International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 4 (2017) pp. 498-508

Application of Means-End Chain Research Model to Explore Attributes of Architecture Studio

Chih Siong Wong[a,b] and Mahmud Bin Mohd Jusan[a]

[a]*Department of Architecture, Faculty of Built Environment, Universiti Teknologi Malaysia (UTM), Malaysia*

[b]*Department of Architecture, School of Built Environment, University College of Technology Sarawak (UCTS), Malaysia*

Abstract

The core of architectural education is the design studio which focuses on the practical "hands-on" aspects of learning in this area. The most important place for students to apply the learned theoretical knowledge along with creativity is in the architecture studio. The manner in which the architecture studio is able to meets its objectives as a learning environment for students is resultant of the person-environment congruence (PEC) relationship. This article focuses on the studio's features as it relates to the user's preferences, which are influenced by personal values utilizing the Means-End Chain (MEC) model of research. Research conducted with 25 students via laddering interview brought out sixteen (16) key studio attributes. These findings reflect a distinct direction for design reference which relates to the design features of architecture studio to the personal values expressed. In that case, designers are able to make conscious design decisions which support the redefinition of the studio as the most important learning space in architectural education.

Keywords: Architecture Studio, Architecture Studio Attributes, Architectural Education, Means-End Chain (MEC), Person-environment Congruence (PEC), Laddering Interview, User Value.

INTRODUCTION

For many years, the architecture studio was noted as an important place in architectural education. No one can disagree to the architecture studio's importance in the learning process for students pursuing an education in architecture. Since an architecture studio provides a similar environment compared to an architect's office, it inspires not only creativity, but camaraderie among a group of students. Students' learning abilities are enhanced and supported by the spatial design in the architecture studio. The actual studio design plays an important role in the architecture students' learning and development. Therefore, these students should be in a studio which supports their learning needs and meets their spatial quality preferences. Conversely, little empirical research data exists which supports what an ideal studio environment actually is, especially in relation to the person-environment relationship. Not much is really known about the studio in which students meet, discuss and confer with each other and showcase their projects and exhibits (1), (2), (3), (4).

Since there is no systematic documentation, educators, designers and students all face challenges in understanding the design features of an architecture studio. Therefore, it is not an easy task to try to make changes to a studio without the systematic understanding of the process of interaction between the students and the studio's atmosphere. What complicates the situation is that the persons who have the power to make the decisions on changes to the studios are usually not the persons who use the studio. Developing a supportive architecture studio therefore needs input from the intended users. Consequently, the optimal method to understand the design aspect of the architecture studio is to ask the intended users how they view and would use the area. This article therefore aims to portray the students' perspective on what the ideal studio environment would have so that conditions in the studio would not produce undesirable results. The research is based on what is termed the person-environment congruence (PEC) model, which adapts value hierarchy concepts in the architecture studio setting via the means-end chain (MEC) theory.

ARCHITECTURE STUDIO AND LEARNING

Architectural education is often regarded as being very complex endeavour. An architect has to be well-versed in numerous areas of learning and study. Expertise in this field, however, is largely attained through intensive practice and theory (5). Design is the most fundamental course for architects given that students are taught to turn their own creativity and the theoretical and practical knowledge that they've gleaned into an actual design model (6), (7). Architectural programme is thus has been modeled on design studios that focus on practical education. Moreover, an architecture studio is considered the center of learning in this field. It is viewed as being the most essential space for those studying architecture. An architecture studio is a learning environment in which students can comfortably work throughout regular class hours. Additionally, students are given the permission to work on their own design ideas outside of the hours reserved for formal learning (8), (9). As such, it is the perfect space for both normal class work and independent creation at once. A lot of students spend the majority of their time in this environment and although they often socialize, they wind up absorbed in the process of completing specified design tasks (7). According to Stamp (8), approximately one-third to one-half of an architecture student's learning time is spend inside of the design studio working on various activities.

Studio-based learning is currently being threatened for architecture students. Institutions throughout the world are experiencing a trend in both decreased teaching hours and decreased physical work space, neither of which support the notable increase in architecture students (10). Learning institutions are becoming increasingly cognizant of the need to constantly analyze the academic and economic efficacy of their facilities and thus, the architectural studio faces a growing amount of pressure to prove its overall worth as a valuable campus resource (11). Ultimately, this issue is about the resources and space required for crits, face-to-face learning and studio teaching methods.

The time when students were able to work within the architecture studio and learn from each other when necessary are slowly fading away (11). Educators are showing increased concerned regarding the issues raised that pertain to the lack of studio use among architecture students. Students are not spending enough time working in these environments anymore. These individuals may be making what is known as a silent protest. More often than not, the studios that learning institutions supply are not sufficient in terms of quantity and more commonly, in terms of overall quality. The average architecture studio is experiencing a loss of meaning in terms of its ability to meet a complex range of learning requirements like individual and group work, crits, tutorials and even student relaxation.

THE DESIGN CHALLENGE OF ARCHITECTURE STUDIO

Research performed in 1998 by Evans & McCoy (12) discovered that humans are more likely to respond to an environment when it is well-designed. Moreover, specific settings can actually lead to specific and intended forms of behavior (13), (14), (15), (16). Thus, it is vital for designers to have a keen understanding of how environments can impact those who use them. As such, an architecture studio can be seen as being the most powerful resource for those entering this field when it is capable of providing students with all of the conditions that are vital to successful architectural learning. The obvious question, however, is what the criteria for studio design is, in order for the studio design to actually benefit students. To answer a question like this one, we have to find reliable info concerning the relationship between man and his environment (17), (18), (15), (19). Ultimately, we have to have a keen understanding of the architecture studio and the impact that this environment has on students via scientific and systemic inquiries. Architects need an improved understanding of the design studio so that spatial characteristics that are unnecessarily stressful can be eliminated. Additionally, more emphasis must be placed on positive attributes that promote student growth, learning and development.

