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Student-Centred Studio Environments: A Deep Dive into Architecture Students' Needs

Chih Siong Wong
School of Built Environment, University of Technology Sarawak (UTS), Malaysia

ABSTRACT: Architectural education has long placed a strong emphasis on the studio, which serves as a crucial place for teaching and learning. The architecture studio is a dynamic and lively place where students can engage in design discussions, exchange ideas, and receive feedback from instructors and peers. Despite recognising the vital role architecture studios play in shaping the learning experience of architecture students, limited research has explored which specific attributes of the studio environment are most important to students. This research aims to address this gap by determining the priorities of architecture students regarding key studio attributes. The research employs a quantitative approach using the Best-Worst Scaling (BWS) model and a questionnaire survey. A pilot study was conducted with undergraduate architecture students. The results reveal the ranking and relative importance of key studio attributes, organised into five categories: Physiological Facilities, Information and Communications Technology, Indoor Environment Quality, Territoriality, Furniture, and Reference. This research provides a valuable reference for designing student-centred studio environments and demonstrates the viability of using the BWS method to determine students' priorities for studio attributes.

KEYWORDS: Architecture Education, Best-Worst Scaling, Studio, Studio Attributes, Studio Environment.

INTRODUCTION

The architecture studio is more than just a place of learning. It is a physical environment that shapes the creative and intellectual development of architecture students. The studio is designed to foster collaboration, experimentation, and innovation in design. It is typically an open, flexible space with large worktables, ample natural light, and access to the latest technology and resources. The atmosphere of the studio is intended to encourage interaction and discourse among students, as well as with instructors and visiting professionals. The physical space of the architecture studio is carefully curated to promote the exploration of new ideas, the refinement of design skills, and the growth of each student as a creative and confident professional [1-3]. The architecture studio is a vital component of the architecture education experience, whether for individual or group projects. It gives students the resources and support they need to develop their design skills and create meaningful work. Therefore, the architecture studio is a dynamic and inspiring environment where the next generation of architects and designers are nurtured and developed.

Despite recognising the role of the studio environment in shaping architecture students' learning experience, limited research has specifically addressed how students prioritise their preferences for the physical space of their studios. The lack of empirical research in the studio environment significantly hinders understanding it for educators, students, and designers. This makes it challenging to bring about positive changes and becomes even more problematic when decision-making power is given to those not directly involved with the users. In order to establish a supportive studio, it is essential to conduct systematic inquiries with actual users using the space. Therefore, this research examines architecture students' perception of the studio environment by looking at their prioritisation of studio attributes through the Best-Worst Scaling method. This research provides valuable insights into the relative importance of different attributes in the studio environment. It helps to guide the design of studios that meet the needs and preferences of students.

LITERATURE REVIEW

The architecture studio can be a unique learning environment beyond the conventional classroom setting [4]. This is because architecture students spend considerable time in the studio, more so than students pursuing other programmes. The students work in the studio during the scheduled class hours and after hours. This additional time spent in the architecture studio can account for up to one-third to one-half of their educational experience [5-7].

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In contrast to other professional programs, architecture students tend to occupy the same studio for an extended period, which could be as long as a semester, a year, or even the entire design education. This differs from the typical classroom setting, where students only attend lectures during class hours, and multiple student groups use the same class space for various courses or activities throughout the day or week.

In the architecture studio, students continuously work on a single project over a specific time frame [8]. This allows them to personalise their work area to their preferred work style, pace, and needs. Furthermore, students can continue their work without setting it up from scratch each time. The studio hours are not set in stone and serve more as rough guidelines than a fixed schedule, which is typical of other classrooms [8]. As project deadlines approach, students and instructors often spend time in the studio before and after the scheduled class hours, including weekends, evenings, and even holidays.

The architecture studio can transform into a vibrant hub of activity during class hours. Participants, including instructors and fellow students, often come together around a table to discuss the project at hand. The studio becomes familiar, and students can work at their desks, take a quick meal break, or simply catch up with friends [5, 6, 8]. This type of structure and the inherent pedagogical features of the design studio play a significant role in supporting student development and promoting inspiration and the expression of architectural ideas [8]. In fact, Schön [9] views the architecture studio's ability to offer a practical and invaluable model for educational reform.

