

Students' Perceptions of University Library Spaces; Evidence from Government Universities in Sri Lanka

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Abstract - Academic libraries are fulfilling a special role in higher education institutes. It is one of the most important, memorable and highly functional spaces for campus communities. Conceptually, libraries are considered as the brains of universities. However, the rapid physical developments and growing student population of universities are demanding the well-designed and highly functional spaces within universities including libraries. Thus, it is important to know the perceptions of main stakeholders towards the spaces they used in campuses. Therefore, this study is predominantly focused to research the students' perceptions of university library spaces to incorporate in designer guidelines which can be used in practicing the library architecture in Sri Lanka. Thus, the methodology was adopted to find students' perceptions using a quantitative analysis. The structured questionnaire was circulated among the sample of 150 university students who use the library spaces representing the selected three case studies. Using IBM SPSS software, collected data were evaluated via the reliability tests, the mean value tests and the correlation tests. The issues pertaining with the case studies were prioritized on their levels of impact and the degree of negligence levels in common ground. The list of drawbacks that should be addressed, design recommendations and solutions for identified problems were provided individually to uplift the standards of all three case studies. Pierson correlations tests were also used to determine the relationship between demographic data and measured parameters. Finally, a check-list was presented to incorporate in designer guidelines to ensure the quality of academic library spaces.

Key words – Academic library, Undergraduates, Postgraduates, User perception, Design framework, Universities of Sri Lanka

I. INTRODUCTION

A library is a collection of resources selected by experts and accessible to a defined community for reference or borrowing. Further, a library provides physical or digital access to reading materials in many formats, as well as access to information, music or other content held on bibliographic databases (Xie and Matusiak, 2016). A library could be organized and maintained by a public body, such as a government, institution, corporation, or private individual. As explained in literature there are four major types of libraries such as, 1) Academic libraries which serve colleges and universities, 2) Public libraries which serve cities and towns of all types, 3)

School libraries which serve students from kindergarten to grade 12, and 4) Special libraries which are in specialized environments such as hospitals, corporations, museums, the military, private business, and the government (Fabian, 2002). However, the way of designing libraries has changed throughout history as a result of dynamics of modern life, as well as the modified requirements of readers and the rapid development of information technology (Applegate, 2009), (Korte, 2020), (Alison, 2016).

There are fifteen government universities in Sri Lanka and all these universities are having library facilities. Thus, optimum utilization of physical spaces in academic libraries have been always debated in the university education (Alison, 2016). Most of the designers have argued that academic library buildings in universities are characterizing the institutional legacies while creating spaces for academic collaborations, multi-model learning and social life within universities (Alison, 2016), (Kumar and Bhatt, 2015), (Lotfy *et al.*, 2022), (Beatty, 2016), (Soria, Fransen and Nackerud, 2013). However, most of the higher educational institutes are rapidly developing their built environment due to the gradual increase in the students' intakes in each year. Thus, it was questionable whether the designed spaces in the existing libraries are well-enough to serve the particular campus community, because concept of library architecture has been evolved with the time and the modern requirements. According to literature most of the academic buildings including libraries are having several functional drawbacks in the day-to-day operations due to issues such as, 1) limitations in design process, 2) upcoming demands due to modern technology and the number of users, 3) non-compliance with accepted library building standards, 4) haphazard conversion of existing buildings to library buildings, 5) minimum consideration of biological and psychological factors, 6) negligence of environmental factors, 7) non-compliance with physical factors, 8) unsuitable and undesirable stack spaces and working areas, 9) hindered accessibility to the location, 10) difficulties pertaining to maintenance, 11) external and internal appearances are not up to satisfaction, and 12) security and supervision difficulties (Muhammad, Sapri and Sipan, 2014), (Abdul Lateef, Khamidi and Idrus, 2011), (Dawodu *et al.*, 2022), (Allison, 2015). Therefore, it was questionable whether the said qualitative parameters are simultaneously achieved in the academic libraries with these all the drawbacks found through literature. Having said that, it is important to understand the perceptions of university students towards the library spaces that they are

already using and the difficulties that they come-across while using the said spaces. A set of questions were aroused through the thought process such as, 1) what are the design parameters effect on quality of a space and user comfort?, 2) what are the perceptions of university students towards their existing library spaces?, 3) what are the most impactable parameters on the optimum usage of existing library spaces?, and 4) how user perceptions can be used to improve the quality of library spaces in universities?. To find answers to the questions, a comprehensive literature review was done. Unfortunately, there are very limited literature found on library architecture in Sri Lanka. Thus, the need of studying the particular subject area formed set of research objectives as follows;

- i. To identify the parameters impact on quality of a space and user comfort through a comprehensive literature review.
- ii. To identify the perceptions of university students on usage of their existing library spaces and analyze the specific set of parameters affecting library space usage.
- iii. To prepare a check-list which could be used to develop designer guidelines to enhance and maintain the quality of library spaces based on user perceptions.