Design skills are attained by students in the studio space and thus, the use of the studio is a crucial part of an education in architecture, and the design studio can be classified as a highly specialized learning environment. Throughout this century, an increased emphasis is being placed on learning methods and approaches that are student-focused. Learning spaces such as these have to be flexible and adaptable so that various parties can use them at once. Given that important learning results from interactions between students, these spaces must be designed to include areas in which students can interact, exchange ideas, socialize and consult (20), (21), (22). It has been shown that glare, air quality, room temperature, comfortable seating, lighting and overall arrangement all have an impact on the standards of learning and teaching within these studios (2). Other issues that should be considered when designing spaces like these include flow between different elements, functionality and the connections between those who are working in or using these resources. People should also consider group sizes, the level of involvement that staff will have with students, structural features and aspects pertaining to both physiology and psychology (23).

While the design process is happening, the input of the envisioned end-users is critical during the design process (24) because the setting may have different effects on various users. For the human and physical environment to blend, meaning, as a part of the function, has to be involved to foster the communication between the two elements (17). Tangible environmental elements are the signals which show the meaning to the users. Each user's decoded meaning matters, and this impacts their choices and evaluation of the environment. The built environment can be better understood once the important aspects of functions, the meaning that users read, are realized (19). As it relates to a design studio, the spatial characteristics present useful meaning to architecture students, as well as make noticeable function to the students. Students can relish their time working in the design studio once the meaning read is fine-tuned and matched to their partialities and needs via effective spatial design. Various studies and findings support this concept (25), (26).

Lewin (13) shares that the behavior of students has to be evaluated in the characteristic of the learning environment, as well as to the students' characteristics. Therefore, a student's choice to leave or remain in a design studio could be linked to the deficiency of the assigned studio's facilities to provide the supportive environment based on the student's personal characteristic. Thus, the behaviour of architecture students in a design studio is determined primarily by the congruence of the students' characteristics and the characteristic of the studio's environment. Strange and Banning (19), after evaluating several research papers on human characteristics on the learning environment, established that the complete features of any environment are influenced and informed by the combined data about the persons in that environment. Therefore, the differences in the environment or the prevailing features are results of the combined effects of the users' demographic and psychological factors (27), (28), (29), (30), (31), (31), (32), (33), (34). Psychological factors include the inhabitants' interests, personalities and values, just to name a few. The demographic factors include ethnicity, age, gender, etc. It will be interesting to see how education changes as the psychological aspects of it are more deeply understood. The learning space is going to take a different role. This is especially true in architecture where the studio space is due for a rebirth.

ACHIEVING PERSON - ENVIRONMENT CONGRUENCE IN ARCHITECTURE STUDIO

Person-environment congruence (PEC) is the concept that a person's needs are aligned to the ability of the environment to accommodate those said needs (35). Jusan (36), (37), (38) suggests that achieving person-environment congruence is the principal criteria for supporting a built environment which is sustainable for the users. As it relates to education, Bell (39) postulates that an educational environment should present such a setting that facilitates the appropriate behaviour, and helps to meet learning goals; otherwise the environment could cause stress for those using it.

Rapoport (40) adds in agreement to this premise via his three-element model of stress which accentuates the importance of supportive environs for groups which would provide congruence with their culture. These ideas come from synomorphy, which is based on the assumption that such environments should provide the support necessary to meet the needs of the users (14), (41), (42). Therefore, a synomorphic rapport develops as the persons in the environment arrive at a place of consensus, and thus congruence. Unfortunately, a lack of person-environment congruence can cause various levels of stress, including overload, negative interactions, and psychological pressures, in addition to other challenges. Anyone who feels these stresses will either try to alter the setting or change their behaviour while they go through the adaptation process (39).

As it relates to an architecture studio, person-environment congruence exists when the environment has a relaxed and ideal atmosphere for students to learn and study without any prolonged adjustment stress. Therefore, an architecture studio that is able to develop a learning environment that fosters students' learning is a great outcome for the person to environment relationship. This means that the person-environment congruence idea in the architectural sense is created as shown in the Figure 1. The proposed conceptual Design Model of Architecture Studio is adapted from Model of Personalization Jusan (37), Three-element Model of Stress (40), and Eclectic Model of Environment-behaviour Relationship (39).

Based on this model (Figure 1), the proposed studio environment, which is prescribed by its attributes, is firstly processed and evaluated by the individual's filters. Culture is the key component of this filtering system, and this covers various aspects including needs, values, characteristics and standards (40). The result of this evaluative process is the user's perceptions of whether the studio is suitable or has person-environment congruence. Two ways exists for coping with an incompatible environment that lacks person-environment congruence (14), (39). Firstly, one can fail to manage the situation and remain stressed. The other option is adaptation or adjustment to the environment. Adjustment and adaptation determine if students stay in the studio space, or change location. It is important to note that while some individuals achieve person-environment congruence, that situation may not last. According to what is happening or changing with a student's study patterns, he or she may determine that the studio is not adequate, which means that the process would have to start over.

