Reliability and Validity Analysis on the Relationship between Learning Space, Student's Satisfaction and Perceived Performance Using SMART-PLS

Fadhlizil Fariz Abdul Munir

Reliability and Validity Analysis on the Relationship between Learning Space, Student's Satisfaction and Perceived Performance Using SMART-PLS

Fadhlizil Fariz Abdul Munir

Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, 32610 Seri Iskandar, Perak, Malaysia

Abstract

This pilot study aims to examine the possibility of the association between learning space attributes of the environmental, design & facilities with student's satisfaction and perceived performance in an academic building. Hence, this pilot survey was conducted in Universiti Teknologi MARA (UiTM), Perak Branch, Seri Iskandar Campus, Malaysia. A pilot questionnaire was administrated and collected from 50 students, where respondents were asked to select their preferences based on a five-point Likert scale of agreement and satisfaction for Section B and multiple answer question for Section A. Results of the pilot survey indicated that there is a significant relationship between the learning space attributes of the environmental, design & facilities with student's satisfaction and perceived performance in an academic building especially of all the independent variables of the study. These results highlighted the importance of the learning space attributes such as the environmental, design & facilities in perceiving student's satisfaction and perceived performance. Analysis of this pilot study was conducted by using PLS-SEM: SMART-PLS Version 3.2 to examine the reliability and validity of the questionnaire, thus, determining the significance of every independent variables and dependent variable in the research. The result further confirmed that the instrument used in this pilot study fulfil the acceptable requirements of the reliability and validity ranged for main data collection purpose of the intended study.

Keywords: Learning Space, Environment, Design, Student's Satisfaction, Performance, SMART-PLS

Introduction

The shift in the learning patterns of the current generation motivates the changes in the setting of learning spaces. Today, an expansive group of students camping out at cafes and fast-food joints are not an unusual sight, particularly in the weeks prompting to exam season. Students seek out institutions that provide personal, unique and memorable educational experiences (Archambault, 2008). Buildings must be able to demonstrate alacrity and to accommodate both

social and individual learning from all levels while incorporating the technologies that are transforming how learning takes place. Universities are now developing a more strategic, cohesive, institution-wide approach to the management of buildings and space, including learning space; formal and informal (Matthews, Walton, & Matthews, 2016). Many researchers in the field define formal learning as highly structured, institutionally sponsored learning that takes place in educational environments designed to support learning, specifically schools, colleges and universities (Malcolm, 2003; Andreatos, 2007; Hall, 2009). Informal learning is often defined as being learning that is not professionally organized or highly structured and occurs outside of the formal learning framework through everyday activities in settings such as the workplace, local communities, family environments, online environments, online communities, student organizations, study groups, etc. (Schugurensky, 2000; Marsick & Watkins, 2001; Andreatos, 2007). Therefore, learning space can be categorised into two types; formal and informal.

Literature Review
Learning Space Attributes
Environment
Wider research suggests that the atmosphere generated in learning spaces is influenced by more than just the physical design. According to Cambridge dictionary, an environment can be defined as the conditions that you live or work in and the way that they influence how you feel or how effectively you can work. Thus, improving environmental conditions may bring substantial gains to student achievements by reducing distractions and missed school days (Earthman, 2002; Mendell and Heath, 2005). Chism (2007) has highlighted that the sensory stimulation of learning spaces such as the decor, carpeting and lighting greatly influences students' perceptions of where it is good to study. Fister (2009) claimed that "good lighting, comfortable furniture, warm colours and access to food" were the most important design features of libraries for students. To sum up, physical environment such as lighting, temperature, ventilation, noise, and space organisation can have such an impact on student's satisfaction, which then may lead to their productivity.