To achieve the above three objectives following research methodology was designed. (See Figure 1)

II. METHODOLOGY

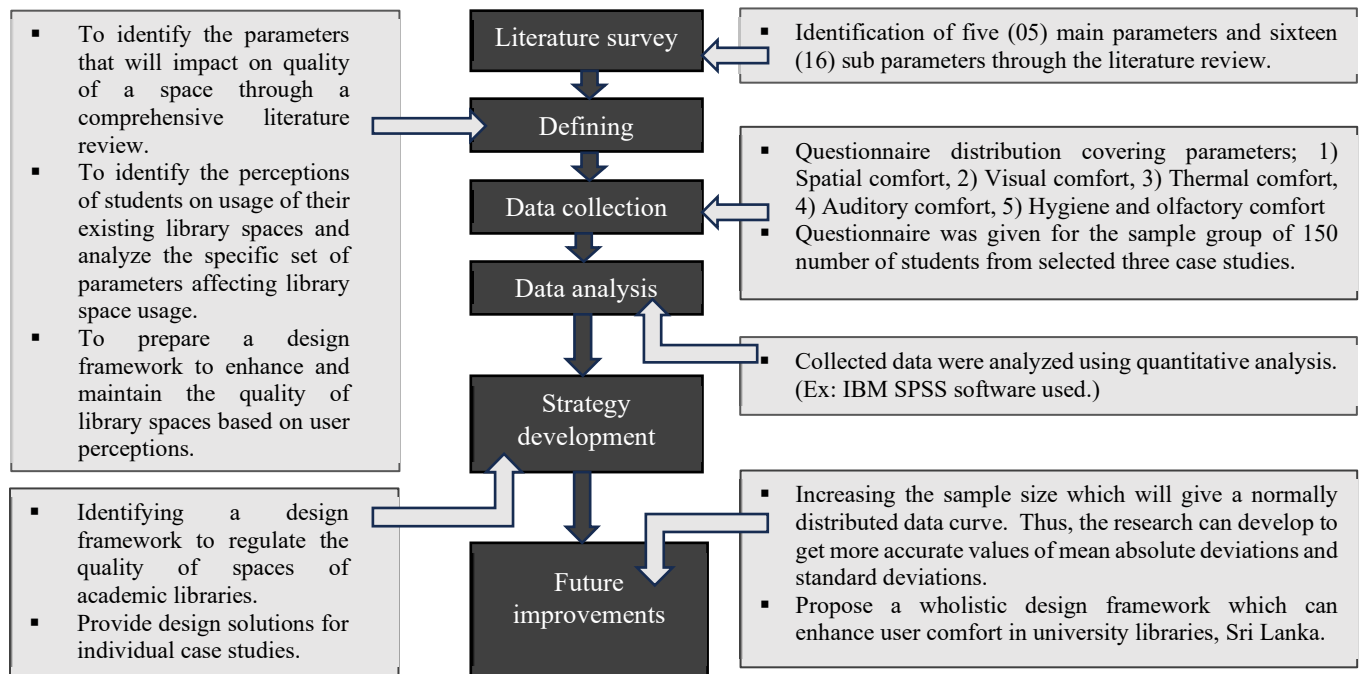


Figure 1. Research Design

Source: Author

A comprehensive literature survey was conducted to analyze the different parameters impact on a quality of space. Further, different frameworks, guidelines, and standards which were used to design and construct the academic libraries in global and local context were referred to understand the existing practice of the library architecture. The five (05) main

parameters and sixteen (16) sub parameters were identified which can be impacted on quality of space and the user comfort (Lotfy *et al.*, 2022), (Zhou *et al.*, 2021), (Shiwa, Fukumoto and Nitamizu, 2023), (Javdani, 2015), (Alison, 2016), (Qi, Huang and Zhang, 2019), (Frontczak and Wargocki, 2011), (Al horr *et al.*, 2016), (Dong *et al.*, 2022), (Kawshalya, Weerasinghe and Chandrasekara, 2022), (Mewomo *et al.*, 2023), (Kaushik *et al.*, 2021), (Lee *et al.*, 2022), (Paevere, 2008), (Alison, 2016) and (Hsu, Chin and Yau, 2022). A structured questionnaire was designed based on the identified parameters to evaluate the perceptions of university students who are using academic libraries.