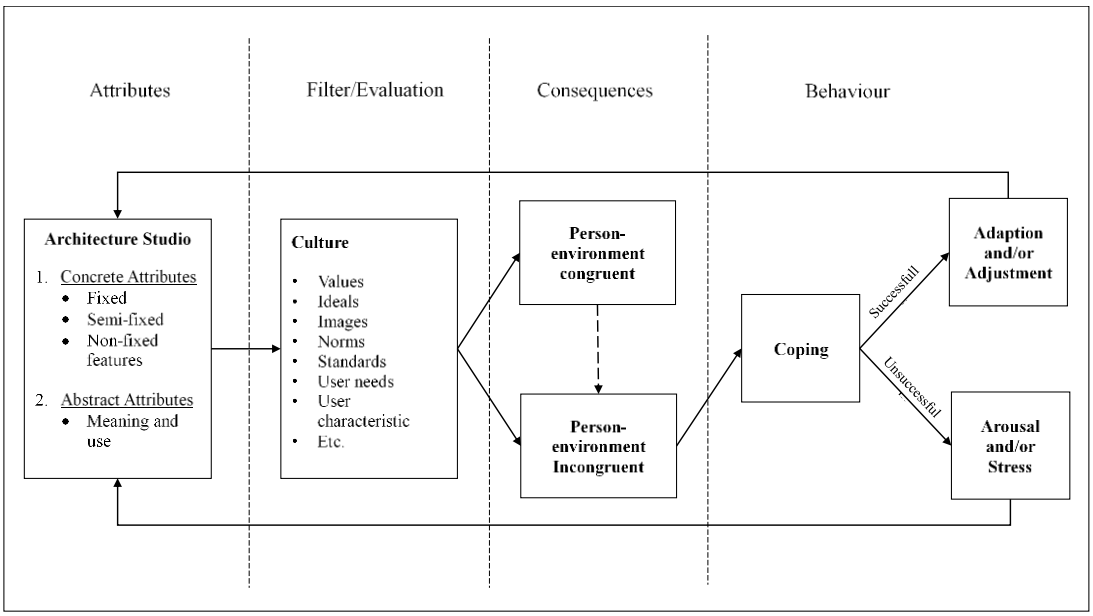

Figure 1: Design Model of Architecture Studio (Adapted from Model of Personalization (37), Three-element Model of Stress (40), and Eclectic Model of Environment-behaviour Relationship (39))

THE USE OF MEC IN EXPLORING PEC

From the psychology field comes the Means-end Chain research model which can be utilized for researching the Person-environment Congruence premise in the architecture studio. This model has been used in marketing research (43), and the results are utilized in the design of merchandise

products. This research model can provide comparable benefits as it relates to architectural design (44), (45), (46), (47).

The MEC and PEC concepts focus on the link between individuals and the respective merchandise and environment. The MEC reflects the product's content which actually includes a variety of features which offer multiple attributes to accommodate the needs and expectations of the individual. Likewise, With the PEC theory, the congruence linked with the individual and the environment is regulated by the schemata, desires and values, and the environment's attributes.

Gutman's Means-end theory (48) focuses on a psychological line of thinking because it emphasizes the relationships between the attributes that the product has with personal values. The attributes of the products are the means. It offers intended consequences that are influenced by values termed as the end. , The means-end concept is very similar to the thinking presented by Rosenberg's Theory of Expectancy-Value, which theorizes that the consequences develop from the actions of consumers; and consumers can associate certain results along with the attributes of the products which they have emphasized from the purchasing behaviour (43).

These theories postulate that consumers learn to select produces which have attributes that are key to them reaching the desired outcome. Means-end theory, which came from research by Rokeach (49), posits that the significant personal values direct individual behaviours and choices (48), (43). Accordingly, it is a concept which is aimed at meeting the consumers' behaviour with their values via the development of an associative linkage of consequences reinforcing merchandise attributes and individual values as shown in Figure 2 (48).

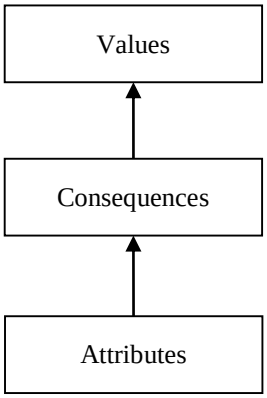

Figure 2: Means-end Chain Model

The MEC research model value system is created from Rokeach's value system (50). The present research that uses MEC in the built environment uses value domains by Schwartz (51), which are additions to Rokeach's value system (Figure 3). Coolen and Hoekstra (44), and Jusan (37) postulate that Schwartz's value system application is more adaptable to the present built environment context.

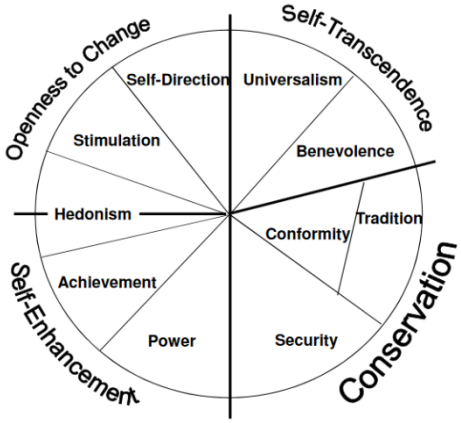

Figure 3: Schwartz's value system (51)

METHODOLOGY

The MEC Research model utilizing laddering interview technique employed by Jusan (36), (37) Coolen and Hokestra (44) was used in evaluating an architecture studio in University College of Technology Sarawak, Malaysia. This article relies on a 2016 study which utilized the Laddering interview method to gather responses from twenty five individuals. The interviewees were undergraduate architecture students who were pursuing their first degree of architecture. Sixteen of the interviewees were year three students while the rest were all from year two. Only year two and three students were selected mainly because they have richer user experiences in studio usage. Therefore they could provide better insight into the condition of studio environment compared to first year students. The Interviews were conducted in students' respective studio and ran for about an hour each per student.