Design
The need for pedagogy to lead design by considering what is required for the learning activities that will result in the required learning outcomes, suggesting that if students are provided with the necessary spaces and tools, they can construct their understanding (Oblinger, 2006). According to MacMillan dictionary, design can be defined as the way that something is made so that it works in a certain way or has a certain appearance. There are factors that need to be considered in the design of university buildings, such as layout, size, cleanliness, aesthetics and furniture of office (Marans and Yan, 1989; Veitch et al., 2007; Choi et al., 2009; Schakib-Ekbatan et al., 2010; Bluyssen et al., 2011). Also, factors such as durability, accessibility, safety and spaciousness to avoid overcrowding are also need to take into account in the general design of an institution (Rivlin and Weinstein, 1984; Evans and Wener, 2007; Durán- Narucki, 2008). In sum, design elements comprise of many factors such as layout, cleanliness and physical appearance.

Facilities

According to Cambridge dictionary, facilities comprise buildings, equipment, and services provided for a particular purpose. The relationship between school facilities conditions and student achievement are relatively shown by recent empirical investigations (Hopland, 2012). The presence of technology today, real-time or synchronous interaction among students and between students and faculty a very real possibility as wireless net-working exists with mobile computing such as laptop and hand-held. By that, the term classroom can no longer encompass the teaching and learning options as collaborative and synchronous learning activities can be achieved by the current technologies (Brown & Lippincott, 2003). The variety of learning styles which cater for both group and individual study need a range of environments and facilities like large foyer that can provide more space for social interaction with Wi-Fi connectivity, computer and tools of collaborative learning such as large computer screens and whiteboards and the omnipresent café (Anders et al., 2009; Bryant et al., 2009; Lonsdale and Hanson, 2010; Bailin, 2013; Hunt, 2014; Montgomery, 2014). Conclusively, facilities can be divided into several items such as tools, equipment, cleanliness and café.

Relationship between Satisfaction and Performance

According to Oxford dictionary, satisfaction can be defined as a fulfilment of one's wishes, expectations, or needs, or the pleasure derived from this. Satisfaction has been characterised as the purchaser's esteem judgment in regards to joy got from the usage of level fulfilment (Oliver, 1981). Satisfaction also considered an enthusiastic response to an item or administration encounter (Spreng and Singh, 1993). The satisfaction idea has additionally been stretched out to the context of higher education. Student satisfaction is being moulded consistently by experiences in campus life by referring to Oliver and DeSarbo's (1989) definition of satisfaction. Meanwhile, performance can be defined on how well a person does a piece of work or activity as mentioned in Cambridge dictionary. Many researchers support that student performance depends on different socio-economic, psychological and environmental factors. The findings of research studies focused that student performance is affected by different factors such as learning abilities because new paradigm about learning assumes that all students can and should learn at higher levels, but it should not be considered as a constraint because there are other factors like race, gender, sex that can affect student's performance. (Hansen, Joe B., 2000). According to Chang and Fisher (2003), the level of a student's satisfaction in a lesson is a very important component for them to acquire the knowledge or skill. A student can be considered to be satisfied if he feels that the lesson meets his needs and expectations. This can motivate the student to put more efforts on learning, increase his/her positive attitude towards the lesson, and to attend other courses in future. Hence, it can be concluded that student satisfaction influences their learning performance.

Hypothesis and Research Model

Figure 1.0 represents the proposed conceptual research model for this research. It is hypothesised there are three factors of Learning Space that effect student's satisfaction which lead to perceiving of performance by occupants in an academic building. These factors comprises of: (1) Environmental, (2) Design and (3) Facilities. The proposed initial conceptual model for the research is as presented below:
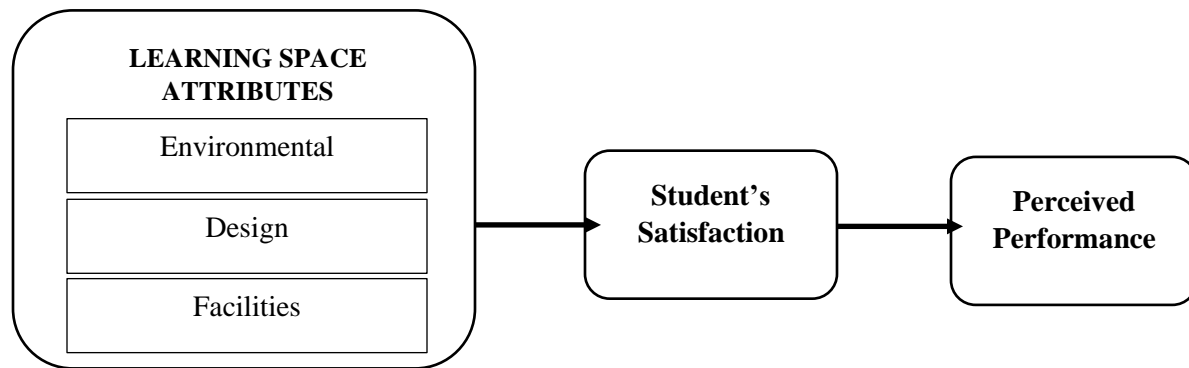
Figure 1.0: Conceptual Research Model