A. Sample Selection

Three case studies were selected as stated in Table 1.

Table 1. Selected Academic Libraries

Case study No:	Name of university that selected academic library belongs to,	*Abb.	Members	Daily users
01	University of Kelaniya	UKL	16,140	4,325
02	University of Moratuwa	UML	10,258	2,226
03	University of Ruhuna	URL	12,626	3,060

Source: Author (*Abb. – Abbreviation)

Fifty (50) number of university students (undergraduates and postgraduates) were randomly selected from each university to conduct the questionnaire survey. Altogether, 150 number of students (undergraduates and postgraduates) were randomly selected to participate the questionnaire survey. Similarly, self-observation of the physical spaces was done

incorporating with a photographic survey to identify the existing spatial qualities and the issues pertaining to the selected case studies. The Figure 2, Figure 3 and Figure 4 show the interior images of selected case studies.



Figure 2. Case Study - 01- Interior of UKL
Source: <https://www.kln.ac.lk/>



Figure 3. Case Study - 02 - Interior of UML
Source: <https://uom.lk/lib>

B. Scope and Limitations

The research was conducted in the middle of Covid-19 pandemic, so it was difficult to collect a large data set. Thus, only 150 complete responses were filtered among all the responses were received through the questionnaire survey conducted among university students of the selected three number of government universities. Due to limited sample size, mean values and standard errors of mean values are considered to interpret the findings of this research.



Figure 4. Case Study - 03 - Interior of URL
Source: <https://www.ruh.ac.lk/>

C. Data Analysis

The questionnaire was developed using the literature summary. The questionnaire includes two sections as section 'A' and 'B'. Section – A encompasses with the questions to collect 'general background information'. Section – B was prepared using the specific parameters identified through literature review, which are directly affecting to the quality of spaces and user comfort (Lotfy *et al.*, 2022), (Zhou *et al.*, 2021), (Shiwa, Fukumoto and Nitamizu, 2023), (Javdani, 2015), (Alison, 2016), (Qi, Huang and Zhang, 2019), (Frontczak and Wargocki, 2011), (Al horr *et al.*, 2016), (Dong *et al.*, 2022), (Kawshalya, Weerasinghe and Chandrasekara, 2022), (Mewomo *et al.*, 2023), (Kaushik *et al.*, 2021), (Lee *et al.*, 2022), and (Paevere, 2008). There are five (05) main parameters and sixteen (16) sub parameters incorporated in the Section - B as follows;

1) Section - A: (Independent variables)

- i. General background information
 - a) Gender
 - b) Age
 - c) Education level
 - d) Number of hours spend daily in the library

2) Section - B: (Dependent variables)

- i. Spatial comfort (Sc)
 - a) Space recognizability and accessibility
 - b) Space allocations and configuration
 - c) Space for current needs and future developments
 - d) Interior space arrangement
- ii. Visual comfort (Vc)
 - a) Lighting levels and qualities
 - b) Balance of contrast and disturbed objects
 - c) Colours and colour temperature
 - d) Presence or absence of glare
- iii. Thermal comfort (Tc)
 - a) Air temperature and freshness
 - b) Radiant temperature
 - c) Humidity
 - d) Air movement

- iv. Auditory comfort (Ac)
 - a) Outdoor sounds
 - b) Indoor sounds
- v. Hygienic and olfactory comfort (Hc)
 - a) Micro organisms
 - b) Dust and smells

Section – B of the questionnaire is basically designed to provide answers according the five-point Likert scale ranging from “Strongly agree” to “Strongly disagree”. (See Table 2)

Table 2. Five-point Likert scale used to weight the responses

Strongly Agree	(1)
Agree	(2)
Neutral	(3)
Disagree	(4)
Strongly disagree	(5)

