Development of Post-Occupancy Design Evaluation ™ (PODE) Technique as a Design Studio Criteria for Future Open-Plan System (OPS)

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DOI: https://dx.doi.org/10.47772/IJRISS.2024.807127

Received: 18 June 2024; Revised: 07 July 2024; Accepted: 30 July 2024; Published: 09 August 2024

ABSTRACT

This study aims to identify the standard guidance priority of design criteria for open-plan system design furniture for students. The main data collection was conducted at UPM involving design students who occupied the studio space. This study has adopted a mixed-method approach through the close-ended interview for the Designer Voice (DV) and Participatory Design (PD) for the User Voice (UV). The DV and UV were transferred into the Design Evaluation (DE) survey form. They were used to identify the priority of design criteria of the Open-plan System (OPS) furniture for student use. The ranking system in DE analysis will be used to develop the Post-Occupancy Design Evaluation™ (PODE) form. The PODE™ form is a novel approach that adopts the concept of the Post-Occupancy Evaluation (POE) and Quality Function Deployment (QFD) as design approach references. The result revealed that the priority of design criteria led to the usability while sketching, ergonomics of the table, aesthetic in color, and function in flexibility. The result also revealed the user requirement to change the height and angle of a table for sketching are the highest prior criteria in standard guidance of OPS furniture students use.

Keywords: design criteria, Open-plan System (OPS) furniture, Post-Occupancy Evaluation (POE) and Quality Function Deployment (QFD)

INTRODUCTION

Open-plan System (OPS) furniture is becoming a trend for student design studios at Universiti Putra Malaysia. Another reason people enjoy open-plan offices is the perception that it makes communication and work more productive (Dolah, M. S., 2014). To date, there were no specific design criteria for OPS used by students. Thus, there was no standard evaluation technique to validate the relevancy of the product to the current user.

In architecture, they have the Post-Occupancy Evaluation (POE) which is the standard form to validate the building that users have used. Lawrence and Keime (2016) state that, to improve the low-energy design, feedback measures such as POE are becoming more popular as they encourage dialogue between designers and occupants, and provide a basis for future design assumptions. Design criteria develop a relationship with the user's needs through the product development process. The right design criteria lead to quality products.

A research methodology has to be created to help designers identify users' environmental experience at work and propose a process to assess users' needs and aspirations (Dolah, 2014). This study was essential to clarify the importance of validation to a real user for the product development process. Furthermore, this validation helped designers develop the attributes or design criteria for new product development. In this research, the

implementation of a Design Evaluation (DE) survey to gain the priority of design criteria and come out with the standard guidance to validate design called the Post-Occupancy Design Evaluation™ (PODE) form. There is a need to develop the PODE™ standard guidance design criteria of OPS for student use. To sustain product quality in the future, the developed priority of design criteria will be used to create an evaluation form called Post-Occupancy Design Evaluation™ (PODE).

RESEARCH OBJECTIVES

This research aims to;

i. To identify the priority of design criteria of the Open-plan System (OPS) Furniture for student use.

ii. To develop the Post-Occupancy Design Evaluation™ (PODE) of Open-plan System (OPS) furniture standard guidance design criteria for a student used.

LITERATURE REVIEW

3.1 Quality Function Deployment (QFD)

Taifa & Desai (2015) argue that the combination of Quality Function Deployment, the Kano Model, and the Ergonomics Principles approach will help satisfy students who spend six to eight hours a day and eventually address ergonomically the design issues that could arise if students use classroom furniture in the long run. This paper demonstrates the implementation of one method to measure the quality of the product is Quality Function Deployment, which can be used to lead the student's satisfaction against the furniture used in the classroom for a very long time. Bergquist & Abeysekera, (1996) believe that the QFD approach will therefore be an acceptable complement to ergonomic approaches, to define human needs and requirements. Bolar, Tesfamariam & Sadiq, (2017) state that, in the process of fulfilling customer requirements, QFD may also be defined as a tool providing factual engineering specifications, recording customer requirements, and addressing customer requirements.

3.2 Post-Occupancy Evaluation (POE)

Riley, (2010) noted that the notion of POE was formed as a direct response to problems associated with buildings within the care industry, such as mental hospitals, nursing homes, and correctional facilities. POE is typically performed within 4 to 24 months following occupancy of a new or renovated facility and is performed only once for an individual building Khalil & Husin, (2009). Three steps in the POE process were;

1) planning, 2) conducting and 3) applying have been proposed by Khalil, & Husin, (2009).