The studio environment is undeniably a crucial aspect of the learning experience for architecture students. A well-designed studio space can significantly impact the quality of education and overall student outcomes. From air quality and temperature to lighting, noise levels, and seating comfort, the physical characteristics of the studio can significantly influence the learning experience [10-15]. Additionally, students appreciate the availability of technology and amenities, such as computers and printing facilities, that support their learning and creativity [3].

Understanding how students interact with, shape, and perceive the studio environment is essential to create an effective design. The functional and symbolic elements of the studio should align with the needs and preferences of the students to provide a positive and meaningful learning experience [16-18]. Additionally, nonverbal cues, such as the flow between spaces and the physical connection between individuals, can significantly shape student perceptions more than verbal or written messages [19].

Other considerations in the studio space design include the size of the groups using the space, the structural elements, the level of student and staff involvement, and various physiological and psychological factors [20]. It is essential to take these factors into account and design a space that is functional, meaningful, and supportive of the learning experience in the studio environment.

METHODOLOGY

Best-Worst Scaling (BWS) Method

This research employs Best-Worst Scaling (BWS) object case to rank and determine the relative significance of different studio attributes. The focus is on understanding the level of importance respondents place on various studio attributes that can impact studio usage adoption. Respondents were asked to select the best and worst attributes from a set, which provides more reliable and valid results than selecting middle attributes, as they offer greater discrimination [21].

Questionnaire Design

The questionnaire used in this research was structured in two main parts. The first section aimed to obtain demographic information from the respondents, such as their gender, age, and academic year. The second section consisted of 20 questions utilising the Best-Worst Scaling (BWS) approach to determine the participants' preferences for the "Best" and "Worst" studio attributes.

The questionnaire design was influenced by the work of Wong and Jusan [3], who conducted qualitative research using the Means-End Chain Model. They identified 16 studio attributes critical in meeting undergraduate architecture students' educational needs. These studio attributes comprise High-Speed WiFi, Power Socket, High Spec Computer, Plotter, Private Workspace, Group Work Area, Table and Chair, Cabinet, Pantry, Sleeping Area, Leisure Area, and Pot Plant. These attributes served as the foundation for the BWS questions in the second section of the questionnaire.

The BWS questions design utilised an Incomplete Balanced Block Design (BIBD) [21]. The design format was specified as 20,5,4,1 (b, r, k, λ) for 16 attributes (v). The BWS questions consisted of 20 choice sets (b), with each attribute appearing 5 times (r) across all sets. Each choice set contained 4 attributes (k), and each attribute was compared once with each of the other attributes

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(λ). The 20 choice sets were designed and presented as individual sets in the questionnaire. Figure 1 illustrates a sample of BWS choice set used in the questionnaire.

	Best	Worst
a) Lighting	□	□
b) Ventilation	□	□
c) High-Speed WiFi	□	□
d) Group Work Area	□	□

Figure 1. A Sample of BWS Choice Set

BWS Data Collection

This research utilised purposive sampling and conducted a pilot study at Universiti Teknologi MARA Sarawak, Malaysia. A total of 90 architecture students from the same university were approached as the target respondents. All the participants were undergraduate students pursuing a Bachelor of Science (Hons) (Architecture). The decision to only select undergraduate students from the same programme was based on the assumption that they would share a similar cultural orientation within the architecture department. The questionnaires were personally handed out to the respondents during their studio classes and collected immediately after completion, taking about 15 minutes on average.

BWS Data Analysis

The data collected from the BWS questionnaire was then analysed to calculate each attribute's ranking and relative importance. This analysis was performed using IBM SPSS Statistic software. The BWS analysis was performed at both the individual and category levels. At the individual level, the data were analysed to determine the ranking and relative importance of the attributes for each student. At the category level, the data were aggregated to determine the overall ranking and relative importance of the attributes for the entire sample. The ranking provided information about the relative ordering of the attributes, indicating which attributes were considered most important by the students. The relative importance measured the extent to which each attribute contributed to the overall importance of the set.