Source: Author

The questionnaire was distributed via a google sheet to fill among randomly selected students of three universities. The collected data were filtered to gather the compete responses and quantitative analysis was conducted using IBM SPSS software. The reliability test, normality test, correlation test and the mean value test were used to analyse the data and evaluated the user perceptions over user comfort parameters. As explained in literature, reliability analysis allows to study the properties of measurement scales and the items that compose the scales (Chiang, Jhangiani and Price, 2015). A normality tests was conducted to check whether the collected data sample has the normal distribution or not. The correlation analysis was used to investigate the relationship between the variables. The mean value test was used to identify the tendency of user perception on each question designed to evaluate the five parameters. As per the Likert scale, answer number three represents the neutral position. When it reaches less than three, the tendency of user perception represents the area of good or positive, and more than three represents the bad or negative side. The average value ‘03’ represents the neutral position and cut off lines lays as follows;

- i. Average < 2.5 : Positive (existing conditions are good)
- ii. Average 2.5-3.5 : Neutral
- iii. Average > 3.5 : Negative (existing conditions need to be developed)

III. RESULT AND DISCUSSIONS

A. General Background Information

The University of Kelaniya Library (UKL) was represented by 50 users, with 82% undergraduates and 18% postgraduates. The 22% of library users are male and 78% are female. The 92% of these users are aged 20-29 years old and 8% are 30-40 years old. The number of spending hours in the library is divided into two categories such as 18% spend less than 01 hour and 82% spend 01- 04 hours. The preferred seating locations are 66% close to a window directly open to an outdoor view, 14% in the center of the building, 12% directly connect with landscape (outside of the library) and 8% other.

The University of Moratuwa Library (UML) was represented by 50 users, with 68% of undergraduates and 32% postgraduates. The 34% of library users are male and 66% are female. The 80% of the users are aged 20-29 and 20% are aged 30-39. No one is available in the category of 40 and above. The 08% of library users spend less than 01 hour, 84% spend 01- 04 hours, and 8% spend 04 - 08 hours. Preferable seating locations are 52% close to a window directly open to an outdoor view, 16% in the center of the building, 22% directly connect with landscape (outside of the library) and 10% other.

The University of Ruhuna Library (URL) was represented by 50 users, with 92% of them being undergraduates and 8% being postgraduates. 30% are male and 70% are female, with 92% representing the age group of 20-29 and 8% representing the age group of 30-39. No one is available in the category of 40 and above. 60% of library users spend less than 01 hour, while 40% spend 01- 04 hours. 46% of URL users prefer to be close to a window directly open to an outdoor view, while 14% URL users prefer to be in the center of the building. 28% users chose the seating locations directly connect with landscape (outside of the library) and 10% users preferred other seating locations respectively.

B. Reliability Test and Normal Distribution Test

Prior to conduct the analysis of collected data regarding five parameters, reliability tests were conducted for all the data to identify that whether the data are statistically suitable for further analysis. Additionally, normal distribution tests also were conducted and identified that respective data sets were not normally distributed. Thus, the standard error was calculated in each data set collected based on the parameters mentioned from Section B-i to B-v (Refer Table 3).

Table 3. Reliability and the standard errors of the variables

Variables		No. of questions	UKL	UML	URL
Spatial comfort (Sc)	Cronbach's alpha	14	0.934	0.861	0.798
	Standard error		0.081	0.067	0.055
Visual comfort (Vc)	Cronbach's alpha	12	0.709	0.709	0.742
	Standard error		0.076	0.047	0.049
Thermal comfort (Tc)	Cronbach's alpha	09	0.723	0.863	0.908
	Standard error		0.095	0.063	0.053
Auditory comfort (Ac)	Cronbach's alpha	04	0.736	0.754	0.745
	Standard error		0.085	0.081	0.071
Hygienic & olfactory comfort (Hc)	Cronbach's alpha	05	0.799	0.917	0.769
	Standard error		0.125	0.084	0.087

Source: Author

The Cronbach's alpha value between ±0.41 and ±0.70 represents moderate reliability of the measuring scale and values greater than ±0.70 represent higher internal consistency (Sekaran and Bougie, 2009). As shown in Table 3, Cronbach's

alpha values are higher than 0.70 for all the variables considered and it interprets that the internal consistency of the collected data is good and can be used for further analysis. The question statements were ranked according to the mean rank derived by Friedman's test using SPSS software. The formula used for Friedman's testing is as follows:

$$\text{Mean Rank} = \frac{12}{n_r k(k+1)} \sum R_i^2 - 3n_r(k+1)$$

Here, n_r = number of rows; k = number of columns; R_i = Sum of the ranks.

