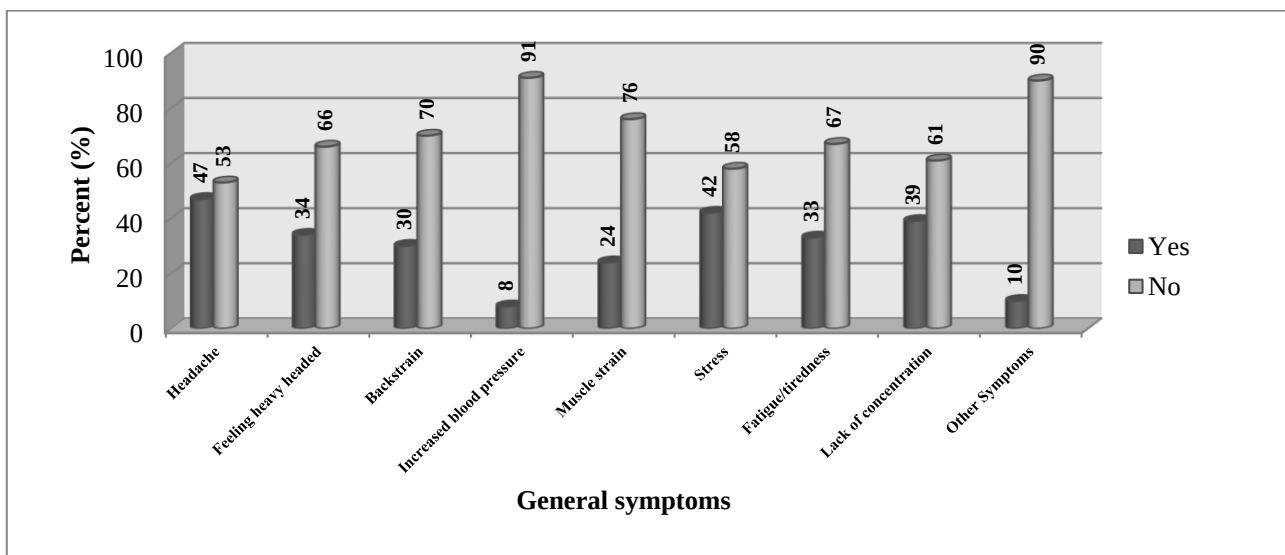


Fig. 6 Effects of furniture discomfort.

Source: Field survey (2010).

Thirteen percent of the respondents do not perceive the furniture arrangements to being at least manageable, 16 percent do not perceive the furniture size to being at least manageable and 15 percent do not perceive the furniture comfort to being at least manageable. It must be emphasized at this juncture that over 85 percent of the respondents that opined furniture ergonomics is unsatisfactory are international students. All these results obtained support the several comments made by the respondents during the pilot survey (Table 1).

4.6 General Symptoms Arising from Furniture Use

Fig. 6 shows the distribution of the general effects arising from furniture discomfort.

With reference to the section of the questionnaire that asked the respondents whether they experienced any of the general symptoms outlined in Fig. 6, results for these effects in a descending order indicate that more respondents experience headache (47 percent), then stress (42 percent), then lack of concentration (39

percent), then feeling heavy headed (34 percent), then fatigue/tiredness (33 percent), then muscle strain (24 percent) and then increased blood pressure (8 percent). Ten percent of the respondents also confessed to experiencing other effects related to discomfort in furniture ergonomics than those aforementioned.

4.7 Relationships between General Symptoms of Furniture Ergonomics and Student's Satisfaction

Relationships between furniture ergonomics and the general effects arising from furniture ergonomics are all positive in this study. They all range from a "small effect size" to a "small-to-medium" effect, which all are considered satisfactory. Results are as shown in Table 2.

Further analysis reveals the level of significance between furniture ergonomics and the general effects arising from furniture discomfort as depicted in Table 3.

Table 2 Eta square values from correlating furniture ergonomics and the effects of furniture discomfort.

Effects	Source	Furniture ergonomics
Headache		0.028
Feeling heavy headed		0.077
Back strain		0.112
Increased blood pressure		0.056
Muscle strain		0.051
Stress		0.081
Fatigue/tiredness		0.061
Lack of concentration		0.105
Other effects		0.032

Source: Field survey (2010).

Table 3 Significance level between furniture ergonomics and the effects of furniture discomfort.

