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Fadhlizil Fariz Abdul Munir

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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:
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 emphasises 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).

| 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              |
|                     |                | -Hostel/Home        | 4              |
| **Gender**          |                | **Formal Learning Space** |                |
| Female              | 66             | -Library            | 26             |
| Male                | 34             | -Classroom          | 24             |
|                     |                | -Studio             | 48             |
|                     |                | -Lab                | 2              |
| **Research Mode**   |                | **Favourite Learning Space** |            |
| Diploma             | 0              | -Informal           | 60             |
| Bachelor Degree     | 100            | -Formal             | 40             |
|                     |                | **The Importance of Learning Space** |        |
| Year 1              | 0              | Yes                 | 98             |
| Year 2              | 94             | No                  | 2              |
| Year 3              | 6              |                     |                |
| Year 4              | 0              |                     |                |
| **Faculty**         |                |                     |                |
| 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](image)

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 | Confidence Interval Does Not Include 1 |
| Environmental Factor (EF)   | 18   | >0.50               | >0.50                            | 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 0.601-0.905 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.
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