FINDINGS AND DISCUSSION

Characteristic of Respondents

Table 1 showcases the demographic profile of the 90 participants in the BSW survey. These respondents are all undergraduates in their first to third year of study, with 46 in their first year, 23 in their second year, and 21 in their third year. Of the 90 participants, 33 are male, and the remaining 57 are female. The average age of the respondents is 19 years old.

Table 1. Characteristics of The Respondents

Demographic Items		**Frequency**	**Percentage**
Gender	Male	33	37%
	Female	57	63%
	Total	90	100%
Year of Study	One	46	51%
	Two	23	26%
	Three	21	23%
	Total	90	100%
Age	18	44	49%
	19	23	26%
	20	14	16%
	21	5	6%
	22	4	4%
	Total	90	100%

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Ranking of Studio Attribute Categories

Table 2 and Figure 2 show four categories of studio attributes with a positive Category BWS Score. These categories, ranked in order, are Indoor Environmental Quality, Information and Communications Technology, Territoriality, and Furniture. These categories are considered more important than the remaining two categories. The respondents in the sample rated the attributes in these four categories as "Best" or "most important" more often than "Worst" or "least important." On the other hand, Physiological Facilities ranked second to last, followed by Reference, which is considered the least appealing category. Both Physiological Facilities and Reference categories are chosen as "Worst" more frequently than "Best" by respondents, resulting in a negative Category Best-Worst Score. Hence, the attributes within these two categories are considered the least important for the studio among the entire sample.

Table 2. Best-Worst Scaling (BWS) Summary Statistics of Studio Attribute Categories

Rank	Category	Attribute	BWS Score	SQRT BWS Score	Category BWS Score	Category SQRT BWS Score	Category Relative Importance
1	Indoor Environmental Quality	Air Conditioning	0.45	2.22	0.22	1.62	7.09
		Lighting	0.22	1.68			
		Ventilation	-0.01	0.97			
2	Information and Communications Technology	High-Speed WiFi	0.50	2.43	0.13	1.43	6.26
		Power Socket	0.21	1.68			
		High Spec Computer	0.02	1.06			
		Plotter	-0.23	0.57			
3	Territoriality	Private Workspace	0.28	1.74	0.11	1.29	5.65
		Group Work Area	-0.07	0.85			
4	Furniture	Table and Chair	0.19	1.55	0.01	1.08	4.73
		Cabinet	-0.16	0.61			
5	Physiological Facilities	Pantry	0.09	1.22	-0.23	0.69	3.02
		Sleeping Area	-0.14	0.77			
		Leisure Area	-0.22	0.59			
		Pot Plant	-0.66	0.19			
6	Reference	Mini Library	-0.48	0.23	-0.48	0.23	1.00