Subsequently, this research has four hypotheses that are tested in this initial research which is as follows:

H1. Environmental Factor in a learning space has a positive relationship with Students' Satisfaction
H2. Design Factor in a learning space has a positive relationship with Students' Satisfaction
H3. Facilities provided in a learning space has a positive relationship with Students' Satisfaction
H4. Students' Satisfaction has a significant positive influence on Perceived Performance.

Method

This study intended to employ a cross-sectional research design that enable the integration of the literature review and the real data survey that utilises both the subjective and objective measurement as the main procedure of data collection that will hinder and reduce the possibility of research bias and bringing the best accuracy in collected data (Azman et al 2014). However, as for this paper, the results presented are based on the data collected for this pilot study. Therefore, the initial stage of this pilot study is to test the reliability and validity of the instruments (subjective measurement) by conducting a hands-on survey to the students. The unit analysis of this pilot study is the student studying at Universiti Teknologi MARA (UiTM), Perak Branch that includes students from the Faculty of Architecture, Planning and Surveying (FSPU). Subsequently, as for the pilot study, according to previous researchers Isaac and Micheal (1995) and Hills (1998) the sample size acceptable for a preliminary research is suggested to be between 10 to 30 respondents for the pilot in survey research. Conversely, Julious (2005) and Van Belle (2002) suggested 12 respondents in the medical field. Hence, as for this study, a total of fifthly (50) questionnaires were distributed among the students' of FSPU UiTM Perak. A total of fifthly returned questionnaires were received which represents 100% of response rate.

Analysis

The survey questionnaires used in this research consist of two main sections: 1. Respondent Profile and 2. Students' Perception on Learning Space. The second section of the questionnaire is divided into five parts where part A, B and C of this survey emphases on the independent variable (IV) of this research which are: (Part A) Environmental Factor, (Part B) Design Factor and (Part C) Facilities Provided. While part D of this questionnaire survey focused on the aspect of

student's satisfaction as the indirect variable between the independent variable and the dependent variable of the research. Lastly, part E of this survey inquired on the student's perceptions towards their perceived performance in relation with their learning space satisfaction level. All items in Section 2 of the questionnaire survey were adapted and modified from previous research on Indoor Environmental Quality (IEQ) (Hamimi, Hanim & Mazran, 2017) and also taken from different satisfaction literature. These items in the second sections of research survey were measured using a 5-item scale and were analysed using SPSS 22 and Smart PLS 3.2.

SPSS 22 and Smart PLS 3.2 were employed to assess the reliability and validity of the survey questionnaires data and conduct preliminary testing the research hypothesis. The demographic profile of the respondents is analysed using the SPSS version 22 while the measurement and structural model of the research framework were analysed using the SmartPLS 3.2. The significant advantage of using the SmartPLS 3.2 in determining study reliability and validity is that this method delivers latent variable score thus avoiding the problem of small sample size and efficiently handling complex models with many variables (Henseler et al 2009).