Eliciting Architecture Studio Attributes

This research was qualitative in nature. The semi-structured interview technique called laddering interview was used to gather responses based on student perception of attribute-consequence-value (A-C-V) elements. The methods used by Coolen and Hoekstra (44), Jusan (36), (37) were used with some amendment to match this particular study. The interviews were started with gathering the architecture studio attributes and the dominant question asked for the most important features based on personal preferences.

Each respondent was asked to share the preferred features in the architecture studio design which would get them to utilize and stay in the space. The researchers interviewed the students in the students' own architecture studio space. If the respondent was unable to share what they presume or was unsure of the manner to respond, the interviewer would request that the respondent scan the present studio environment.

Conducting the interviews in the respondent's studio was therefore intended to be used as a guide to aid the students responding to the questions. The researches paid close attention to avoiding making suggestions or asking leading questions which have encouraged the respondents to share their thoughts on any specific attribute.

With gathering a list of attributes in relation to the studio, the laddering interviews employed the repeated questioning technique of the importance of mentioned attributes to the respondent. The objective was to find the links between each critical conceptual element over a certain attributes: attributes (A), consequences (C), and values (V). Each interview was recorded digitally and transcribed for content analysis.

Content Analysis and Coding

The collected data was analysed used content analysis similar to what was used by Jusan. Transcription of the interviews into text was the first step. Consequently, the raw ladders for each student could be constructed. Codes were developed and assigned for consistent and key meanings within words, phrases and sentences. The codes were grouped according to attributes (A), consequences (C), and values (V) as shown in Figure 4. All this coding help in constructing the Summary of Implications Matrix (SIM) and Hierarchical Value Maps (HVM).

Development of the SIM and HVM

The SIM is a table which reflects how many times each element is matched, whether indirectly or directly, to other aspects. The raw ladders were utilized in developing the SIM. HVM reflects a graph of every frequently recorded element in the values, consequences and attributes linked to the cumulative results of each the ladders of the respondents. Gutman encourages the utilization of cut-off levels from three to five to develop the HVM. This research adopted four as the cut-off level similar to Reynolds and Gutman (43), and Alaraji and Jusan (45). This suggests that the elements which are linked to other elements four or more times either directly or indirectly are included in the development of the HVM.

Interpreting Dominant Perceptual Orientations (Interpreting HVM)

The developed HVM (Figure 5) for the entire studio is utilized to pinpoint the key features in a studio. The perceptual orientations are clearly depicted through a series of chains move from bottom to top. Every desired attribute is linked to a specific value within a chain using partition. Since students' preferences and behaviour are driven mainly by values, the interpretations are therefore heavily relying on the relevant chains of attribute, consequence and value. Both direct and indirect the connecting numbers coming from each perceptual orientation chain are calculated to determine the strength of each attribute. Then, the summary of intra-chain relationships can be grouped and evaluated (Table 1).

FINDINGS AND DISCUSSION

The HVM as shown in Figure 5 portrays students' preferences of optimal studio features viewed as a whole. All the attributes are linked to values indicating the attainment of PEC. Based on the HVM, there are sixteen important studio attributes mentioned by students. These attributes can be classified into six distinct categories namely Furniture (FUR), Indoor Environment Quality (IEQ), Territoriality (TER), Physiological Needs (PHY), Information and Communication Technology (ICT), and Reference (REF) as depicted in Table 1.

These findings largely concur with previous study conducted by Obeidat and Al-Share (2), whose work only lacked attributes related to Physiological Needs. One question arises, we wonder about the reasons and motivation behind the selection of these attributes which lack of supporting from previous works. Hence, this research tends to fill the gap by exploring the students' dominant perceptual orientation within PEC and MEC framework. Using a MEC framework, it is possible to distil exactly what students expect and need from each category.

	Attributes			Consequences			Values	
1.	PA	Pantry	17.	FD	Food & Drink	30.	SE	Security
2.	WO	Private Workspace	18.	RE	Rest	31.	CO	Conformity
3.	AI	Air Conditioning	19.	RF	Refreshing	32.	AC	Achievement
4.	SA	Sleeping Area	20.	DF	Disturbance-Free	33.	HE	Hedonism
5.	TC	Table and Chair	21.	CF	Comfort	34.	SD	Self-direction
6.	WF	High Speed WiFi	22.	WT	Working Together	35.	PW	Power
7.	CA	Cabinet	23.	IN	Information			
8.	LE	Leisure Area	24.	LA	Leisure Activities			
9.	HC	High Spec Computer	25.	SR	Personal Storage			
10.	PL	Plotter	26.	HS	High Level Softwares			
11.	LI	Lighting	27.	ED	Electronic Devices			
12.	VE	Ventilation	28.	EF	Efficiency			
13.	PP	Pot Plant	29.	GO	Good Outcomes			
14.	GA	Group Work Area						
15.	PS	Power Socket						
16.	ML	Mini Library						

