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Identifying the Gap in User Satisfaction Assessment from Different Perspectives in Public Institutional Buildings

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Abstract

The building is a place that is responsible for meeting its users' needs and expectations, and offering them a safe and comfortable environment. Many researchers focus on evaluating the user satisfaction level in different Building Performance Levels (BPLs). However, measuring the end-user satisfaction is not an indicator of the importance of the BPLs and its attributes to the end-users. This paper aims to identify the gap between the importance of different performance levels from the user's and the architect's perspective, and the frequency of their application in scientific research. Two surveys were conducted to 172 architects and end-users. Then, a structured review highlights the frequency of applying user satisfaction assessment in each BPLs. The results showed that the gap between the architect and the end-users in identifying the importance of each performance level in building is low not exceeding 12% in any performance level, but there is a clear gap in research related to measuring user satisfaction in the functional, technical, and aesthetic performances by (38%), (39%), (12%) respectively, compared to their importance in affecting the level of user satisfaction in buildings.

Keywords: End-user Satisfaction; Building Performance Levels; Performances Gap; Public Buildings.

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1. Introduction

The building is a place that responsible for meeting its occupants' /users' needs and expectations, and offer them a safe and comfort environment that enhances their behavior and support their activities inside it[1, 2, 3]. The meaning of building shifts from an object of materials and shelter, to a set of experiences, outcomes in relation to the people stays in it [4]. Thus, the idea of evaluating the building performance has spread in the last decades as a way to grantee the building is performing well and highlighted any problem that need to be considered. Accompanied to the spread of the concept of building performance evaluation (PBE), the concept of user satisfaction is highlighted after the researchers, designers, and business funders understand the importance of users' satisfaction for any product's success, improvement, sustaining, benchmarking, and evaluating as well.

In the user satisfaction assessment topic, some research focus on evaluating the building or facility through measuring the user satisfaction level to certain attributes only without relying on any physical measurement as [5, 6, 7, 8]. While other research measure user satisfaction level as a part of the post occupancy evaluation (POE) in order to evaluate the building through its users satisfaction level and physical measurements as [9]; [10]. Other researches measure user satisfaction as a part of building performance evaluation (BPE) through studying the correlation between building performance and user satisfaction as [11, 12, 13, 14].

According to [14] detecting the level of satisfaction of users to a certain attribute is not a reflection of its importance in influencing the user satisfaction in buildings. They added that "a general overview of research on the subject of user satisfaction in buildings in terms of research designs and their influence factors is missing in the scientific discussion". On the other hand, the architects and the design team evaluating the design objectively considering how the design affect user satisfaction level is hard [15]. Accordingly, measuring user satisfaction level to different performances of building is not an indicator of the real effect of those performance levels to the user Satisfaction.

Thus, the objective of the research is to mind the gap between end-users and architects in identifying the importance of different building performance levels in affecting user satisfaction. Then, the research compares the importance of each performance level of building from the end-user, and architect's point of view to the frequency of applying those performances in scientific research.

2. Building Performance Levels and Attributes

In case of the user satisfaction evaluation in buildings, the researchers define the different building performance levels, attributes, and users' requirements differently. Some research define users' needs, simply into physical and non physical or psychological needs with some sub-requirements under each need. For instant, [16] categorize the attributes in case of user satisfaction evaluation into physical and psychological requirements, in which the physical needs are translated into spacial, thermal, acoustical, optical, health and safety requirements. While the psychological needs are translated into privacy, behavioral, aesthetic and social requirement. Similarly, [17] defined the attributes that affect the users' inside the building into physical and non-physical parameters, in which the physical needs refers to the thermal, visual, acoustic environment and air quality, while

the non-physical factors are space quality, space layout, privacy, cleanliness, furnishing. Likewise, [18] reviewed the users' physical and psychological needs that related to building. Then they categorized the human needs into three levels: a) Health, safety and security level, b) Functional, efficiency and workflow level, and c) Psychological, social, cultural, and aesthetic level. On the other hand, [19] classify the factors that need to be evaluated in building evaluation process into 4 aspects: Environmental, Physical and space, Psychological, and Socioeconomic aspects, then they define those performance levels under some attributes While [2,20] divided the BPLs into three main levels that are technical, functional, and behavioural performance. They added a 2 sub performances under the technical performance that are physical and environmental. In addition [3] grouped the building performances and its attributes under three main performance levels that are physical, environmental, and external performances. Then, they go in-depth to categorize each performance level to some attributes and sub-attributes. On the other hand, Center of built Environment (CBE) had listed some attributes that widely used as occupant satisfaction survey in buildings to evaluate the built environment: Office Layout , Office furnishing, Thermal comfort, Air quality, Lighting, Acoustic quality, Cleanliness and maintenance, General comments [21]. Based on the previous studies, this research categorizes the BPLs and attributes into 2 main levels that are 1. Physical performance level, and 2. Psychological performance level. Each of those levels divided into sub-levels, the physical level defined under 4 sub-levels that are a) Functional performance, b) Environmental performance, c) Technical performance, and d) Financial performance. While the psychological performance level is divided to 2 sub- levels that are: a) Behavioral performance, and b) Aesthetic performance. After that, each sub level defined under some attributes that act as the indicators of each performance level as shown in Figure 1.