Table 1.0: Demographic Profile

Description	Percentage (%)	Description	Percentage (%)
Age		**Informal Learning Space**	
>18-21	52	-Campus Cafeteria	36
>21-23	46	-Fast Food Restaurant	52
>23	2	-Musolla/ Mosque	8
Gender		-Hostel/Home	4
-Female	66	**Formal Learning Space**	
-Male	34	-Library	26
Research Mode		-Classroom	24
-Diploma	0	-Studio	48
-Bachelor Degree	100	-Lab	2
Research Year		**Favourite Learning Space**	
-Year 1	0	-Informal	60
-Year 2	94	-Formal	40
-Year 3	6	**The Importance of Learning Space**	
-Year 4	0	Yes	98
Faculty		No	2
FSPU	48		
FSSR	52		

Demographic Profile of the Respondent
Based on Table 1, the percentage between female and male respondent respectively as the female group score is 66 % (female) and while 34% is the male respondent's score. Ages of respondent's majority were occupants between the ages of 18 to 21 years old. Table 1 also indicates that most of the respondents were from the Faculty of Art and Design (FSSR) with 52%. Subsequently, Table 1 also portrays that most of the respondents prefer fast food restaurant (52%) as their favourite informal learning space and studio (48%) as the most favourite formal learning space. Hence, Table 1 shows that respondents of this research preferred an informal learning space compared to formal. Majority (98%) of the respondents agreed on the importance of learning space in an institution.

Measurement Model Analysis
Table 1.1 summarises the results of the measurement model for the proposed conceptual framework of the research. The model consists of 41 items that were divided into ;18 items for environmental, 6 items of the design, 10 items for facilities, 4 items for satisfaction and lastly 3 items from perceived performance. No items were deleted from this pilot questionnaire. Results of the model are presented as illustrated in Figure 1.2:
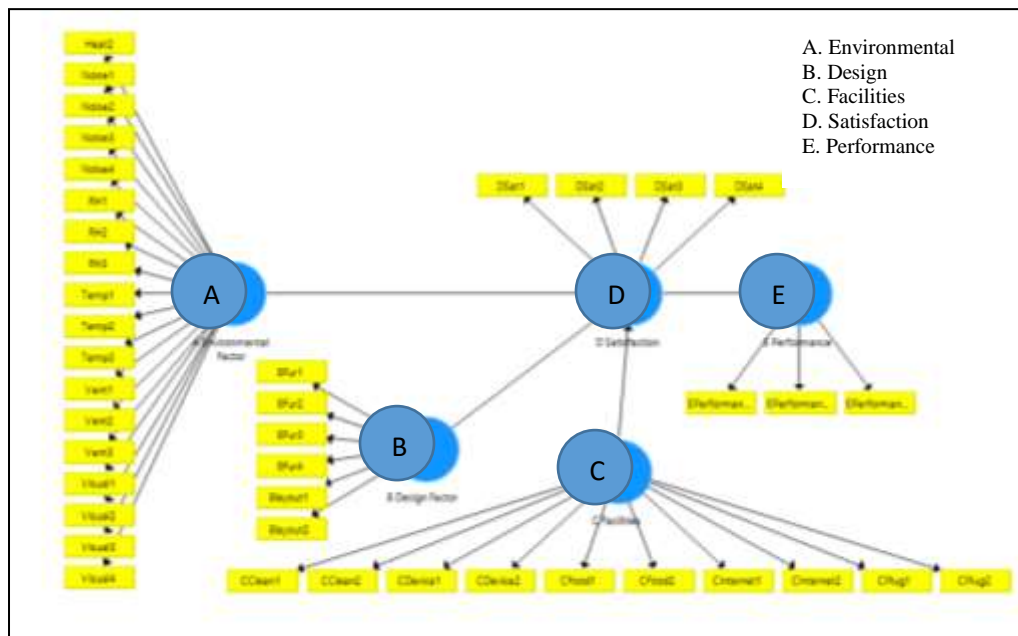
Figure 1.1: SmartPLS Algorithm Value of the Measurement Model

Two of the significant test that need to take into consideration in determining the goodness of measure for a model are the reliability and validity test. According to Sekaran and Bougie (2013), reliability is a test of measuring the consistency of the instruments while validity is a test that indicates the wellness of the developed instrument in measuring a particular concept of the study.