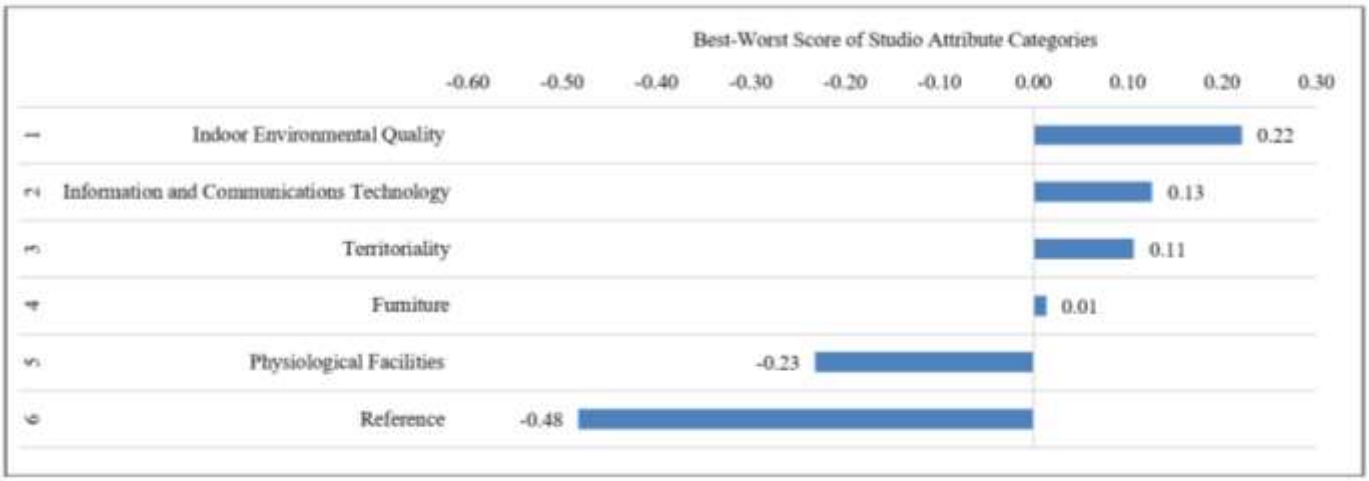

Figure 2. The Ranking of Studio Attribute Categories Based on Category Best-Worst Score

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Relative Importance of Studio Attribute Categories

According to Figure 2, the Indoor Environmental Quality category has the highest Collective Studio Attributes score at 7.09, making it the most important category. This category is approximately 7 times more important than the Reference category, ranked last. The Information and Communications Technology category comes in second place with a score of 6.26, followed by Territoriality and Furniture with scores of 5.65 and 4.73, respectively. The result reveals a significant gap between the fourth (Furniture) and fifth (Physiological Facilities) categories, with Furniture being 1.57 times more important than Physiological Facilities. Lastly, the Reference category is considered the least important among the five categories.