Figure 4: Summary Content Codes for Architecture Studio

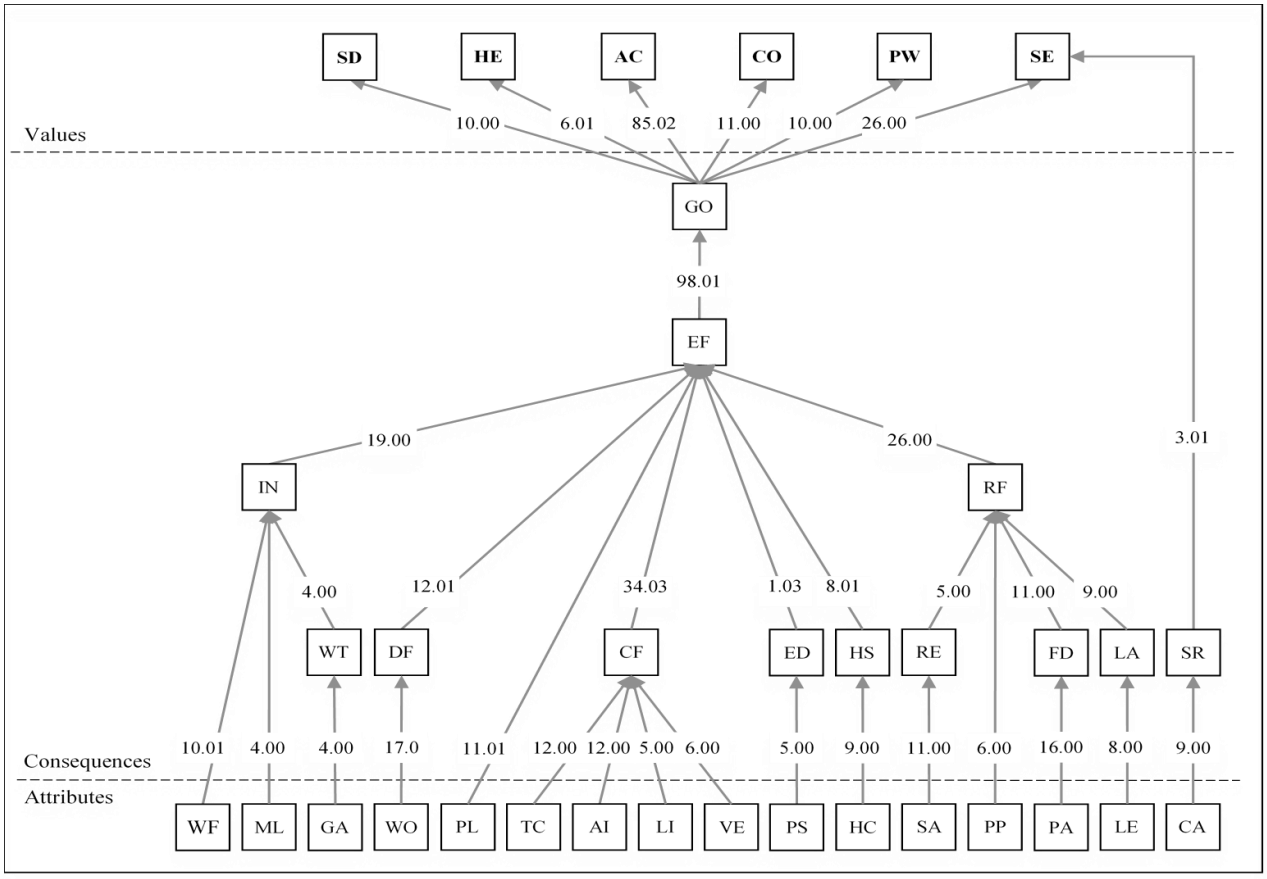

Figure 5: The HVM of the Architecture Studio

Table 1: The influential values on students' preferences for Architecture Studio attributes

No.	Attributes	Values						Total Values Score
		Achievement (AC)	Security (SE)	Conformity (CO)	Self-direction (SD)	Power (PW)	Hedonism (HE)	
1.0	**Physiological Needs (PHY)**							
1.1	Pantry (PA)	236.03	177.01	162.01	161.01	161.01	157.02	3964.36
1.2	Leisure Area (LE)	226.03	167.01	152.01	151.01	151.01	147.02	
1.3	Sleeping Area (SA)	225.03	166.01	151.01	150.01	150.01	146.02	
1.4	Pot Plant (PP)	215.03	156.01	141.01	140.01	140.01	136.02	
2.0	**Information and Communications Technology (ICT)**							
2.1	High Speed WiFi (WF)	212.04	153.02	138.02	137.02	137.02	133.03	3322.72
2.2	High Spec Computer (HC)	200.04	141.02	126.02	125.02	125.02	121.03	
2.3	Plotter (PL)	194.04	135.02	120.02	119.02	119.02	115.03	
2.4	Power Socket (PS)	189.06	130.04	115.04	114.04	114.04	110.05	

3.0	**Indoor Environment Quality (IEQ)**							
3.1	Air Conditioning (AI)	229.06	170.04	155.04	154.04	154.04	150.05	2958.81
3.2	Ventilation	223.06	164.04	149.04	148.04	148.04	144.05	
3.3	Lighting (LI)	222.06	163.04	148.04	147.04	147.04	143.05	
4.0	**Territoriality (TER)**							
4.1	Private Workspace (WO)	212.04	153.02	138.02	137.02	137.02	133.03	1808.24
4.2	Group Work Area (GA)	210.03	151.01	136.01	135.01	135.01	131.02	
5.0	**Furniture (FUR)**							
5.1	Table and Chair (TC)	229.06	170.04	155.04	154.04	154.04	150.05	1024.28
5.2	Cabinet (CA)	0.00	12.01	0.00	0.00	0.00	0.00	
6.0	**Reference (REF)**							
6.1	Mini Library (ML)	206.03	147.01	132.01	131.01	131.01	127.02	874.09
Total Individual Value Score		3228.64	2355.35	2118.34	2103.34	2103.34	2043.49	
Individual Value Ranking		1	2	3	4		5	

The partitioning of chains taken from HVM provides clear picture of students' behaviour towards their studio environment (Table 1). The greatest concern of students in identifying their preferred studio attributes are driven by six personal values. Among those values, Achievement (AC) is by far higher than others. The second most important value related to Security (SE) aspect followed by Conformity (CO). Both Self-direction (SD) and Power (PW) sharing fourth position while the remaining value is Hedonism (HE). Any architecture studio striving to help its students meet their needs must obviously maximize their ability to appeal to these values.

