

The Effect of Educational Spaces Buildings' Design on the Building Performance Efficiency in Egyptian Universities' Architecture Departments

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ABSTRACT: The architectural education buildings' performance efficiency is one of the most important pivotal issues that has received huge attention in Egyptian thought in particular, due to the marked efficiency of architectural education decline in the Egyptian urban community. The practice of the architecture profession has witnessed a major change in recent years, which indicates a need for required changes in the architectural education buildings. Although there are continuous attempts to develop architectural education buildings to achieve the desired future visions, there is still a lack of consensus on what these developments really are. The research aims to set a group of modern design standards to improve the educational spaces performance level, especially drawing studios in architectural education buildings in Egyptian universities, where drawing studios are the most important factors that affect the educational spaces efficiency because they are the direct physical side with which the architect interacts and is affected by during the educational stage, as the student spends most of the time inside it. Then he forms the material side of the society in which he lives, this goal is achieved through achieving a set of secondary steps and goals, which are defining the design foundations for educational spaces, especially drawing studios in architectural education buildings in Egyptian universities that achieve distinct job efficiency, and analysis And evaluation of some architecture departments' models in Egyptian universities.

KEYWORDS: educational spaces - drawing studios - architecture departments' buildings - architectural education buildings - architectural education efficiency – architectural studios standards.

I. INTRODUCTION

Architectural education in Egyptian universities follows engineering colleges, this certainly places many restrictions on the architectural education development process due to the fundamental difference between the requirements of engineering education in its various branches and the requirements of architectural education in particular¹. It is also evident that most departments of architecture lack multiple elements of educational spaces, as attention has become directed to "What does the architecture student study?" Not "where and how does this student study?" Hence the importance of the research, as educational spaces must be reviewed, especially drawing studios of architectural education buildings in Egyptian universities, study of design criteria affecting their efficiency with a view to assessing their impact on the building performance efficiency.

Paper is organized as follows. Section II describes automatic text detection using morphological operations, connected component analysis and set of selection or rejection criteria. The flow diagram represents the step of the algorithm. After detection of text, how text region is filled using an inpainting technique that is given in Section III. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

II. RELATED WORK

1-Architectural Education and Standards for Designing Educational Spaces in Egypt:

There are three schools of architecture contributed to the architectural education development in Egypt: the School of Works and Operations, the School of Engineers, the School of Fine Arts in Zamalek³. After that establishing colleges and departments of architecture continues in Egyptian government universities in addition to the private universities and higher institutes that was established in the end of the twentieth century. The architectural education system in Egypt aims to achieve a system of self-evaluation of the availability of educational needs and requirements as well as the efficient performance of all parties to the architectural education system (the student, the professors, the subject the student receives (curriculum), and thescholastic building⁴). Architectural education buildings consist of educational spaces, administrative spaces, service spaces, and some standards and conditions required in those buildings have been defined in general after being agreed upon by the UNESCO Foundation and the Union of International Architects UIA⁵, the most important of which is the existence of a self-assessment system for all architectural education's departments and colleges, and the presence of compatibility between faculty members' numbers and admitted students' numbers, the availability of an international information network on architectural education, documenting the concept and mechanism of cooperation between architectural education institutions and between architects.

2-1Architectural Buildings' educational spaces:

educational spaces differs according to the activity type and the nature of the study material, and in most cases there are fixed installations found in each educational space such as places for storing materials, paths for movementand transiency⁶.

2-2 General requirements for educational spaces:

They are divided into general requirements (such as ventilation, lighting, colors, and sound processors), and design standards in terms of dimensions, spaces and interior details.

2-2-1 Educational spaces' General requirements in the architectural education buildings:

Educations spaces should provide the appropriate atmosphere to enable faculty members to do their job perfectly, students find the appropriate environment for learning, creativity and exchanging experiences. Therefore, adequate ventilation facilities, the level of lighting, the necessaryacoustic processors and all equipment should be

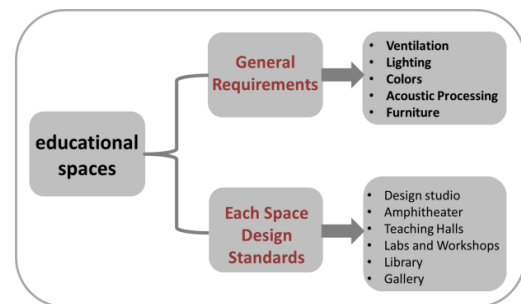


Figure 1.requirements and standards for educational spaces.

Source: (The researcher, 2019)

A- Ventilation:

The internal environmental conditions in the educational buildings are one of the most important elements to support the educational process. Therefore, the architect in his interior spaces design must take into account climatic factors and the environmental conditions that are represented by natural and industrial ventilation, directions and temperature⁸.