C. Mean Rank Values

1) Spatial comfort (Sc):

Table 4. Variables of the perception of spatial comfort parameter and its sub-parameters

Code	Variable
Sc-1	Location of the library in the masterplan of university
Sc-2	Iconic character of the building from its outer appearance
Sc-3	Accessibility and the openness of libraries
Sc-4	Requirement of functional connections with other areas of the university
Sc-5	Identification of boundaries of places
Sc-6	Space arrangement and allocation of functions
Sc-7	Overlapping and disturbing the functions with other functions at university
Sc-8	Provision for well-planned, secure, and sufficient space to meet the perceived needs of staff and users
Sc-9	Provision of conducive study spaces, including enough seats and varied types of seating, etc.
Sc-10	Provision of space for current library collections and future growth of resources developments
Sc-11	Provision of sufficient workspaces
Sc-12	Usage of signage and navigation aids
Sc-13	Provision of ergonomic workstation for its users and staff
Sc-14	Provision of electrical network facility requirements to meet the needs associated with current and future electronic access

Source: Author

Table 5. Mean rank values of spatial comfort parameter and its sub-parameters

Code	UKL	UML	URL	Recommendation
Sc-1	1.96	2.16	1.98	-
Sc-2	1.88	2.34	1.86	-
Sc-3	1.82	2.00	1.90	-
Sc-4	1.94	2.12	2.18	-
Sc-5	1.74	2.08	2.48	-
Sc-6	1.80	2.07	2.22	-
Sc-7	2.24	2.16	2.38	-
Sc-8	2.02	2.00	2.18	-
Sc-9	2.24	2.32	2.40	-
Sc-10	2.08	3.56	2.32	UML needs to be developed
Sc-11	2.04	2.16	2.12	-
Sc-12	2.10	2.48	2.20	-
Sc-13	2.14	2.32	2.44	-
Sc-14	1.88	3.64	2.24	UML needs to be developed

Source: Author

Fourteen number of variables considered under 'Spatial comfort' are shown in Table 4. According to Friedman's test, the first main parameter of 'Spatial comfort', is in 'good' condition in all three case studies (Refer

Table 5). However, most of the users of UML highlighted that there is a need of giving space for current library collections and future growth of resources and developments (Sc-10). In addition, users of UML have urged the requirement of electrical and network facilities associated with current and future electronic access (Sc-14).

2) Visual comfort (Vc):

Table 6. Variables of the perception of visual comfort parameter and its sub-parameters

Code	Variable
Vc-1	Usage of natural lighting
Vc-2	Ability of controlling the natural lighting according to the user requirements
Vc-3	Artificial lighting conditions in interior spaces
Vc-4	Ability of moving the distractive objects (ex: furniture, paintings, etc.)
Vc-5	Provisions to remove visual disturbance (ex: focal points)
Vc-6	Overall composition of interior arrangement
Vc-7	Colours applied on exterior of the library building
Vc-8	Colours applied on interior of the library building
Vc-9	Interior colour composition with lighting levels
Vc-10	Soothing interior colour matching with furniture
Vc-11	Provision of controlling glare occurs from artificial lighting
Vc-12	Provision of controlling glare occurs from natural lighting

Source: Author

Table 7. Mean rank values of visual comfort parameter and its sub-parameters

Code	UKL	UML	URL	Recommendation
Vc-1	2.16	1.68	2.20	-
Vc-2	3.74	2.00	3.60	UKL & URL need to be developed
Vc-3	3.58	2.24	3.54	UKL & URL need to be developed
Vc-4	1.76	1.48	2.44	-
Vc-5	1.72	3.76	2.20	UML needs to be developed
Vc-6	2.48	2.20	2.46	-
Vc-7	2.44	2.44	2.34	-
Vc-8	3.62	1.92	3.52	UKL & URL need to be developed
Vc-9	2.48	1.93	2.48	-
Vc-10	1.76	3.58	2.42	UML needs to be developed
Vc-11	3.70	3.65	2.46	UKL & UML need to be developed
Vc-12	3.84	2.16	3.55	UKL & URL need to be developed