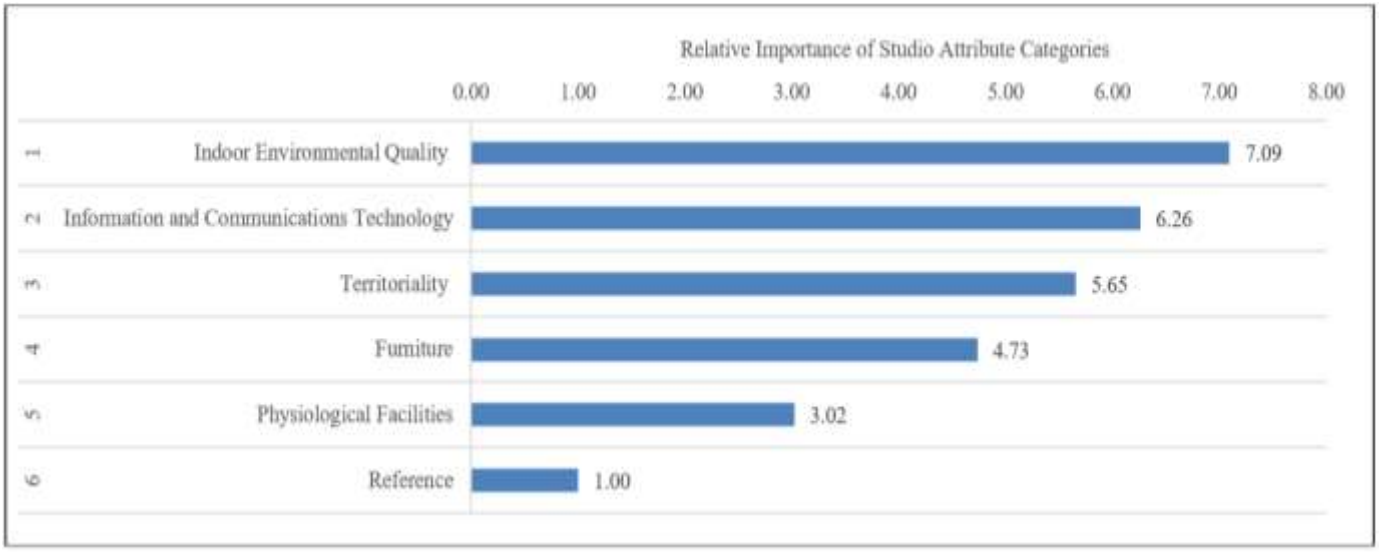

Figure 3. Relative Importance of Studio Attribute Categories

Studio Attributes of Indoor Environmental Quality

The Indoor Environmental Quality category has been deemed the most important among the attribute categories in a studio environment. This is due to the high ranking of its three attributes: Air Conditioning (ranked 2nd), Lighting (ranked 4th), and Ventilation (ranked 9th). Respondents appear to prioritise comfort in a studio setting, placing emphasis on thermal comfort (Air Conditioning and Ventilation), visual comfort (Lighting), and indoor air quality (Ventilation).

Studies have consistently shown that Indoor Environmental Quality, which deals with thermal comfort, visual comfort, and indoor air quality, is critical in determining occupant comfort, productivity, and performance [22-24]. These three attributes are considered the most crucial factors in creating a conducive learning environment in a studio, as a comfortable environment is likely to enhance learning efficiency and outcomes. In other words, the productivity and performance of the respondents are closely tied to the optimal level of Indoor Environmental Quality in the studio.

Studio Attributes of Information and Communications Technology

The Information and Communications Technology category includes four studio attributes, with three of them ranking in the top 8. These three attributes are High-Speed WiFi (1st), Power Socket (5th), and High Spec Computer (8th). These three attributes collectively have a better ranking than the Indoor Environmental Quality category. However, the ranking of the Information and Communications Technology category is affected by the ranking of Plotter at 14th place. If not for Plotter, the Information and Communications Technology category would likely overtake the Indoor Environmental Quality category.

The high priority placed by the respondents on the Information and Communications Technology category is due to generational differences. The average age of the respondents in the research is 19, and they belong to the millennial generation (1980s-2000s), also known as Generation Y, the Net generation, or Digital Natives [25-27]. Millennials possess distinct traits that set them apart from previous generations [25, 28]. Being tech-savvy [29], they are the first generation to grow up surrounded by Information and Communications Technology [30]. Consequently, they are quick to adapt to computer technology, mobile devices,

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and internet applications as they are integral to their daily lives [31]. Thus, millennials tend to prioritise studio attributes related to Information and Communications Technology.

Studio Attributes of Territoriality

Territoriality ranks third among the most crucial studio attribute categories, with Indoor Environmental Quality and Information and Communications Technology being 1.25 and 1.1 times more important, respectively. Territoriality is 1.18 and 1.84 times more attractive than Furniture and Physiological Facilities. It is also 5.65 times more significant than the lowest-ranked category, Reference.

The concept of Territoriality refers to the exclusive control and utilisation of a specific space by individuals or groups [32-34]. The Territoriality category includes two studio attributes: Private Workspace and Group Work Area, representing different space utilisation patterns. Private Workspace is intended for individual use, while Group Work Area is for communal use. However, respondents exhibit a preference for Private Workspace over Group Work Area. The presence of a Private Workspace provides a private, distraction-free working space customised to meet its users' learning requirements and habits.

The respondents' emphasis on the clear separation of private and public workspaces reveals their concern for the different types of activities taking place in the studio context. Clearly defined territorial areas cater to varying learning needs at different times [35], promoting order in the daily operation of the studio environment. This allows respondents to manage their learning activities without any spatial conflicts effectively. The establishment of clear space ownership and boundaries in the studio environment is accomplished through individual decision-making and group agreement, minimising possible conflicts. Territoriality thus serves to organise respondent behaviour and minimise interference among individuals or groups. As a result, Territoriality helps to keep conflicts to a minimum in the studio environment.

Studio Attributes of Furniture

Furniture ranks fourth among the six categories of studio attributes, with Indoor Environmental Quality, Information and Communications Technology, and Territoriality ranking higher. However, Furniture is more appealing than Physiological Facilities and Reference, which rank fifth and sixth, respectively. The importance of the Furniture category is determined by two studio attributes, Table and Chair, and Cabinet.