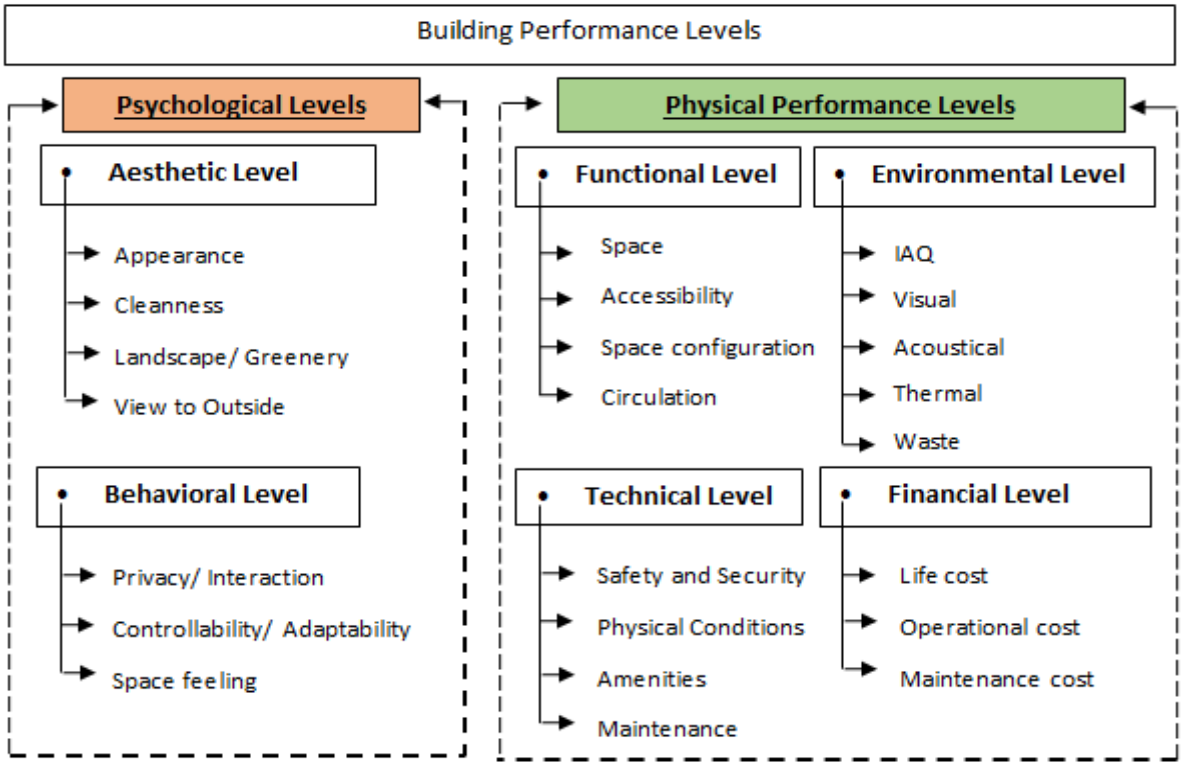

Figure 1: The Building Performance Levels categorization (The author after the review).

3. Methodology

The research depends on the theoretical and survey approach, in order to identify the gap between end-users, architects and research in ranking the importance of different building performance levels in influencing the user satisfaction level in buildings.