B- Lighting:

It is necessary to rely primarily on natural light in educational spaces, as it represents a connection between the internal and external environment, as well as helps to improve the students' psychological and mental level, and industrial lighting comes in the second level, it is represented by light bulbs of various forms⁹.



C- Colors:

It is preferable to use light colors in educational spaces, and the front wall inside the educational amphitheater should be painted with a color darker than other walls of the space, the color of the board should be the same degree as its wall or at least close to it in order to reduce students' eye strain, it is recommended that furniture and tools' color to be bright and light¹⁰.

D- Acoustic processing:

Acoustic measurements must be taken into account to maintain domination and control of internal or external noise. Educational spaces should be in quiet places, rely on building afforestation, separate the quiet places from the noise places, and use insulation materials on walls and ceilings to prevent noise, walls' thickness should be taken into account¹¹.

E- Furniture:

spaces should contain all fitting furniture elements at an appropriate level such as (study tables, seats, ledge, board, graphics display board and projection screen¹²).

2-2-2 Drawing Studios design Standards:

The activities and projects addressed and implemented in the Design Studio are mostly in groups to exchange opinions and experiences, therefore the level of noise resulting from that participation should be taken into account not to excess of the permissible limit¹³. The presence of spaces and corridors must be taken into account as it allows movement and collective participation in the projects presentation and discussion¹⁴. In general the predominant design on the design studio is a rectangular shape, the lighting is northern, and its space is flawless. The student's space inside the design studio must be at least 3.5 square meters, natural lighting surfaces must not be less than 15% of the total area. Industrial lighting must be balanced between studio elements, including furniture, there must be some key elements inside the design studio such as an appropriate sized board, tables and chairs for drawing and all equipment distributed appropriately. A supplement area may be attached to the design studio to be used for annotation or a computer lab for students' use¹⁵.

III. METHODOLOGY

3-Study and analysis of architectural education buildings' models in Egypt:

The research study focuses on studying and analyzing five models of Architecture Departments in Egypt (Architecture Department at Cairo University, Architecture Department at Ain Shams University, Architectural Department at Fayoum University, Architecture Department at Helwan University and Architectural Department at Al-Nahda University). Analysis is based on four main points: an introduction to the model, a description of the building, the architectural designs for each model, and model space analysis.

3-1 Architecture Department, Faculty of Engineering, Cairo University

Architect	Prof.Dr. Ali Bassiouni
Model location	Giza.
Brief of the building	The Architecture Department was established in 1992 inside Cairo University in a building consisting of eight floors, Architecture Department occupies four floors, the third, the fourth, the fifth and the sixth floors.

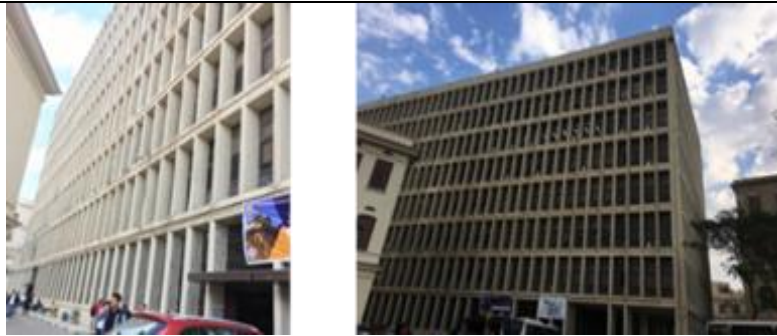


Figure 2. Architecture Department, Cairo University
Source (the researcher,2019)