Motivational Values in Architecture Studio Environment

From the perspective of students, Self-enhancement values covering Achievement, Power and Hedonism make the quest of personal status and accomplishment as their main motivation in studio life. Achievement is by far the most important consideration, representing a student's ability to complete his or her training in order to prove their intelligence, competence, and future ability to work as an architect. They believe that the Power hold by architect is a social status and recognition leading to Hedonism which is pleasure and sensuous gratification for oneself.

Conservation values centered on Security and Conformity are also playing dominant role in their preferences choice. Security refers to safety, future job security, health, and stability of studio society in term of relationship among students. Besides, students' self-discipline in achieving good performance is the right way to honour parents support in education. While on the other hand, Self-direction value represents the Openness to Possibilities focusing on the independence creative thought and action in exploring, choosing and creating better design.

Achieving Good Outcomes

The affordances of selected attributes make known once ascertaining the motivational values mentioned beforehand. The "consequences" level portrayed in the HVM is related to attributes' affordances in term of the function and uses in better accomplishment of daily operations within MEC framework (52). It is mainly associated to the beneficial effects of studio attributes in parallel to the personal values. As revealed in Figure 5, students make Good Outcomes (GO) as their ultimate consequence or rather called goal in their studio life. Good Outcomes in this context is referring to their learning outcomes in term of design studio products. Hand on nature of design studio projects emphasizing on the creative design proposal leading to design panels with physical design model. The challenges of different design scopes make student a creative designer. Time after time, students push their body and mind to the limit in realizing the targeted design ideas into viable and constructible solutions. That's explaining why self-enhancement values become so prominent in determining studio attributes.

Increasing Efficiency

Influenced by self-enhancement values, Efficiency (EF) becomes an important component bridging almost all other elements in consequences level towards Good Outcome. Efficiency aimed to minimize students' effort to carry out the required actions in accomplishing the design studio outcomes. In other words, it is a matter of easiness and duration that takes

them to achieve their goal. Obviously efficiency relies on the effectiveness of collective studio features. It is the quality aspect of studio features influencing students' feeling and attitudes towards studio environment determining their satisfaction labelled as usability by Alexander (53). Therefore, the ranking of attributes category (Table 1) provides a glimpse of their expectation in fulfilling the Efficiency need.

Fundamental Physiological Needs

Physiological Needs (PHY) takes the lead among other category of attributes making it the most considered factors. It deal with the maintenance of the student's body and mind showcasing the obvious need of Pantry (PA), Leisure Area (LE), Sleeping Area (SA) and Pot Plant (PP). All these attributes cover the instinctive needs fall under first level of Abraham Maslow's hierarchy of needs (54) especially dealing with long working hours in studio environment. A drained student will not be effective at the design table. Food, drink, relaxation, rest and sleep are essential for them refresh and rejuvenate their body and mind to prevent fatigue and burnout from the lengthy challenges of studio works. All other needs become secondary until the basic survival needs are met to uphold their efficiency level.

Effective Use of Information and Communications Technology

The lecturer or tutor is the main focus in traditional classroom. However, studio based learning consider student as an active learner. Lecturer or tutor is therefore playing a mentor role encouraging student to explore freely during the design process. Self-directed architecture students are capable independent learners. Unlike older generation, they are able to harness the advantages of Information and Communications Technology (ICT) and use it confidently. ICT has become an integral part of their everyday life in the quest of architectural exploration. They fully utilize the hardware and software devices in order to work effectively. No surprisingly, they demand High Spec Computer (HC) to run resource hungry programs smoothly especially in 3D visualization. The present of Plotter (PL) in studio making printing much more convenient and time saving. While sufficient Power Socket (PS) enables the continuous use of relevant electronic devices accessing to information superhighway of internet. Without High Speed WiFi (WF), communication and lacking of information at fingertips become a major barrier hindering students' design process. Although Mini Library (ML) could be a great source of reference, its mini nature of collection can't compare to unlimited information online. ICT is no doubt becoming a functional requirement for studio's works and life.

Optimal Indoor Environmental Quality

Architectural design has never neglected the Indoor Environmental Quality (IEQ) regarding comfort issues either perceived subjectively or physically. Avoiding psychological and physical discomfort is primary concern of human (54). Due to the hot-humid tropical climate, studio temperature should not be too warm as it will make people feel tired and loosing concentration (2). However, the temperature shall not be overly cold. Air-condition is thus a choice for student to ensure comfortable temperature range within studio being controlled. At the same time, air ventilation is required to preserve a low level of contamination. Mechanical or natural ventilation devices like fan and window could be useful to maintain the desired level of comfort. Apart from thermal comfort, Lighting (LI) is another important feature that influences students' satisfaction because it affects their performance (2), (55). Studio tasks always dealing with lines required special attention in visual clarity. The mixture of suitable daylight and artificial lighting helps in completing studio tasks efficiently.

Distinct Territoriality

Territoriality (TER) exists within comfortable environment is actually responsible for smooth operation of studio society. Clear layout organization and boundaries avoids spatial disputes (56) because it functions as non-verbal communication indicating space ownership or occupancy for certain intended activities. Having an obvious division between private and public workspace keeps interferences to minimal ensuring safe environment is greatly influenced by Security value. Humans are social animals by nature, so a vibrant social scene between students actually assists them in achieving the Good Outcome. Hence, Group Work Area (GA) connects students together to facilitate collaboration and teamwork. Although they are socially interconnected looking for information exchange, they require their own privacy moment (57). Those are time they prefer to regulate incoming and outgoing information (57), (58), (59), (60), (61) within their Private Workspace (WO) avoiding unwanted intervention. Not only does the ability to get away reinforce the Security need, it can also help in producing better design outcomes. Design as a matter of fact requires deep concentration and thorough focus searching for creative and feasible solutions. Existence of both private and public studio space permits various patterns of interaction enhancing their working efficiency according to their needs at different time.