3.3. User Driven design

Ding, (2008) stated that, user participation in office design will increase office environmental satisfaction. Cornell, (2002) identifies four dimensions of user-centered design that are beneficial in scoping the complex nature of furniture design;

1. The furniture must be flexible and mobile to support the learning goals of teachers and students.

2. Comfort, protection, and health: furniture should also be ergonomically built, as well as provide an effortless opportunity to move around a room (e.g., the tipping point on a cabinet on castors should not be so high that it poses a risk when moved).

3. Usability: Furniture should be readily flexible for the customer and easily movable with minimal preparation.

4. Psychological attraction: Furniture must be desirable to appeal to students and set the ideal environment for learning.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VII July 2024

METHODOLOGY

To serve user satisfaction toward the furniture, the quality product should be produced by providing the standard guidance to the designer of the right furniture. The OPS furniture needs to identify the priority of design criteria that are used by students. To reveal user satisfaction, the design evaluation of the furniture should take place to make sure all the criteria follow the standard design criteria. The participants were selected by random selection. There are two types of participants selected: Expert Designers (ED) and Industrial Design students. The expert designer will be categorized as Designer Voice (DV). In contrast, the Industrial Design student is categorized into three types of participants: the respondents for the DE survey, User Voice (UV), and the participant for the pilot test. In other words, the Industrial Design student has three categories in participation for this study.

4.1 Design Evaluation (DE) Approach – House of Quality (HOQ) structure in Quality Function Deployment (QFD)

The DE Form was a novel approach by the researcher that adopted the structure of HOQ in the QFD Approach, which is an application to improve the quality of products. QFD's structure is a relationship concept that the concept was adopted to form a new way to define customer satisfaction with the design elements of a product. Using the DE Form, designers could define which design criteria are the most priority for them to be considered in every new OPS furniture design process. DE Form is a kind of questionnaire, but in another way, it adopts the structure of HOQ in QFD. This is because there were many attributes and that kind of structure will give opportunities to respondents to rate in different thinking. The use of the DE Form does not strictly ask the respondents about the question and gives a choice of answer, despite the DE Form allowing the respondents to think with relating the design criteria with any user requirement that they think will suit and most importantly for them.

4.1.1 Qualitative method - Close Ended Interview - Designer Voice (DV)

The close-ended interview was conducted online. 10 Expert Designer (ED) were involved in the close-ended interviews. ED was asked to list out the main design criteria of OPS furniture. Table 1 shows the main design criteria after the attributes have been grouped. The filtration has been made by comparing the repetition of opinions by every designer. Further, the attributes have been classified in the group of design criteria.

Table 1: Designer Voice (DV) Design Criteria Table

Designer Voice (DV)	
Design Criteria	**Design Criteria Attribute**
Usability	IT Access, Sketching, Communication and Personalization
Ergonomic	Table Height, Partition, Chair and Storage
Aesthetic	Colour, Form and Configuration
Function	Flexibility, Durability and Adjustable

4.1.2 Qualitative method - Participatory Design (PD) - User's Voice (UV)

The User Voice (UV) has been identified as shown in Table 2 through Participatory Design (PD) with 10 students in Industrial Design studio, FRSB, UPM. It has been conducted for an hour in a group of 10 students. The pen and paper were provided and briefed on the upcoming task. All students are required to point out their opinions regarding the desired OPS furniture in their future studio. Participatory design is a collaborative design approach that includes the designer and stakeholders in the design process to achieve the design specifications defined (Dolah & Rust, 2017). The Participatory Design (PD) approach was implemented for industrial design students which is the occupant of the design studio to identify User Voice (UV).

Table 2: User Voice (UV) Design Criteria Table

User Voice (UV)
User Requirement
Working space for model making
Digital watch at the workspace
Stationary organizer
Table Arrangement
Easy Access
Sketches space pin-up partition
Transparent partition glass
Interactive Colour
Bigger table space
Storage for project stuff
Compartment storage for personal stuff
Fixed table lamp
Change height and angle of table for sketching
Fabric partition for easy to pin the notes and photo
Whiteboard Panel
Socket for laptop and USB Hub

4.2 Quantitative Method - Design Evaluation (DE) survey

DE surveys were created by the researcher by adopting the House of Quality (HOQ) structure in Quality Function Deployment (QFD). The DE survey form has been distributed to 20 students in the Faculty of Design and Architecture (FRSB), UPM. It has been held in the design studio by individual contact for 2 hours. They were briefed on the purpose and the objective of the study. The researcher also explained how to fill in the form since the new approach was created for this study. Based on their time, the DE form survey took 15 to 20 minutes to fill in rating the value to relate the user requirement and the design criteria attribute.