Source: Author

Twelve number of variables considered under 'Visual comfort' are shown in

Table 6. According to Friedman's test, the 'Visual comfort', is not completely in a favorable condition. There are certain developments should be done in all three libraries namely UKL, UML and URL (Refer Table 7). There are 07 areas such as Vc-2; ability of controlling the natural lighting as per the users' requirement, Vc-3; ample artificial lighting conditions in interior spaces, Vc-5; provisions to remove visual disturbance while reading, Vc-8; colours applied on

interior of the library building, V-10; soothing interior colour matching with furniture, V-11; provision of controlling glare occurs from artificial lighting and V-12; provision of controlling glare occurs from natural lighting had been neglected in designing and maintaining the libraries. When looking at the results it was evident that there are no proper mechanisms provided to control the glare inside the libraries and it is a crucial matter to consider in designing and operating the building.

3) Thermal comfort (Tc):

Nine number of variables considered under ‘Thermal comfort’ are shown in Table 8. According to Friedman’s test, the ‘Thermal comfort’, is in a critical condition in all three academic libraries and need proper developments (Refer Table 9).

Table 8. Variables of the perception of thermal comfort parameter and its sub-parameters

Code	Variable
Tc-1	Comfortable indoor temperature inside the library
Tc-2	Freshness of air inside the library
Tc-3	Good ventilation
Tc-4	Ability of controlling the ventilation as per users’ requirement
Tc-5	Drought level in the library
Tc-6	Humidity level in the library
Tc-7	Ability of controlling the openings (ex: windows) as per users’ requirement
Tc-8	Comfortable indoor temperature at particular spaces in the library
Tc-9	Availability of mechanical HVAC systems

Source: Author

Table 9. Mean rank values of thermal comfort parameter and its sub-parameters

Code	UKL	UML	URL	Recommendation
Tc-1	3.92	3.84	3.80	All three need to be developed
Tc-2	3.74	3.52	3.54	All three need to be developed
Tc-3	3.51	2.10	3.58	UKL & URL need to be developed
Tc-4	3.92	3.88	3.58	All three need to be developed
Tc-5	1.90	1.98	2.78	URL needs to be developed
Tc-6	3.76	2.34	3.62	UKL & URL need to be developed
Tc-7	3.60	3.70	3.78	All three need to be developed
Tc-8	3.92	3.62	3.56	All three need to be developed
Tc-9	3.70	3.72	3.60	All three need to be developed

Source: Author

4) Auditory comfort (Ac):

Table 10. Variables of the perception of auditory comfort parameter and its sub-parameters

Code	Variable
Ac-1	Level of privacy within the library
Ac-2	Ability of controlling the noises at indoors
Ac-3	Acoustic comfortability within the spaces in the library
Ac-4	Ability of controlling the noises from outdoors

Source: Author

Four number of variables considered under ‘Auditory comfort’ are shown in Table 10. According to the mean rank analysis UML is providing more privacy in indoor than other

two libraries considered. However, all three libraries were failed to provide acoustic comfortability within the spaces in the library and controlling the noises from outdoors (Refer Table 11).

Table 11. Mean rank values of auditory comfort parameter and its sub-parameters

Code	UKL	UML	URL	Recommendation
Ac-1	3.56	2.28	3.68	UKL & URL need to be developed
Ac-2	3.58	3.84	2.36	UKL & UML need to be developed
Ac-3	3.72	3.59	3.60	All three need to be developed
Ac-4	3.68	3.77	3.81	All three need to be developed

Source: Author

5) Hygienic and olfactory comfort (Hc):

Table 12. Variables of the perception of hygienic & olfactory comfort parameter and its sub-parameters

Code	Variable
Hc-1	Level of indoor air concentration
Hc-2	Level of unhygienic content (ex: virus, bacteria) in the indoor air
Hc-3	Oduors of indoor spaces
Hc-4	Usage of fragrance to make comfortable indoors
Hc-5	Ability to remove unhygienic particles (ex: dust) from indoor air

Source: Author

Table 13. Mean rank values of hygienic & olfactory comfort parameter and its sub-parameters

Code	UKL	UML	URL	Recommendation
Hc-1	1.88	1.44	2.04	-
Hc-2	1.74	1.45	2.22	-
Hc-3	1.94	1.30	2.04	-
Hc-4	3.55	3.67	3.92	All three need to be developed
Hc-5	2.32	2.41	2.46	-

Source: Author

Four number of variables considered under ‘Hygienic and olfactory comfort’ are shown in Table 12. According to Friedman’s test, ‘Hygienic and olfactory comfort’ is in a favourable condition of all three libraries. However, majority of the users prefer to have soothing fragrances (ex: aromas, air freshness) in their library spaces (Refer Table 13).