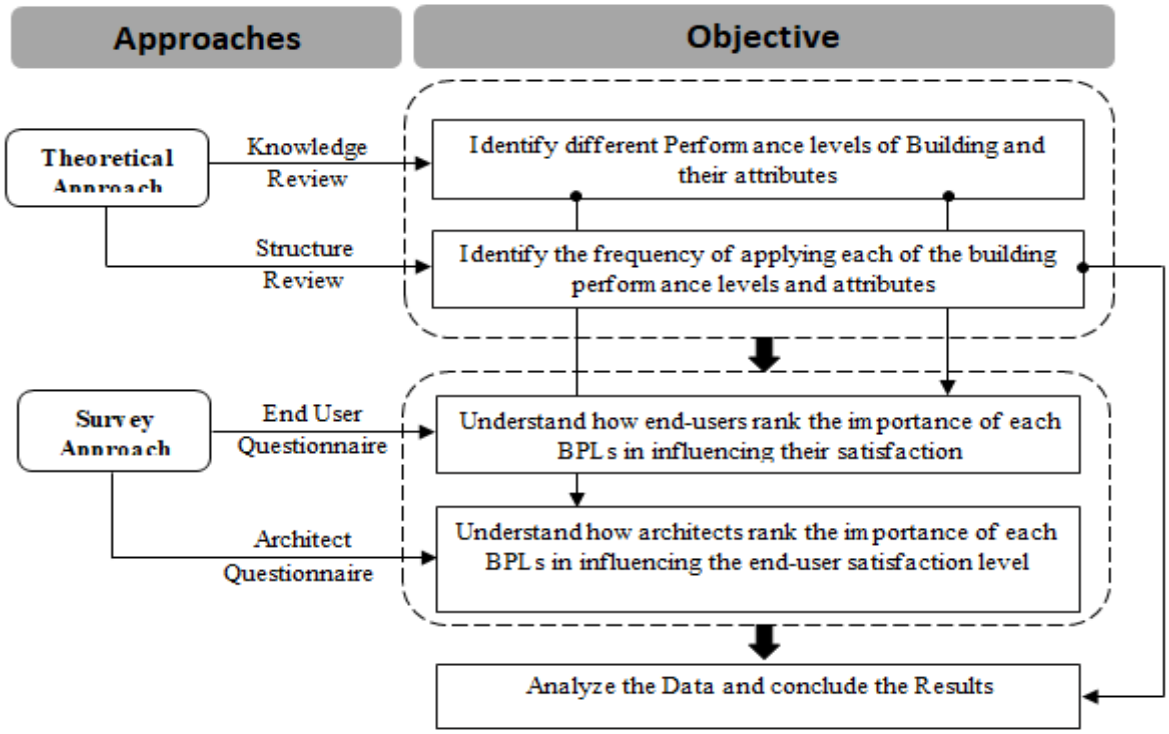

Figure 2: The Research Methodology.

Figure 2 presents the methodology of research, The theoretical approach includes the knowledge and structure literature review. Firstly, a general knowledge review takes place to identify and categorize the different buildings performance levels and the attributes under each performance level. Then, we review the science direct platform for relevant studies that measures user satisfaction in buildings. We search for the three keywords of user satisfaction; post occupancy evaluation; and building performance evaluation in both titles or abstracts. Since the research depends on comparing between the previous research results and the users and the architect's point view, this research relies on research published in the last 5 years only from 2017 to 2021. 36 papers have been considered in the research after excluding all not related research. The study excludes any research that did not present a user satisfaction measurement as: 1) theoretical or review papers, 2) papers built its methodology of evaluation on the physical measurements or observation of building only without considering end-users, 3) papers that deal with outdoor spaces (Urban Scale) not Buildings. Then, a two online questionnaire survey had designed based on the categorization of performance levels of building concluded from the first phase in the theoretical approach. Firstly, the end-user questionnaire to understand how end-users rank the different performance levels of building that affect their satisfaction in Institutional governmental buildings through the operational phase. Secondly, the architects and design team questionnaire that understands how architects and design team rank the pre-mentioned performance level that affect user satisfaction in public

buildings. Both of questionnaires based on a 5 Likert scale. Figure 3 shows a sample of the online questionnaire for both architects and end-user.

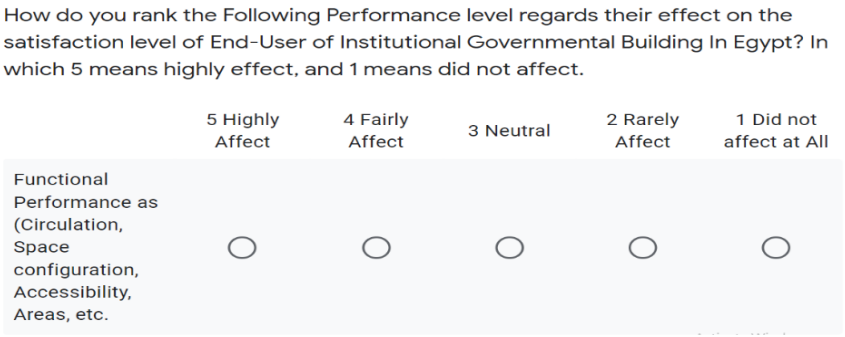

Figure 3: Sample for the Architect and Design team Questionnaire.