Effects	Source	Furniture ergonomics
Headache		0.164
Feeling heavy headed		0.001
Back strain		0.000
Increased blood pressure		0.010
Muscle strain		0.018
Stress		0.001
Fatigue/tiredness		0.006
Lack of concentration		0.000
Other effects		0.112

Source: Field survey (2010).

There is a significant relationship (for $p < 0.001$) between furniture ergonomics satisfaction as against back strain and lack of concentration. All other effects (headache, feeling heavy headed, increased blood pressure, muscle strain, stress, fatigue/tiredness and other effects) are not significantly related (for $p < 0.001$).

4.8 Relationship between Effects of Furniture Ergonomics and Student's Satisfaction

Associations between general furniture ergonomics effects and student's satisfaction are all positive in this study. They all are of a "small effect size" to a "small-to-medium effect size" which is considered satisfactory. Results are as shown in Table 4.

Further analysis reveals the level of significance between student's and general furniture ergonomics effects as depicted in Table 5.

Table 4 Eta and Eta square values for satisfaction as against general effects from furniture ergonomics.

Independent	Dependent Students satisfaction (Eta values)	Students' satisfaction (Eta square values)
Headache	0.149	0.022
Feeling heavy headed	0.213	0.046
Back strain	0.260	0.067
Increased blood pressure	0.260	0.067
Muscle strain	0.307	0.094
Stress	0.222	0.049
Fatigue/tiredness	0.180	0.033
Lack of concentration	0.273	0.075
Other effects	0.089	0.008

Source: Field survey (2010).

Table 5 Significance levels of general effects from furniture ergonomics as against students satisfaction.

Independent	Significance	Students' satisfaction
Headache		0.023
Feeling heavy headed		0.001
Back strain		0.001
Increased blood pressure		0.000
Muscle strain		0.000
Stress		0.001
Fatigue/tiredness		0.006
Lack of concentration		0.000
Other effects		0.176

Source: Field survey (2010).

Results from Table 5 show that “other” effects are insignificantly related to student's satisfaction. Furthermore, headache; feeling heavy headed; back strain; stress; fatigue/tiredness; increased blood pressure; muscle strain; and lack of concentration are significantly related to student's satisfaction (for $p < 0.05$).

5. Conclusion and Recommendations

5.1 Conclusion

Ergonomics is a vast subject, covering many aspects of people and their working environment. Amongst the general symptoms studied results indicate that only back strain and lack of concentration are significantly related to student's satisfaction in relation to furniture ergonomics. This implies that the higher the effect in back strain and lack of concentration on the students, the higher these general effects of furniture ergonomics affect their (students') satisfaction and vice versa. As such, the more the furniture arrangements, size and shape is perceived not manageable, the more its effect on back strain and lack of concentration towards the students.

5.2 Recommendations

In line with the variables studied, this study recommends that an IEQ continual improvement guideline should be designed and validated by library management to be strategically feasible, physically practicable and cost effective. Also, the researchers are of the view that more in-depth analysis of such symptoms studied could yield several other results that may be detrimental to student's satisfaction and ultimately affect their performance or productivity.