D. Summary of Case Studies

According to the research findings, following areas need to be developed in the considered three case studies. The library of University of Kelaniya (UKL) has to be developed, most of the areas related to visual, thermal, and auditory comfort. In detail, there are total 18 issues need to be relooked in enhancing user comfort in UKL. The library of University of Moratuwa (UML) having the issue of expanding the infrastructure facilities with the demand of student population which directly affects to the users of the library. Thus, it is one of the critical parameters to consider when enhancing the spatial comfort of UML. Similar to UKL, the UML and the URL also need to be developed critically in the areas related to the visual, thermal, and auditory comfort. In detail, there are 15 issues to be solved in the purpose of enhancing user comfort level of UML. In addition, the library of University

of Ruhuna (URL) has 16 issues to address in the purpose of enhancing the user comfort. Specifically, URL needs more attention in providing thermal comfort for its users. Further, most of the users of all three universities were preferred to sit near to a window directly open to an outdoor view in their respective libraries.

E. Findings of Correlation Test

The Pierson correlation test was conducted to see the relationship between independent and dependent variables that were considered in the research. Four main independent variables such as gender, age, education level and number of hours spend daily in the library were tested with respect to five dependent variables stated in Table 3.

Independent and dependent variables are normalized by subtracting their means and dividing by their standard deviations, then the correlation coefficient is the slope of the regression line between them. According to the Pierson correlation test there is a positive correlation between the independent variable - ‘gender’ and the dependent variable - ‘spatial comfort’, where females students looking for more spacious indoors in libraries. Similarly, this finding has been proved by Agosto, Paone and Ipock, (2008), in their research by stating that, “Teenage girls tend to express more positive views of public libraries than do boys. It is good that libraries are seen as friendly places for girls, as girls need public places where they can feel comfortable, welcome, and confident”. However, this finding was not incorporated in the check list (Refer Table 14), because the focus is to design spacious academic library buildings for both genders in universities. But this research finding could be useful for a designer who is willing to do a gender oriented academic library building specifically for females.

However, other three independent variables such as age, education level and number of hours spent daily in libraries had given a neutral correlation with dependent variables considered in the study, which show there are no relationship to one another. So those three independent variables were not incorporated in the developed check-list (Refer Table 14).

IV. CONCLUSION & RECOMMENDATIONS

This study investigated the university students’ perception of university library spaces with reference to three case studies selected in Sri Lanka. Data were collected via a questionnaire survey and statistical analysis was done using IBM SPSS software to quantify the collected data. The questionnaire focused on five main parameters which are directly affecting on the quality of library spaces. These five main parameters such as spatial comfort (Sc), visual comfort (Vc), thermal comfort (Tc), auditory comfort (Ac), and hygienic & olfactory comfort (Hc) were identified through a comprehensive literature review. Additionally, 16 sub-parameters were identified to define the main parameters considered on maintaining the quality of library spaces. Three number of academic libraries at government universities namely, library at University of Kelaniya (UKL), library at University of Moratuwa (UML) and library at University of Ruhuna (URL)

were selected as case studies. A sample of 150 library users including undergraduates and postgraduates gave their opinions to the given questionnaire based on their experiences. The validity of the data set was tested via reliability test and calculated the standard error for each case. Friedman’s test was conducted to calculate the mean rank values and quantify the user perceptions over considered parameters. According to the mean rank values the issues relating user comfort of all three libraries were identified and prioritized. The prioritization of issues gave the direction on what to improve immediately to achieve the standard user comfort in the respective libraries. The considered 05 main-parameters, 16 sub-parameters and 44 depended variables were outlined the complete ‘check-list’ that need to be followed in designing and operating the academic library buildings on the aspect of enhancing user comfort (Refer Table 14).