4. The Results and Discussion

The characteristics of the papers included in the study are presented in both Figure 4, and Table 1 In which Figure 3 presents the number of papers per year, and Table 1 shows the journals and the cite scores of the reviewed paper.

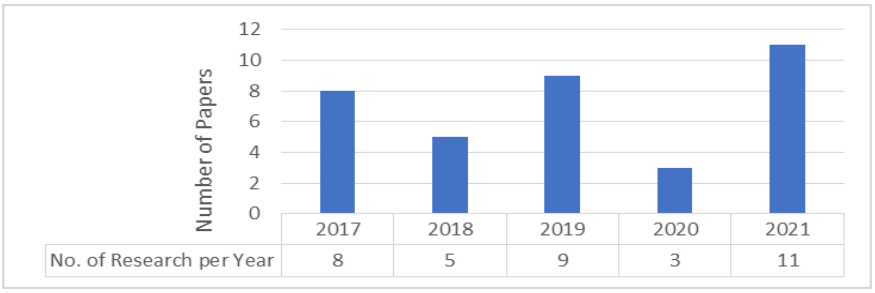

Figure 4: The No. of paper the reviewed per year of publication.

Table 1: The Journals of the reviewed papers.

Journal	Number of Papers	Cite Score
Building and Environment	23	9.7
Journal of Building Engineering	5	5.5
Energy and Buildings	2	10.9
Frontiers of Architectural Research	1	3.2
Sustainable Cities and Society	1	10.7
Procedia Engineering	2	4
Energy Procedia	1	4.4

Whereas for buildings type, it was found that the office building attracts most of the focus on the user satisfaction assessment research followed by the residential building, then the educational buildings as shown in

Figure 5. While the institutional building defined in the figure was a museum, library, and airport terminal.

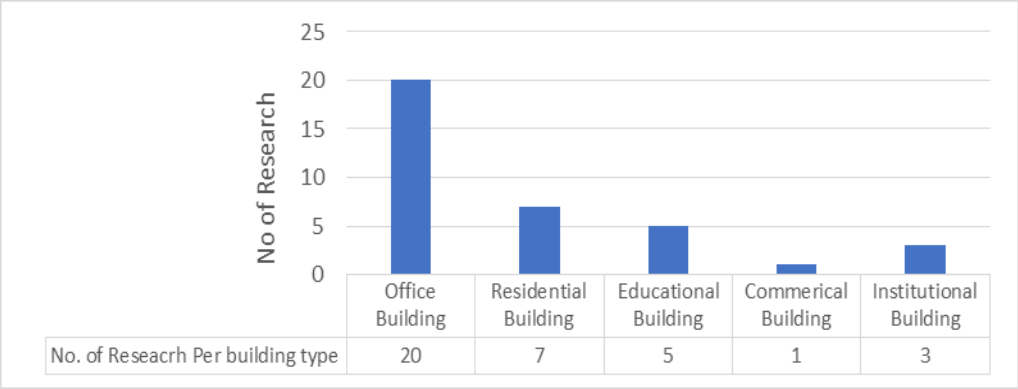

Figure 5: Number of Research per each type of building.

Table 2 presents the research applied user satisfaction assessment in each attribute of the main building performance level.

Table 2: A view of attributes measured in building performance levels.

Performance Levels		Attributes	References
Physical Performance	Functional Performance	Space	[22] [2] [23] [24] [25] [26] [27] [8] [28] [17] [29] [30] [31]
		Accessibility	[2] [26] [17]
		Layout	[2] [32] [25] [27] [31]
		Circulation	[2] [32] [27]
	Environmental Performance	IAQ	[33] [22] [34] [2] [32] [23] [24] [35] [25] [26] [27] [8] [36] [28] [37] [17] [38] [29] [39] [40] [41] [30] [31] [42]
		Visual Comfort	[33] [43] [22] [2] [32] [23] [24] [35] [25] [26] [27] [8] [36] [28] [37] [17] [38] [44] [29] [39] [40] [30] [42] [31]
		Sound Comfort	[33] [43] [22] [2] [32] [23] [24] [25] [26] [27] [8] [28] [37] [17] [38] [44] [29] [39] [40] [41] [30] [42] [31]
		Thermal Comfort	[33] [43] [22] [2] [32] [23] [24] [35] [25] [27] [8] [36] [28] [37] [17] [38] [44] [45] [29] [39] [46] [47] [40] [48] [49] [41] [30] [50] [42] [51] [31]
		Waste	[33] [43] [22]
	Technical Performance	Physical Conditions	[22] [2] [26] [17]
		Safety and security	[33] [2] [23]
		Amenities	[33] [2] [24] [26] [30]
		Maintenance	[25] [27]
Psychological Performance	Aesthetic Performance	Appearance	[22] [2] [32] [24] [26] [27] [30]
		Cleanness	[24] [25] [27] [8] [17] [30]
		Landscape /Greenery	[2] [24] [26] [40] [30] [42]
		View to outside	[23] [26] [27] [8] [44] [40] [30] [42] [31]
	Behavioral Performance	Privacy/Interaction	[22] [27] [8] [40] [31]
		Controllability/ Adaptability	[33] [25] [27] [8] [36] [28] [17] [44] [29] [39] [30] [42] [31]
		Overall design	[22] [32] [23] [26] [17] [38] [44] [29] [39] [47] [31]