Ergonomic Furniture

Carefully designed furniture decreases accidents and increases productivity. Human factors psychology or ergonomics discovers and applies information about human characteristics to tools, machines and so on for comfortable and effective human use (62). At its simplest, literally means the applied science of product design. As for studio, ergonomic furniture intended to maximize productivity by reducing fatigue and discomfort. Unlike ordinary classroom, studio requires specific furniture like drafting Table and Chair (TC). Additional tables for model making and computer also support learning activities. The adjustable and movable features of provided furniture ensure smooth working hours in studio. In additional to tables and chairs, personal storage issues shall not be overlooked. Studio works required a broad range of specialized tools and materials, so some kind of storage when they are not in use is

essential for every student. Cabinet (CA) provided shall accommodate enough storage spaces to make it more functional. Ergonomic furniture has been a key criterion in keeping students focused and comfortable hence creating enjoyable studio learning environment.

CONCLUSION

This article suggests that supportive learning space should be rooted in an understanding of the ways in which students engage a studio. Studio space available to students must be congruent with students needs eliminating possible negative psychological effects. The phenomenon must be understudied in three folds. Firstly, the user expectations and perceptions driven by personal values. Secondly, the characteristics and functions provided by studio attributes. Finally, Person-environment Congruence (PEC) is achieved through connecting attributes to relevant values. Means-end chain model (MEC) is therefore a viable tool to study such relationship within studio context. It opens door to understand users' dominant perceptual orientations or way of thinking in attribute-consequence-value (A-C-V) manner based on their perceptions of the reality. Identifying of sixteen attributes through MEC's laddering technique are evaluated based on students' value system. Six dominant motivational values fall within Self-enhancement, Conservation, and Openness to Possibilities group explaining students' choices of preference. The influencing values define exactly what students expect and require from attributes in term of Physiological Needs (PHY), Information and Communications Technology (ICT), Indoor Environment Quality (IEQ), Territoriality (TER), Furniture (FUR), and Reference (REF) ranked according to their order of importance. Efficiency is the key influencing element reinforcing connection between quality functional aspects of studio attributes and students' learning outcomes. Any studio attributes striving to assist students meet their goals must obviously maximize their ability effectively to enhance efficiency. The findings of this study has shed new light into what and why certain studio attributes matter to students. Due to its explorative nature, the findings do not necessary offer generalized guideline for studio design but rather a viable and systematic method in identifying students preferred studio attributes driven by their personal values. However, the findings would be useful reference in designing more value-oriented architecture studio in order to establish supportive learning environment that is congruent with the student's needs.

REFERENCES

1. Lueth PLO. The architectural design studio as a learning environment: A qualitative exploration of architecture design student learning experiences in design studios from first- through fourth-year. United States: Iowa State University; 2008.
2. Obeidat A, Al-Share R. Quality Learning Environments: Design-Studio Classroom. Asian Culture and History. 2012;4(2):165-74.
3. Durling DC, N. Johnson, J. Personality and learning preferences of students in design and design-related disciplines. Loughborough University; 1996.
4. Huang RC-F. An exploration of an open-plan design studio: A conceptual model of the physical and social-psychological environment. Canada: University of Guelph; 1998.
5. Vitruvius P. The Ten Books on Architecture. Cambridge: Harvard University Press; 1914.
6. Schön DA. The architectural studio as an exemplar of education for reflection-in-action. Journal of Architectural Education. 1984;38:2-9.
7. Schön DA. Educating the Reflective Practitioner. San Fransisco: Jossey-Bass Publishers; 1987.
8. Stamps AE. .Jungian epistemological balance: A framework for conceptualizing architectural education. Journal of Architectural Education. 1994;48:105-12.
9. Demirbas OO. Design studio as a life space in architectural education: Privacy requirements. Ankara: Bilkent University; 1997.
10. Port J. Physical Infrastructure for Teaching and Learning. Presentation given at ICT Physical Learning Spaces workshop (March 2003) 2003.
11. Duggan F. The changing nature of the studio as an educational setting: CEBE; 2004.
12. Evans GW, McCoy JM. When building don't work: The role of architecture in human health. Journal of Environmental Psychology. 1998;18:85-94.
13. Lewin K. Principles of topological psychology. New York: McGraw-Hill; 1936.
14. Barker RG. Ecological psychology: Concepts and methods for studying the environment of human behavior. Stanford, CA: Standford University Press; 1968.
15. Moos RH. The human context: Environmental determinants of behavior. Malabar, FL: Krieger; 1986.
16. Dewey J. How we think: A restatement of the relation of reflective thinking to the educative process. New York: D. C. Heath; 1993.
17. Rapoport A. The Meaning of the Built Environment: A Nonverbal Communication Approach: University of ARIZONA Press; 1982.
18. Rapoport A. On 'The Invisible in Architecture'. In: Bouman O, Van Toorn R, editors. The Invisible in Architecture. Academy Editions, Limited ed1994.
19. Strange CC, Banning JH. Educating by design: creating campus learning environments that work: Jossey-Bass; 2001.
20. Deasy CM, Lasswell TE. Designing Places for People: A Handbook on Human Behaviour for Architects, Designers and Facility Managers. New York: Broadway; 1985.
21. Kuh G, Kinzie J, Schuh J, Whitt E. Student Success in College: Creating Conditions that Matter. San Francisco, CA: Jossey-Bass; 2005.
22. Chism N. Challenging Traditional Assumptions and Rethinking Learning Spaces. In: Oblinger D, editor. Learning spaces. Washington D.C.: EDUCAUSE; 2006.
23. Temple P. Learning Spaces for the 21st century: A Review of Literature. London: Centre for Higher Education Studies, Institute of Education, University of London; 2007.