4.2.1 Design Evaluation (DE) Form

Based on the Designer Voice (DV) and User Voice (UV), the Design Evaluation (DE) form has been constructed as shown in Table 3 below. The structure of the DE survey form was adopted from the HOQ structure in the QFD method. The WHAT and HOW columns were adopted as it is for the design attribute and user requirement column. The Designer Voice (DV) and User Voice (UV) are transferred into the table of DE form.

Table 3: Design Evaluation (DE) form structure

Rate should be given from value 1 (Unimportant),2 (Least Important), 3 (Moderate Important), 4 (Important) and 5 (Very Important)							
Design Evaluation (DE) Form				**Cumulative (CL)**	**Average (AV)**	**Percentage (%)**	**Ranking**
No	**Design Criteria**	**Design Criteria Attribute**	**User Requirement** / **User Voice (UV)**				
1	Designer Voice (DV)	Designer Voice (DV)	Relationship rate for a relationship between user requirement and design criteria	DE Analysis			Top Rank
2							
3							
4							
5							
6							
7							
9							
Subject to: What product to be evaluated.							

RESULT AND DISCUSSION

5.1 Design Evaluation (DE) Analysis Result

Based on Figure 1, the overall result has been found which is the Overall Cumulative (OCL), Average (AV), percentage (%) and ranking in graph illustration to show the highest rank of the design criteria.

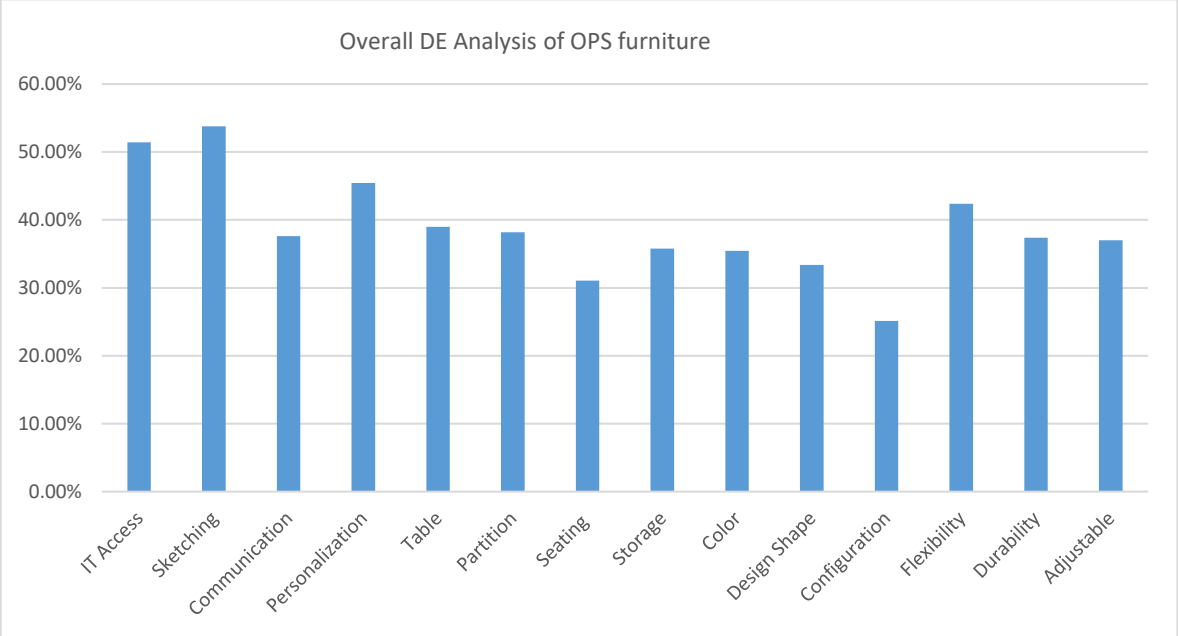

Figure 1: Overall DE Analysis of OPS Furniture - Overall Cumulative (OCL), Average (AV), Percentage (%) and Ranking Graph

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VII July 2024

5.2 Priority of Design Criteria

Referring to Table 4, the DP1 was sketching, table, color, and flexibility which was the top priority needed to be considered by the designer in OPS development. DP2 where IT access, partition, design shape, and durability have been taken place. Followed by the DP3, personalization, storage, configuration, and adjustable were included. Finally, the DP4 has two attributes which are communication and sitting. These design priorities can be as design guidance for stakeholders, designers and students in developing a new OPS design.