Table 14. Check list to enhance user comfort in academic libraries

1 - Spatial comfort (Sc)	Requirement	Status	Remarks
a) Space recognizability and accessibility	Sc-1	Yes/No	<input type="checkbox"/>
	Sc-2	Yes/No	<input type="checkbox"/>
	Sc-3	Yes/No	<input type="checkbox"/>
	Sc-4	Yes/No	<input type="checkbox"/>
	Sc-5	Yes/No	<input type="checkbox"/>
b) Space allocations and configuration	Sc-6	Yes/No	<input type="checkbox"/>
	Sc-7	Yes/No	<input type="checkbox"/>
	Sc-8	Yes/No	<input type="checkbox"/>
c) Space for current needs and future developments	Sc-10	Yes/No	<input type="checkbox"/>
	Sc-11	Yes/No	<input type="checkbox"/>
d) Interior space arrangement	Sc-12	Yes/No	<input type="checkbox"/>
	Sc-13	Yes/No	<input type="checkbox"/>
	Sc-14	Yes/No	<input type="checkbox"/>
2 – Visual comfort (Vc)	Requirement	Status	Remarks
a) Lighting levels and qualities	Vc-1	Yes/No	<input type="checkbox"/>
	Vc-2	Yes/No	<input type="checkbox"/>
	Vc-3	Yes/No	<input type="checkbox"/>
b) Balance of contrast and disturbed objects	Vc-4	Yes/No	<input type="checkbox"/>
	Vc-5	Yes/No	<input type="checkbox"/>
	Vc-6	Yes/No	<input type="checkbox"/>
c) Colours and colour temperature	Vc-7	Yes/No	<input type="checkbox"/>
	Vc-8	Yes/No	<input type="checkbox"/>
	Vc-9	Yes/No	<input type="checkbox"/>
	Vc-10	Yes/No	<input type="checkbox"/>
d) Presence or absence of glare	Vc-11	Yes/No	<input type="checkbox"/>
	Vc-12	Yes/No	<input type="checkbox"/>
3 – Thermal comfort (Tc)	Requirement	Status	Remarks
a) Air temperature and freshness	Tc-1	Yes/No	<input type="checkbox"/>
	Tc-2	Yes/No	<input type="checkbox"/>
	Tc-3	Yes/No	<input type="checkbox"/>
	Tc-4	Yes/No	<input type="checkbox"/>
b) Radiant temperature	Tc-5	Yes/No	<input type="checkbox"/>
	Tc-8	Yes/No	<input type="checkbox"/>
c) Humidity	Tc-6	Yes/No	<input type="checkbox"/>
d) Air movement	Tc-7	Yes/No	<input type="checkbox"/>
	Tc-9	Yes/No	<input type="checkbox"/>

4 – Auditory comfort (Ac)	Requirement	Status	Remarks
a) Outdoor sounds	Ac-4	Yes/No	
b) Indoor sounds	Ac-1	Yes/No	
	Ac-2	Yes/No	
	Ac-3	Yes/No	
5-Hygienic & olfactory comfort (Hc)	Requirement	Status	Remarks
a) Micro organisms	Hc-1	Yes/No	
	Hc-2	Yes/No	
b) Dust and smells	Hc-3	Yes/No	
	Hc-4	Yes/No	
	Hc-5	Yes/No	

Source: Author

The developed check list could be used to assess and improve the conditions of a proposed academic library construction as well as the conditions of existing academic libraries in Sri Lanka. The check list (Refer Table 14) includes four rows such as, 1) user comfort parameters, 2) requirement to be fulfilled to achieve the specific user comfort parameter, 3) current status of the facility provided in the proposed or existing library building, and 4) the remarks to explain the actions need to be taken in detail by the respective person or authority. Thus, the remarks section was symbolized by ‘’ to annex the required documents in detail, so one can easily refer and take actions to improve or rectify the situation. Further, the remarks should be provided by the responsible person of the project (ex: Consultant / Contractor / Client/ etc.) who handle the particular subject area.

However, the check list could be improved and detailed further (Refer Table 14), by conducting the same research for the similar case studies in Sri Lanka. Because, a larger random sample will offer the opportunity to get more accurate mean values and it will lower the standard deviations. Further, the developed questionnaire and the method of analysis could be used on other academic libraries of both government and private sectors in Sri Lanka to identify the areas to be developed as per the users’ perception in future. The analysis which will be taken from a large data set, could use to validate and improve the parameters of the ‘check – list’ further. Moreover, the considered parameters of the validated check list could be incorporated in building regulations where building consultants, contractors and operators could easily refer when designing, constructing and maintaining the academic library buildings in Sri Lanka.

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