Based on Table 2, the frequency of applying the user satisfaction assessment in the scientific research in each attribute is presented in Figure 5.

This frequency calculated through the relation between the number of research applied in each attribute compared to the total number of research included in this study. It was found that the thermal indicator is the most measurable topic, followed by visual comfort and IAQ by 92%, 69%, and 69% respectively.

While the waste management and maintenance are the less attribute that have been considered in research (6%), followed by the accessibility, circulation, and the physical conditions that applied in 8% of the research in this study.

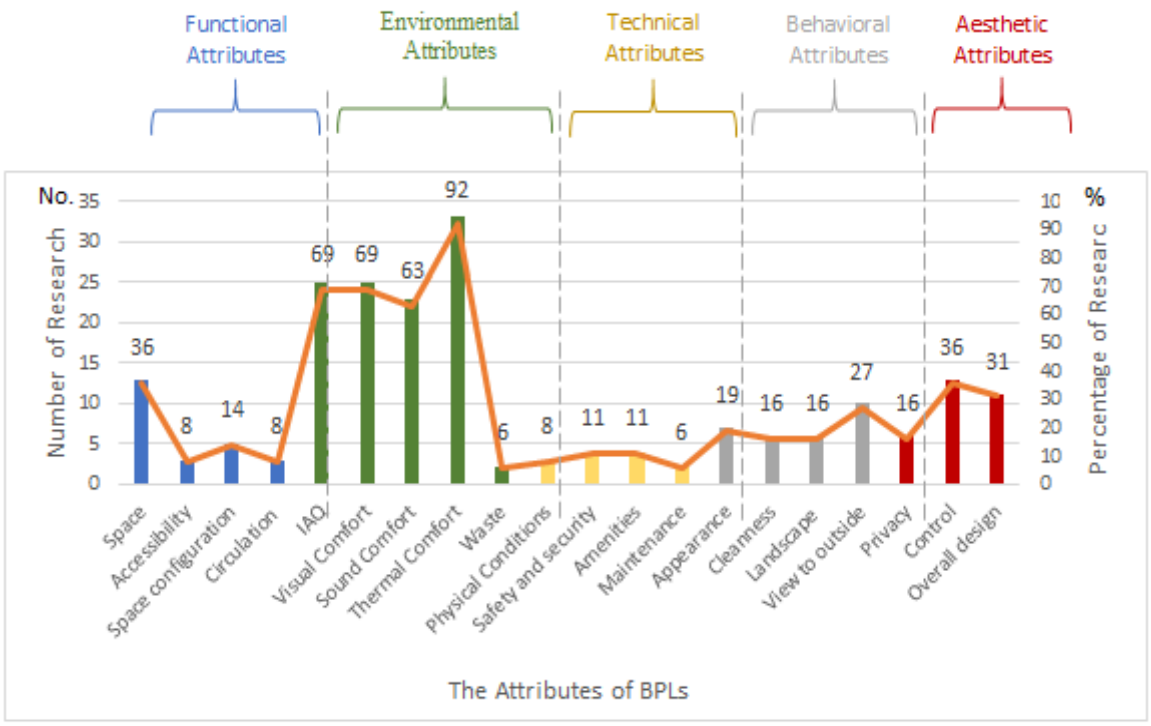

Figure 5: Frequency of Different Performance Indicators in Research.

To understand the most performance level that attracts the researchers, the date in Figure 5 that present the number of research in each attribute translated into a number of research applied in each performance level. Figure 6 presents the frequency of applying each performance level in the research, in which the frequency of applying reflects the importance of each performance level in the scientific field.