Table 1.1: Measurement Model Analysis Result

Construct	Item	Convergent Validity		Internal Consistency Reliability		Discriminant Validity	
		Cross Loading	AVE	Cronbach Alpha	Composite Reliability	HTMT	VIF
		>0.50	*>0.50*	*0.60-0.90*	*0.60-0.90*	*Confidence Interval Does Not Include 1*	*<5.00*
Environmental Factor (EF)	18	0.250-0.751	0.209	0.746	0.764	Yes	1.455
Design Factor (DF)	6	0.769-0.848	0.656	0.895	0.920	Yes	1.935
Facilities Provided (FP)	10	0.565-0.829	0.492	0.885	0.905	Yes	2.086
Satisfaction (SAT)	4	0.773-0.903	0.698	0.855	0.902	Yes	1.000
Performance (PER)	3	0.597-0.815	0.540	0.601	0.776	Yes	

Table adapted from Hair et al. 2017
*AVE: Average Variance Extracted; HTMT: Heterotrait-Monotrait Ratio; VIF: Collinearity Statistic

Reliability and Validity

Reliability of the measurement model can be accessed using two values which are the Cronbach's alpha coefficient of above 0.6 and composite reliability where value ranged from 0.7 or greater is considered as acceptable (Fornell and Larcker 1981). Table 1.1 indicates that the composite reliability of the model measurement values ranged from 0.601-0.895 for Cronbach's Alpha value and range of 0.764-0.920 for composite reliability. The values prove that it is acceptable to consistently measure the instruments. While the validity test is to measure the theories fitness of the designed test (Sekaran and Bougie 2013). It can be tested through convergent validity and discriminant validity test. Convergent validity can be assessed by looking at the results of measurement model's factor loading, composite reliability and also its average variance extracted (AVE) of exceeding 0.5 (Hair et al. 2014). Table 1.1 shows that the factor loading of each item in the construct exceeded the endorsed value of 0.5 as stated by Hair et.al (2014). Although the cross-loading value of items in the first construct (Environmental) was quite low (below 0.5), researcher decided to maintain all the 18 items for the main data collection. Thus, this low loading value may be due to the small sample size of the respondents in the pilot study, therefore no items were omitted from the pilot questionnaire survey after the analysis. Subsequently, Table 1.1 described the validity of the model by indicating the value of composite reliability of the model that ranged from 0.764-0.920, which surpassed the recommended value of 0.7 (Hair et.al 2010). As for the collinearity issue of the questionnaire survey, according to Cheung and Lee (2010), discriminant validity test can be indicated by the low correlation between items in a different construct. This test can be identified by looking at the collinearity statistic of the Varian

Inflation Factor (VIF) value of the constructs if less than 5 as portray in Table 1.1 which indicates that there are no collinearity issues between the constructs in the proposed conceptual model. To further examine the status of model discriminant validity, as suggested by Henseler et.al (2015), it is best to assess the discriminant validity in PLS-SEM. This is performed by looking at the HTMT criterion value to confirm that the items across the construct measure different construct in the model. It is identified by looking at the fact that the confident interval value of HTMT statistic must not comprise the value of 1 for an entire combination of the construct and by assessing the value of HTMT below that 0.90 (Hair et.al 2014) as presented in Table 1.2. Consequently, Table 1.2 shows the value of HTMT of the entire construct is less than 0.90 which indicates minimal discriminant validity for the model.

Table 1.2: Heterotrait-Monotrait Ratio HTMT

Variables	EF	DF	FP	SAT	PER
Environmental Factor (EF)	**0.457**				
Design Factor (DF)	0.482	**0.810**			
Facilities Provided (FP)	0.536	0.681	**0.702**		
Satisfaction (SAT)	0.606	0.696	0.737	**0.835**	
Performance (PER)	0.549	0.451	0.582	0.707	**0.735**

Discussion

Based on the proposed model measurement analysis findings, it can be summarized that all the three constructs of the Learning Space Attributes which are the environmental, design, and facilities are all valid measures of their individual constructs based on their factor estimations and statistical significance. Therefore, the measurement model established adequate reliability and validity standard that can be used in the actual data collection stage. The results suggest that the Learning Space Attributes variables of the environmental, design, and facilities are positively contributed to student's satisfaction. Meanwhile, student's satisfaction was found to have positive relationship on perceived performance.