Building architectural designs

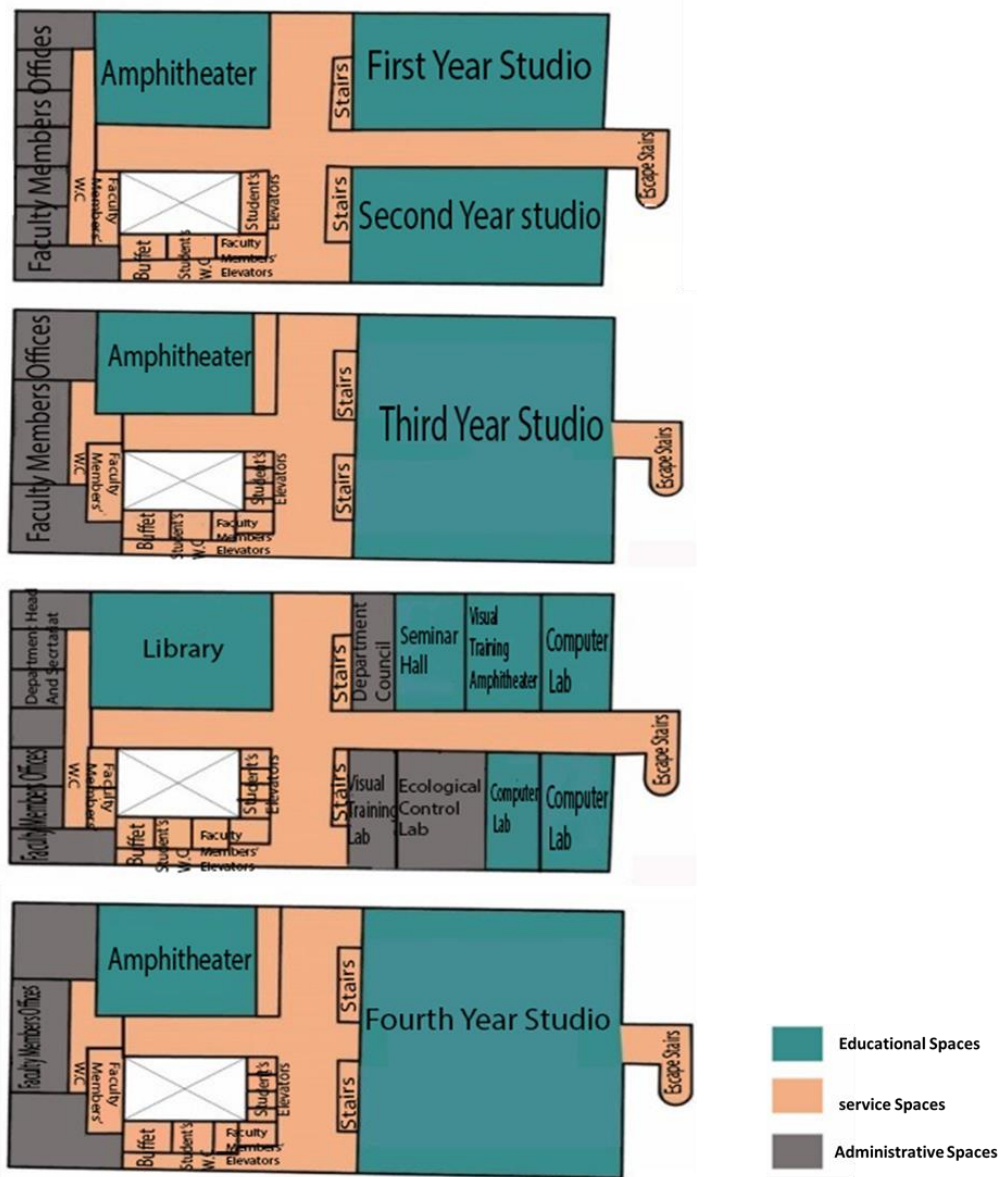


Figure 3. Plans of Architecture department - Cairo University
Source: (The researcher, 2019)



Figure 4. First and Second year Studios, Cairo university
Source: (The researcher, 2019)

Building space analysis	Department surface	9235 m ²
	Educational Spaces Surface	4826 m ²
	Educational spaces percentage of total	52.3%
	Design studio surface	3000 m ²
	Lecture halls space	910 m ²
	Floor surface	2320 -2290 m ²
	Department students Number	800 students
	Student's Educational space portion	6 m ²
	Student's design studio portion	3.75 m ²
	Ventilation	(Very good) Educational Spaces North oriented except the third floor studioSouth East.
	Lighting	Very good Natural and artificial
	Colors	(Good) dark Furniture colors
	Acoustic Processors	(Very good) Educational spaces are in quiet places and glass windows prevent external noise.
	Furniture	(Very good) All facilities and the necessary items are available at an appropriate level.

3-2 Architecture Department, Faculty of Engineering, Ain Shams University.