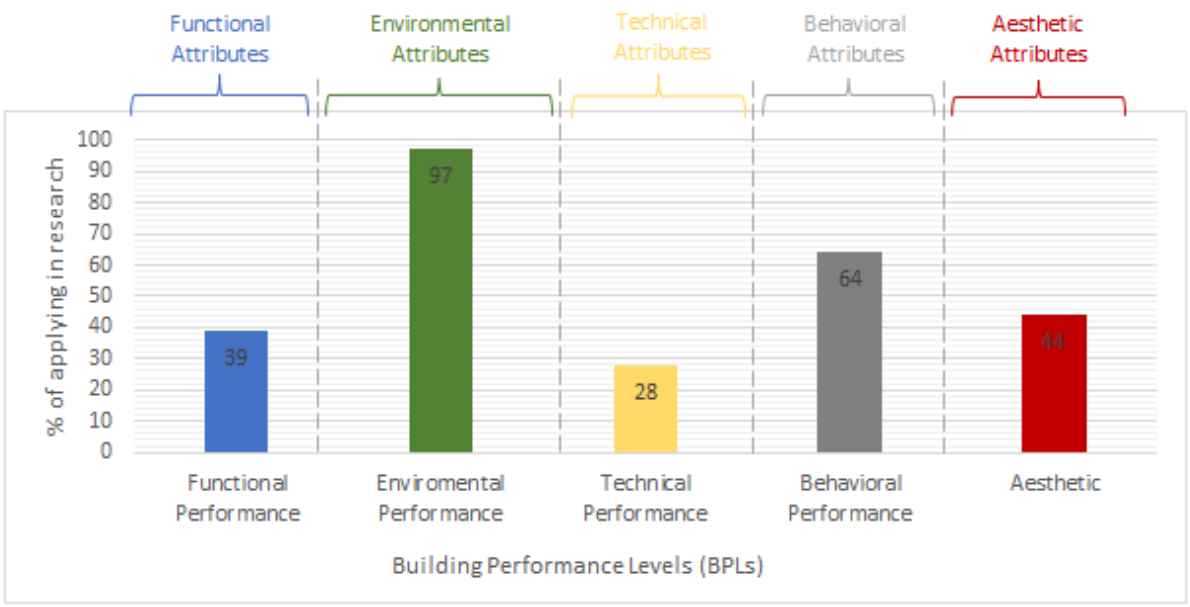

Figure 6: The frequency (%) of applying building performance levels in research.

The results showed that the environmental performance is the most performance that attracts the researchers in which (97%) of the research measure user satisfaction to environmental indicators, it followed by the behavioral performance level that presented in the reviewed research by (64%). While the technical and the functional performances are the less performance levels applied in the reviewed papers by 28% and 39% respectively.

It is not surprising that the environmental indicators present the high applying rate in the scientific research, since the end-user satisfaction survey mostly appears as a part of building evaluation process, and the environmental indicator can be easily measured through many tools and provide objective results. Unlike the other performance levels as functional and technical levels.

4.1 Survey Results

The survey takes place to measure the importance of each performance level in affecting the end-user satisfaction in governmental institutional buildings. Thus, the end-user of building can be any citizen. The total population of Egypt is 102,334,403 people.

The research focuses on the people between 15 to 65 years old. According to the Egypt population pyramid, this age range is equal to 61200000.

The sample calculated by Quartix online software with 95% confidence level, and 5% margin of error to be 385. Accordingly, 385 surveys sent to different end-users, 79 responds were received with 20.5 % response rate. On the other hand, in the architects and the design team survey, 80 survey has been sent randomly to architects. 48 only fill the survey with 60% response rate. Table 3 presents the characteristics of the respondents in both end-user and architect surveys.

Table 3: The Characteristic of respondent of the end-users and the architects survey.

Characteristics of End-users Respondent			**Characteristics of Architect/Design team Respondent**		
	No.	(%)		No.	(%)
Gender			**Occupation Title**		
Male	28	(35.5%)	Academic Career	24	(50%)
Female	51	(64.5%)	Industrial Career	24	(50%)
Age			**Years of Experiences**		
Younger than 20	20	(25.3%)	Fresh Graduate	4	(8.3 %)
20-35	27	(34%)	Less Than 5 yeas	17	(35.4 %)
36-45	16	(20%)	between 5 to 10 Years	17	(35.4 %)
46-60	9	(11%)	Between 11 and 20 years	6	(12.5 %)
Older than 60	7	(9%)	More than 20 Years	4	(8.3 %)

Based on the end user survey, it was found that the functional and environmental performance of building highly affects the end-user satisfaction in Institutional Governmental buildings by the same rate (77%). Followed by the technical and behavioural performance of buildings by 55% and 52% respectively. While the aesthetic performance of buildings is the less performance that influences the user satisfaction level in this type of building.