This research revealed that the design development process should be developed based on this result starting with design criteria in DP1, DP2, DP3 and DP4. This design criteria priority can be used as a guidance for future

OPS development processes.

Table 4: Priority of Design Criteria (DC)

	DC Usability	**DC Ergonomic**	**DC Aesthetic**	**DC Function**
Design Priority 1 (DP1)	Sketching	Table	Colour	Flexibility
Design Priority 2 (DP2)	IT access	Partition	Design shape	Durability
Design Priority 3 (DP3)	Personalization	Storage	Configuration	Adjustable
Design Priority 4 (DP4)	Communication	Sitting	NA	NA

NA: Not Applicable

5.3 Priority Design Criteria

Table 5 shows the standard guidance of OPS furniture for Design Priority 1 (DP1).

Table 5: Standard guidance of OPS furniture - DP1

Design Priority 1 (DP1)	**Top user requirements**
Sketching	Change height and angle of table for sketching
Table	Change height and angle of table for sketching
Colour	Interactive colour
Flexibility	Socket for laptop and USB Hub

Table 6 shows the standard guidance of OPS furniture for Design Priority 2 (DP2).

Table 6: Standard guidance of OPS furniture - DP2

Design Priority 2 (DP2)	**Top user requirements**
IT access	Socket for laptop and USB Hub
Partition	Change height and angle of table for sketching
Design shape	Change height and angle of table for sketching

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VII July 2024

Durability	Socket for laptop and USB Hub

Table 7 shows the standard guidance of OPS furniture for Design Priority 3 (DP3).

Table 7: Standard guidance of OPS furniture - DP3

Design Priority 3 (DP3)	**Top user requirements**
Personalization	Table arrangement
Storage	Storage for project stuff
Configuration	Table arrangement
Adjustable	Change height and angle of table for sketching

Table 8 shows the standard guidance of OPS furniture for Design Priority 4 (DP4).

Table 8: Standard guidance of OPS furniture -DP4

Design Priority 4 (DP4)	**Top user requirements**
Communication	Whiteboard panel
Sitting	Working space for model making

5.3.1 Post-Occupancy Design Evaluation (PODE)™ Form

Table 9 shows the Post-Occupancy Design Evaluation (PODE)™ form of OPS furniture.

Table 9: Post-Occupancy Design Evaluation (PODE)™ Form of OPS furniture

Post - Occupancy Design Evaluation (PODE) Form										
No	**Design criteria**	**Priority Design Criteria Attribute**	**Priority User Requirement**							
			Socket for laptop and USB Hub	**Whiteboard Panel**	**Change Height and angle of Table for Sketching**	**Storage for project stuff**	**Interactive colour**	**Table arrangement**	**Stationary organizer**	**Working space for model making**
1	Usability	Sketching								
2		IT Access								
3		Personalization								
4		Communication								

5	Ergonomic	Table								
6		Partition								
7		Storage								
8		Seating								
9	Aesthetic	Colour								
10		Design shape								
11		Configuration								
12	Function	Flexibility								
13		Durability								
14		Adjustable								
Subject to: Student's Open-plan System (OPS) furniture in Industrial Design Studio, FRSB, UPM. **Latest update:** 28 December 2020										

CONCLUSION

6.1. Contribution to Stakeholder

To date, the new approach of the Post-Occupancy Design Evaluation™ (PODE) Form has listed the standard design criteria of OPS furniture that the faculty can refer to for future furniture planning for student studios. This PODE™ form is guidance for the designer, suppliers, office manager, and OPS furniture manufacturer in the future to reveal the priority design criteria.

6.2. Contribution to Students

This study aimed to fulfill the user's need that led to user satisfaction with the OPS furniture. The future furniture will be better quality furniture in terms of requirements followed by the guidance in PODE™ form. The upcoming furniture will provide satisfaction to students when the user drives all the design criteria through the PODE™ form.

6.3. Contribution to Designer

The novel approach identifies the priority of design criteria of new niche furniture and evaluates the design for new furniture. This study has contributed knowledge to designers who are responsible for designing and developing new furniture. To date, the are no standard design criteria for OPS furniture that target used for the student.

Based on this study, the Post-Occupancy Design Evaluation™ (PODE) form has been developed and the first approach that comes out with the standard design criteria of OPS furniture for students is used.

ACKNOWLEDGMENT

The authors would like to acknowledge the Department of Industrial Design, Faculty of Design and Architecture, Universiti Putra Malaysia. Last but not least, to all the expert designers who have contributed their knowledge in this research in developing the novel approach.

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