Conclusion

This pilot study tested a proposed conceptual framework based on the academic building learning space literature. The instrument used in this study fullfill the acceptable requirementsof the reliability and validity analyses by using the Smart-PLS. The outcome of the path model analysis has confirmed that Learning Space Attribute is significantly correlated with Student's Satisfaction and Perceived Performance. Thus, currently, the main data collection of this study conducted at UiTM Perak has collected a large number of respondents which hoped to encourage and contribute to research findings that are more substantial.

References

Hamimi, A. T., Hanim, M. A. S., & Mazran, I. (2017). SOCIAL SCIENCES & HUMANITIES Relationship between Indoor Environmental Quality (IEQ), Occupant ' s Satisfaction and Productivity in GBI Rated Office Building using SEM-PLS, 25, 323–334.

Azman, I., Fuad, M. Z., Aimi, A., Hasan Al-Banna, M., & Rashidi, A. (2014). Effect of manager's role in performance based pay on employee outcomes. *GJAT 4(2).*

Anders, D., Calder, A., Elder, K., and Logan, A. (2009), "Investigating the dynamics of an integrated learning space at James Cook University"

Andreatos, A. (2007). Virtual communities and their importance for informal learning. International Journal of Computers, Communications & Control, 2(1), 39-47.

Archambault, L. Z. (2008). Measuring service performance, student satisfaction and its impact on student retention in private, post-secondary institutions. Proceedings of the EDU-COM International Conference, Edith Cowan University Retrieved from http://doi.org/10.1108/AAOUJ-10-01-2015-B002

Bailin, K. (2013), "Changes in academic library space: a case study at The University of New South Wales", Australian Academic & Research Libraries, Vol. 42 No. 4, pp. 342-359

Barclay, D., Higgins, C., & Thompson, R. (1995). The Partial Least Squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration. *Technology Study, 2* (2), 285-309.

Bluyssen, P. M., Aries, M., and Dommelen, V. P. (2011) Comfort of workers in office buildings: the European HOPE project, Building and Environment, 46, 280-288.

Brown, M., & Lippincott, J. (2003). Learning spaces:More than meets the eye. EDUCAUSE Quarterly 1. Retrieved on October 7, 2017, from http://www-cdn.educause.edu/ir/library/pdf/PUB7102.pdf

Bryant, J., Matthews, G., and Walton, G. (2009), "Academic libraries and social and learning space: a case study of Loughborough University Library, UK", Journal of Librarianship and Information Science, Vol. 41 No. 1, pp. 7-18

Chang, V., & Fisher, D. (2003). The validation and application of a new learning environment instrument for online learning in higher education

Chism, N. (2007), "Challenging traditional assumptions and rethinking learning spaces", in Oblinger, D. (Ed.), Learning Spaces, EDUCAUSE, Boulder, CO

Choi, J. H., Aziz, A., and Loftness, V. (2009) Decision support for improving occupant environmental satisfaction in office buildings: The relationship between sub-set of IEQ satisfaction and overall environmental satisfaction

Duran-Narucki, V. (2008). School building condition, school attendance, and academic achievement in New York City public schools: a mediation model. *Journal of Environmental Psychology*, 28, 278–286.

Earthman, G. I. (2002). School facility conditions and student academic achievement. Posted at the scholarship repository, University of California. Retrieved from http://repositories.cdlib.org

Evans, G. W., & Wener, R. E. (2007). Crowding and personal space invasion on the train: Please don't make me sit in the middle. Journal of Environmental Psychology, 27(1), 90-94. Retrieved from http://doi.org/10.1016/j.jenvp.2006.10.002

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*, 39-50.

Fister, B. (2009), "The glorious study hall: how libraries nurture a life of the mind", Library Issues, Vol. 30 No. 2, pp. 1-4.

Hair, J. F., Hult, G. T., Ringle, C. M., & Sarstedt, M. (2012). A primer on partial least squares structural equation modelling (PLS-SEM)*. 126-145.

Hair, J. F., Hult, G. T., Ringle, C. M., & Sarstedt, M. (2014). *A primer on partial least squares structural equation modelling (PLS-SEM),* 60-78*.