On the other side, in the Architect's point of view, the functional and behavioural performance ranks the high performance level that affects user satisfaction in governmental institutional building through 86% and 72% respectively, followed by the environmental performance. Both agreed that the aesthetic performance is the less that influence user satisfaction in those types of buildings. Based on the previous results, however, end-users and architects did not rank the different performance level in institutional governmental buildings the same. The survey findings present that there is no clear gap between users' needs and architect perception to the users needs in different building performance level as shown in Figure 7. Which shows the relation between the rate of influencing of each performance level on the end-user satisfaction level from the architect as building and space creator and citizens as the end-user.

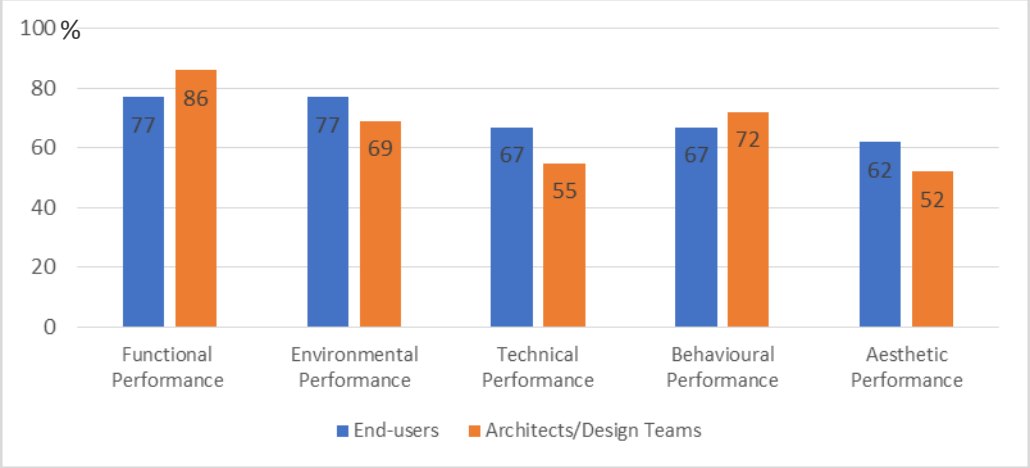

Figure 7: Comparison of the Architect and End-user Ranking for each performance level.

4.2 The Gap Between End-Users, Architect, and Scientific Research

The main gap between users, architects, and research appeared in the functional and technical performance levels. In which the users and the architects rank the importance of functional performance to the user satisfaction level 77% and 86% respectively. While only 39% of research consider the user satisfaction in the functional performance of buildings. Similarly, the users and the architects rank the importance of technical performance to the user satisfaction level 67% and 55% respectively. While only 28% of research consider the user satisfaction in the technical performance of buildings. While the less gap appears in the behavioral performance level as shown in figure 8.

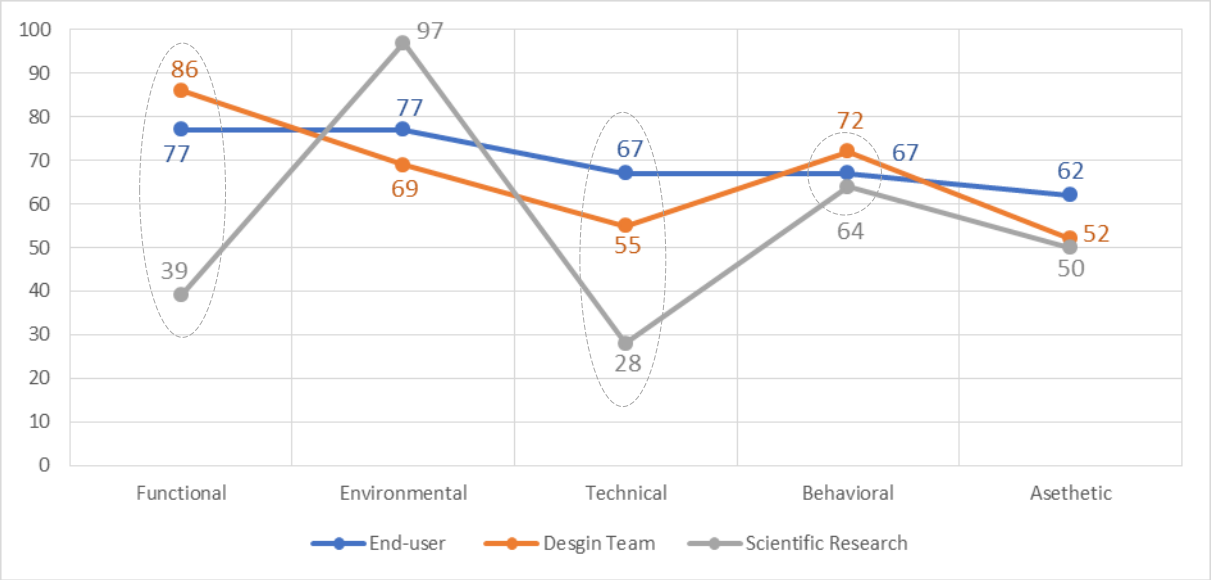

Figure 8: The gap between the end-users, architect, scientific research in factors affect user satisfaction in buildings.