24. Sanoff H. Designing a responsive school environment. Children's Environment. 1993;10:140-53.
25. Maslow AH, Minz N. Effects of those aesthetic surroundings: Initial effects of those aesthetic surroundings upon perceiving "energy" and "well-being" in faces Journal of Psychology. 1956;41:247-54.
26. Sommer R. Personal Space: The Behavioral basis of design. Englewood Cliffs: NJ: Prentice Hall; 1978.
27. Holland JL. The psychology of vocational choice: A theory of personality types and model environments. Waltham, MA: Blaisdell; 1966.
28. Holland JL. Making vocational choices: A theory of careers. Englewood Cliffs, NJ: Prentice Hall; 1973.
29. Walsh BW, Holland JL. A theory of personality types and work environments. In: Walsh WB, Craik KH, Price RH, editors. Person–environment psychology: Models and perspectives. Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc; 1992. p. 35-69.
30. Clark B, Trow M. The organizational context. In: Newcomb T, Wilson E, editors. College peer groups: Problems and prospects for research. Chicago: Aldine; 1966. p. 17-70.
31. Astin AW. The college environment. Washington, DC: American Council on Education; 1968.
32. Myers IB. Gifts differing. Palo Alto, CA: Consulting Psychologist Press.; 1980.
33. Kolb D. Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ Prentice Hall; 1983.
34. John Ov, Srivastava S. The Big Five trait taxonomy: History, measurement, and theoretical perspectives. In: Pervin LA, John OP, editors. Handbook of personality: theory and research 2nd ed ed. New York: Guilford; 1999. p. 1002-138.
35. Moore KD. Using Place Rules and Affect to Understand Environmental Fit: A Theoretical Exploration. Environment and Behavior. 2005;37(3):330-63.
36. Jusan MBM. Identification of User's Expectations in Mass Housing using Means-End Chain Research Model. Journal Alam Bina. 2007;9(4):1-19.
37. Jusan MBM. Means end chain, person environment congruence and mass housing design
J 1 Sep 2010 In : p. 11 p. Open House International. 2010;35(3):76-86.
38. Jusan MBM. Renovation for Personalization - A Development Arm for Sustainable Housing. 1st ed. Malaysia: Penerbit UTM Press; 2010.
39. Bell PA, Greene T, Fisher J, Baum AS. Environmental Psychology, Fifth Edition: Taylor & Francis; 2005.
40. Rapoport A. Culture, Architecture, and Design: Locke Science Publishing Co., Inc. ; 2005.
41. Wicker AW. An introduction to ecological psychology. Cambridge: Cambridge University Press; 1984.
42. Gifford R. Enviromental psychology: Practice and principles. 3rd ed ed. Colville, WA: Optimal Books.; 2002.
43. Reynolds TJ, Gutman J. Laddering theory, method, analysis, and interpretation. Journal of Advertising Research. 1998;Feb/Mar 1988:11-21.
44. Coolen H, Hoekstra J. Values as determinants of preferences for housing attributes:. Journal of Housing and the Built Environment. 2001;16(285-306).
45. Alaraji KA, Jusan MBM. Flexible house attributes as perceived by the end-users. International Journal of Applied Engineering Research. 2015;10(7):18313-24.
46. Bako ZZ, Jusan MBM. Motivational Factors Influencing Housing Interior Finish Choice and Preference. Procedia - Social and Behavioral Sciences. 2012;36:177-86.
47. Moghimi V, Jusan MBM, Izadpanahi P. Iranian household values and perception with respect to housing attributes. Habitat International. 2016;56:74-83.
48. Gutman J. A Means-End Chain model based on Consumer Organization Processes. Journal of Marketing. 1982;46:60-72.
49. Rokeach M. Beliefs, attitudes and values. California: Jossey-Bass Inc.; 1972.
50. Rokeach M. The nature of human values. New York: Free Press; 1973.
51. Schwartz SH. Are There Universal Aspects in the Structure and Contents of Human Values. Journal of Social Issues. 1994;50(4):19-450.
52. Zinas BZ, Jusan MBM. Perceived affordances and motivations for housing interior walls finishes preference and choice. Journal of Civil Engineering and Architecture Research 2014;1(1):71-7.
53. Alexander K. Usability: Philosophy and Concepts. Usability of Workplaces, Phase 2. 2008.
54. Maslow AH. A Theory of Human Motivation. . Psychological Review. 1943;50(4):370-96.
55. Herman M. Adaptable Spaces and Their Impact on Learning 2013 [Available from: http://www.hermanmiller.com/research/research-summaries/adaptable-spaces-and-their-impact-on-learning.html.
56. Sommer R. Personal space. New Jersey: Prentice-Hall; 1969.
57. Demirbas OO, Demirkan H. Privacy Dimensions: A Case Study In The Interior Architecture Design Studio. Journal of Environmental Psychology. 2000;20(1):53-64.
58. Altman I. The Environmental and Social Behavior. Monterey, CA: Brooks/Cole; 1975.
59. Pedersen DM. Psychological functions of privacy. Journal of Environmental Psychology. 1997;17:147-56.
60. Kupritz VW. Privacy in the workplace: The impact of building design. Journal of Environmental Psychology. 1998;18:341-56.
61. Newell PB. A cross-cultural comparison of privacy definitions and functions: A system approach. Journal of Environmental Psychology. 1998;18:357-71.
62. Norman DA. The Design of Everyday Things. US: Basic Books 2013.