References

- [1] Andrew, S., and Michael, P. 2009. “Sustainable Workplaces: Improving Staff Health and Well-Being Using Plants.” *Journal of Corporate Real Estate* 11 (1): 52-63.
- [2] Ertugrul, T., Ergin, S. V. L., and Metin, A. 2004. “A Qualitative Study of Facilities and Their Environmental Performance.” *Management of Environmental Quality* 15 (2): 154-73.
- [3] Edwin, H. W., and Chan, E. A. 2008. “Evaluation on Indoor Environment Quality of Dense Urban Residential Buildings.” *Journal of Facilities Management* 6 (4): 245-65.
- [4] Barry, P. H. 2008. “The Impact of Office Comfort on Productivity.” *Journal of Facilities Management* 6 (1): 37-51.
- [5] Clements-Croome, D. J., Awbia, H. B., Zs Bako, B., Kochhara, N., and Williams, M. 2008. “Ventilation Rates in Schools.” *Building and Environment* 43: 362-7.
- [6] Morris, A., and Dennison, P. 1995. “Sick Building Syndrome: Survey Findings of Libraries in Great Britain.” *Library Management* 16 (3): 34-42.
- [7] David, L. 1998. “Evaluating User Satisfaction: Case Studies in Australia.” *Facilities* 16 (5/6): 138-42.
- [8] James, R. 1994. “Ergonomics in Academic Libraries.” *Library Management* 15 (1): 26-35.
- [9] Reginald, C. 2002. “In Quest of an Ideal Library Environment: The Case of the Main Library, the University of West Indies, St. Augustine, Trinidad.” *Library Review* 51 (6): 287-92.
- [10] Mark, J. M., Terry, B., Lee, H., David, J. O, Francis, J. O., Bradley, H.T., Kenneth, M. W., Richard, C. D., and William, J. F. 2006. “Causes and Prevention of Symptom Complaints in Office Buildings: Distilling the Experience of Indoor Environmental Quality investigators.” *Facilities* 24 (11/12): 436-44.
- [11] Audrey, K., and Stan, A. 1996. “Productivity Paradox: Work Settings for Knowledge Work.” *Facilities* 14 (3/4): 6-14.
- [12] Cynthia, U., and Megan, T. M. 2008. “The Walls Speaks: The Interplay of Quality Facilities, School Climate and Student Achievement.” *Journal of Educational Administration* 46 (1): 55-73.
- [13] Adrian, L., and Bill, B. 1998. *Design for Manageability in Sick Building Syndrome: Concepts, Issues and Practice*. London: E. and FN Spon, pp. 135-50.
- [14] Thad, G. 1995. *Sick Buildings; Definition, Diagnosis and Mitigation*. Boca Raton: CRC Press Inc.
- [15] Nyuk, H. W., and Wy, L. S. J. 2003. “Total Building Performance Evaluation of Academic Institutions in Singapore.” *Building and Environment* 38: 161-76.
- [16] Zinbarg, R., Yovel, I., Revelle, W., and McDonald, R. 2006. “Estimating Generalizability to a Universe of Indicators That All Have an Attribute in Common: A Comparison of Estimators.” *Applied Psychological Measurement* 30: 121-44.

Appendix A: Sample of the questionnaire

Instruction: Kindly help me fill this to the best of your ability as it relates to your use of the main library (PSZ) in Universiti Teknologi Malaysia

Section A: Personal Details

(Kindly tick the most appropriate)

- (1) Nationality Malaysian ☐ Non-Malaysian (International) ☐
 (2) How long do you stay in PSZ? < 2 hrs ☐ 3-6 hrs ☐ Over 6 hrs ☐

Section B: Ratings of Furniture Ergonomics Parameters

(Kindly circle or tick the most appropriate)

KEY: Unsatisfactory (1); Somehow satisfactory (2); Manageable (3); Satisfactory (4) and; Excellent (5).

Furniture arrangement	Unsatisfactory	1	2	3	4	5	Excellent
Size of furniture	Unsatisfactory	1	2	3	4	5	Excellent
Furniture comfort	Unsatisfactory	1	2	3	4	5	Excellent

Section C: Ratings of Symptoms Arising from Furniture Use

(Kindly tick the most appropriate)

Do you experience any of the following?

GENERAL SYMPTOMS	RATING	
	YES	NO
Headaches		
Feeling heavy headed		
Back strain		
Increased blood pressure		
Muscle strain		
Stress		
Fatigue/tiredness		
Lack of concentration		
Other symptoms		

Appendix B

Photographs of library furniture



Plate I: Reflection and glare from lighting.
Source: Field Survey (2010).



Plate II: Library chairs and desks.
Source: Field Survey (2010).

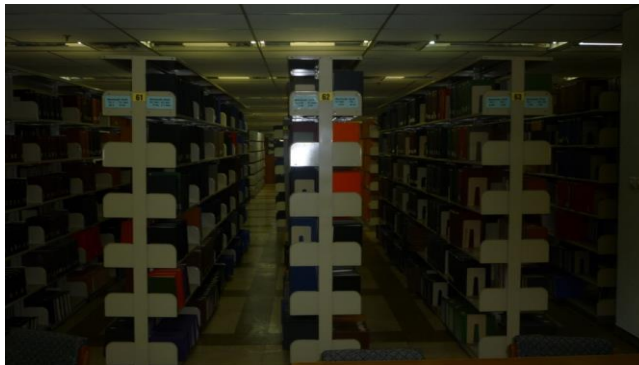


Plate III: Book shelves.
Source: Field Survey (2010).