Hall, R. (2009). Towards a Fusion of Formal and Informal Learning Environments: The Impact of the Read/Write Web. Electronic Journal of e-Learning, 7(1), 29-40.

Hansen, J. B. (2000). "Student Performance and Student Growth as measure of success: A evaluator's perspective"

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of the partial least square path modeling in international marketing. *New Challenges to International Marketing Advances in International Marketing, 20*, 277-319.

Henseler, J., Ringle, C. M., & Sarstrdt, M. (2014). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43, 115-135.

Hunt, S. (2014), "Putting students at the heart of a new library: the John Henry Brookes Building at Oxford Brookes University", Panlibus Magazine, Winter, pp. 4-5.

Hill, R. (1998). What sample size is enough in internet survey research? *Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, 6 (3-4).*

Isaac, S., &Michael, W. B. (1995) Handbook in research and evaluation, San Diego, CA: Eductaional and Industrial Testing Services

Veitch, J. A., Bradley, J. S., Legault, L. M., Norcross, S., Svec, J. M. (2007). Masking Speech in Open-Plan Offices with Simulated Ventilation Noise: Noise Level and Spectral Composition Effects on Acoustic Satisfaction

Julious, S. A. (2005). Sample size of 12 per group rule of thumb for pilot study. *Pharmaceutical Statistics*.

Lonsdale, J., and Hanson, C. (2010), "Centre for active learning evaluation of learning spaces"

Malcolm, J., Hodkinson, P., & Colley, H. (2003). The interrelationships between informal and formal learning. Journal of workplace learning, 15(7/8), 313-318 Retrieved from http://doi.org/10.1108/13665620310504783

Marans, R. W., & Yan, X. (1989). Lighting quality and environmental satisfaction in open and enclosed offices. Journal of Architectural & Planning Research, 6(2), 118-131.

Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. New directions for adult and continuing education, 2001(89), 25-34 Retrieved from http://doi.org/10.1002/ace.5

Matthews, G., Walton, G., & Matthews, G. (2016). Strategic development of university library space Widening the influence. http://doi.org/10.1108/NLW-05-2014-0062

Mendell, M. J., and Heath, G. A. (2005), Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. Indoor Air, 15: 27–52

Montgomery, S. E. (2014), "Library space assessment: user learning behaviors in the library", The Journal of Academic Librarianship, Vol. 40 No. 1, pp. 70-75.

Oblinger, D. (2006). Space as a change agent. In D. Oblinger (Ed.), Learning spaces(pp. 1.1–1.4). Washington, DC: EDUCAUSE

Oliver, R. L. (1981), Measurement and evaluation of satisfaction in retail setting, Journal of retailing, 57, 25-48.

Oliver, R. L., and DeSarbo, W. S. (1989), "Processing of the satisfaction response in consumption: a suggested framework and research proposition", Journal of Consumer Satisfaction, Dissatisfaction and Complaining Behavior, Vol. 2, pp. 1-16.

Rivlin, L. G., & Weinstein, C. S. (1984). Educational issues, school settings, and environmental psychology. Journal of Environmental Psychology, 4(4), 347-364. http://doi.org/10.1016/S0272-4944(84)80005-5

Schugurensky, D. (2000). The forms of informal learning. Towards a conceptualization of the field. Working Paper 19-2000. Presented at the New Approaches for Lifelong Learning (NALL) Fourth Annual Conference Retrieved from http://hdl.handle.net/1807/2733

Schakib-Ekbatan, K., Wagner, A., and Lussac, C. (2010) Occupant satisfaction as an indicator for the socio-cultural dimension of sustainable office buildings - development of an overall building index

Sekaran, U., & Bougie, R. (2013). Research Methods for Business: A Skill- Building Approach. *New York: John Wiley & Sons, Inc.*

Spreng and Singh. (1993), "Analysing service quality in the hospitality industry using the SERVQUAL model", Service Industries Journal, Vol. 1, July, pp. 324-43.

Belle, V. G. (2002). Statistical rules of thumb. New York ; John Wiley.