The selection of Table and Chair, and Cabinet as important furniture items is mainly based on considerations of comfort and storage. Comfort enhances efficiency and contributes to positive learning outcomes, while proper storage addresses safety concerns. Ergonomic furniture is crucial in maintaining student focus and comfort, leading to a pleasant studio learning environment [3].

Studio Attributes of Physiological Facilities

The Physiological Facilities category has been placed fifth on the list of essential studio attribute categories. Compared to Indoor Environmental Quality (first), Information and Communications Technology (second), Territoriality (third), and Furniture (fourth), this category is obviously far less significant. The fifth-ranked Physiological Facilities category is almost three times more enticing than the sixth-ranked Reference category.

Physiological Facilities are related to physiological demands, as the name indicates [36, 37]. The Physiological Facilities category has four attributes: Pantry, Sleeping Area, Leisure Area, and Pot Plant. The physiological needs denoted by these four attributes include food, drink, relaxation, rest, and sleep. Only Pantry (seventh) makes it into the top eight of the overall characteristics rating upon deeper study. In reality, Sleeping Area (twelfth), Recreation Area (thirteenth), and Pot Plant (sixteenth) are positioned at the bottom of the list. Their low position on the list suggests that respondents place less importance on certain studio features. In other words, responders prioritise food and drink (Pantry) to work continuously and productively rather than spending excessive time on relaxation, rest, and sleep (Sleeping Area, Leisure Area, and Pot Plant).

Studio Attributes of Reference

Reference is the least significant among the six attribute categories. At first, the Indoor Environmental Quality category ranks seven times more significant than the Reference category. The categories of Information and Communication Technology, and Territoriality follow it. Both of them are approximately six times more advantageous than Reference. Additionally, fourth-ranked Furniture and sixth-ranked Physiological Facilities are almost five and three times more desirable than Reference, respectively.

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According to the responses, Mini Library is not a priority for studio environments. Sitting in the 15th position, the Mini Library is inferior to other studio attributes. Like Pot Plant, Mini Library had minimal impact on respondents' studio learning. Mini Library does not appear to be a need for studio environments for responders. Internet and libraries are constantly available to them if they need to obtain specific references.

CONCLUSION

The Best-Worst Scaling (BWS) method efficiently determines studio attributes' ranking and relative importance. BWS asks respondents to choose the "most important" and "least important" from a set of attributes. The ranking of 16 attributes, as revealed by BWS, has High-Speed WiFi as the most important, followed by Air Conditioning, Private Workspace, Lighting, Power Socket, Table and Chair, Pantry, High Spec Computer, Ventilation, Group Work Area, Sleeping Area, Cabinet, Leisure Area, Plotter, Mini Library, and Pot Plant. Additionally, BWS results can be used to calculate the Relative Importance Score of each attribute, with ratio properties that allow for easy comparison and calculation of one attribute's importance in relation to others. The Category Relative Importance Scores of the 16 studio attributes indicate that the Indoor Environmental Quality (7.09) and Information and Communications Technology (6.26) categories are the most desirable, followed by Territoriality (5.65) and Furniture (4.73) in third and fourth place respectively. Physiological Facilities (3.02) rank fifth. The Reference category (1.00) is the least desirable among the six categories. This method provides a clear understanding of the reasons behind respondents' priorities.

The results of this research can be presented through environmental quality profiles shown in Figure 2 and 3. These profiles provide a clear and easy-to-understand summary of the users' preferences and priorities for studio attributes. They have the potential to inspire new design concepts for designers, educators, administrators, and others, helping to create student-centred studio environments. This research makes a valuable contribution to the design field by presenting these findings, providing new insights into improving current studio conditions, and inspiring innovative design ideas. Besides, this research offers a practical and relevant approach to determining the preferred studio attributes from the perspective of architecture students. The results of this research will be a valuable reference in the design process for creating a more student-centred studio environment that meets students' learning needs and capabilities. Additionally, these findings may serve as a catalyst for further research in this area, exploring ways to improve studio design and enhance students' learning experience.

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