By considering the users' preferences as a datum, the findings present that the architects give more importance to functional and behavioral performance of the building by 9% and 5% respectively. While they underestimate the effect of technical, aesthetic, and environmental performance to the user satisfaction level in the building by 12%, 10%, and 8% respectively as shown in Figure 9.

On the other hand, the research focus on measuring the user satisfaction to the environmental performance by 20% over the percentage of importance defined by the end-user. While there is a less focusing on user satisfaction assessment to the functional, technical, and aesthetic performances by 38%, 39%, and 12% respectively compared to the user datum. The less gap presented in the behavioral performance.

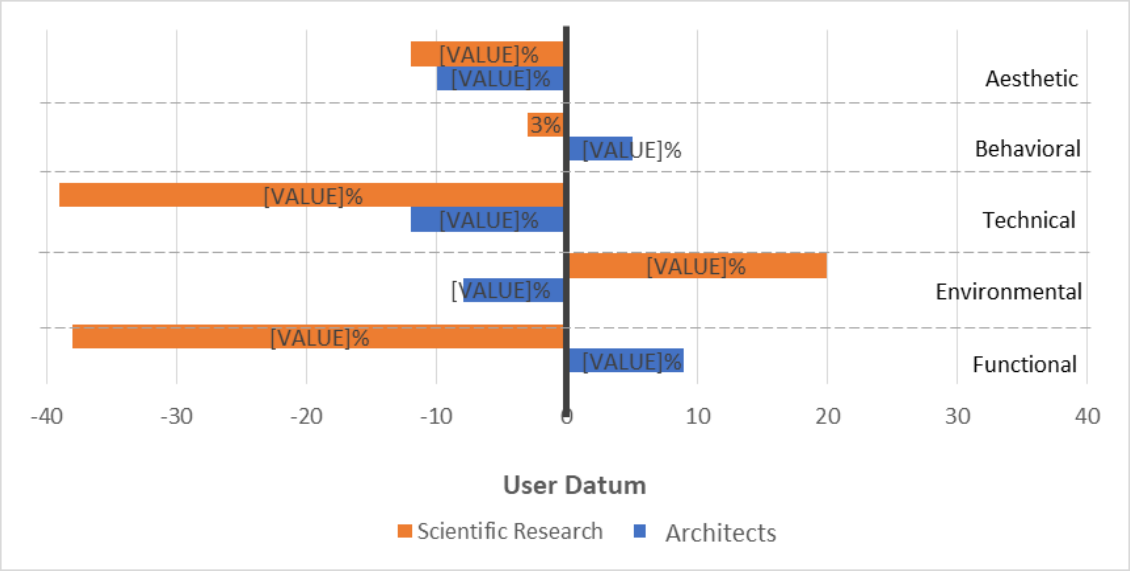

Figure 9: The gap between the end-users, architect, scientific research by considering the end-users preferences as datum.

4.3 The Study Limitations

This research has some limitation, the first issue is the few research numbers that measure the end-user satisfaction in governmental institutional building especially in Egypt and Africa. Thus, the researchers add all the research that considers user satisfaction evaluation regardless the building type and country of case study. However, the end-users and the architect questionnaires conducted in the institutional public buildings. Secondly, the research takes place during the covid-19 pandemic, thus, the questionnaire is filled online without hand to hand or interview surveys.

5. Conclusion

This research focuses on ranking the importance of different building performances in user satisfaction level from different perspectives in public buildings.

The results found that the end-users and architect define the environmental and functional performances as a prime performance that highly affect user satisfaction level in public buildings by (77, 69) % and (77, 86) % respectively. While the aesthetic performance ranks the lowest influence on the user satisfaction level. On the other hand, recently, most research focus on user satisfaction assessment of the environmental and the behavioral aspects. While there is a gap in research that related to studying user satisfaction to the functional and technical levels.

Whereas those performances, highly affect satisfaction levels, according to the user's ranking. This finding highlights the gap between architects, end-users, and scientific research in the functional and technical levels of building that need to be considered in the future research.

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