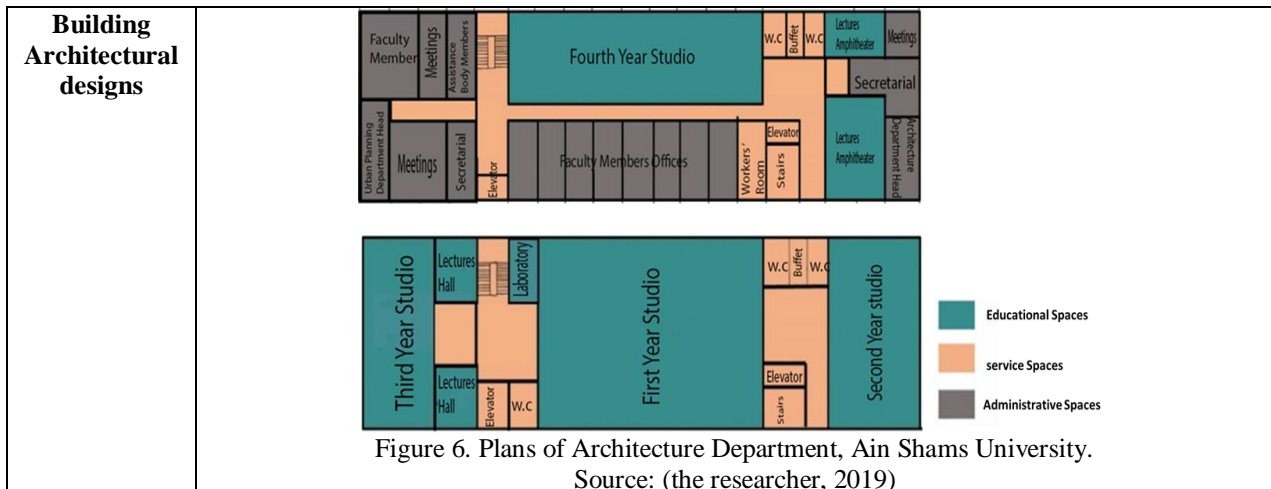
Architect	Prof.Dr. Farouk El-Gohary
Model location	Abbasiya, Cairo
Brief about the building	<p>The Architecture Department, Faculty of Engineering, Ain Shams University, was established in 1985, inside a multiple uses building, it consists of five floors, the Architecture Department occupies the third and fourth floor.</p> 

Figure 5. Architecture Department, Ain Shams University.
Source (the researcher 2019)



Building space analysis	Department surface	2695 m ²
	Educational Spaces Surface	1765 m ²
	Educational spaces percentage of total	65.5%
	Design studio surface	1513 m ²
	Lecture halls space	106 m ²
	Floor surface	1163-1305 m ²
	Department students Number	600 students
	Student's Educational space portion	3 m ²
	Student's design studio portion	2.5 m ²
	Ventilation	(Good) Educational Spaces' orientation differs north, south, east and west.
	Lighting	Very good natural and artificial
	Colors	Very good (walls' colors are bright and the furniture is live and bright.)
	Acoustic Processors	Good (Educational spaces are in quiet places)
	Furniture	(Very good) All facilities and the necessary equipment and items are available at an appropriate level.

3-3 Architecture Department, Faculty of Engineering, Fayoum University.



Architect	Fayoum University Engineering Consultancy Center
Model location	Al-KaimanFayoum Governorate
Brief about the building	<p>The Architecture Department, Faculty of Engineering, Fayoum University, was established in 1988, while study began officially in it in 1995, in a multiple-use building, the Architecture Department mainly occupies the first, second and some voids on the third floor.</p> 

Figure 8. Architecture Department, Fayoum University.
Source: (The researcher, 2019)

Building architectural design	 <div style="display: flex; justify-content: flex-end; margin-top: 10px;"> <ul style="list-style-type: none"> Educational Spaces service Spaces Administrative Spaces </div>
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Figure 9. Plans of Architecture Department, Fayoum University.

Source: (the researcher, 2019)		
		
Figure 10. Studios of Architecture Department, Fayoum University Source: (The researcher, 2019)		
Building spaces analysis	Department surface	3723 m ²
	Educational Spaces Surface	2015 m ²
	Educational spaces percentage of total	%54.1 m ²
	Design studio surface	335 m ²
	Lecture halls surface	95.2 m ²
	Floor surface	1389 m ²
	Department students Number	240 students
	Student's Educational space portion	8.3 m ²
	Student's design studio portion	1.5 m ²
	Ventilation	Good (educational spaces orientation varies north, south, east, and west)
	Lighting	Very good (natural and artificial)
	Colors	Medium (the walls are not bright and the furniture is dark)
	Acoustic Processors	Good educational spaces are in quiet places.
	Furniture	(Very good) All facilities and the necessary items are available at an appropriate level.

3-4 Architecture Department, Faculty of Fine Arts, Helwan University.

Architect	Arab Architectural Office for Design and Engineering Consultations
Model location	Zamalek Cairo
Brief About the building	The Architecture Department at Helwan University was established in the Zamalek area in Cairo, within the Faculty of Fine Arts in 1969. It is known that the buildings of the Faculty of Fine Arts were palaces before and one of them was demolished and Architecture and Photography Departments building was established instead. Architecture Department occupies the second, third and fourth floors.



Figure 11. Architecture Department, Faculty of Fine Arts, Helwan University
Source: (The researcher, 2019)

Building architectural designs

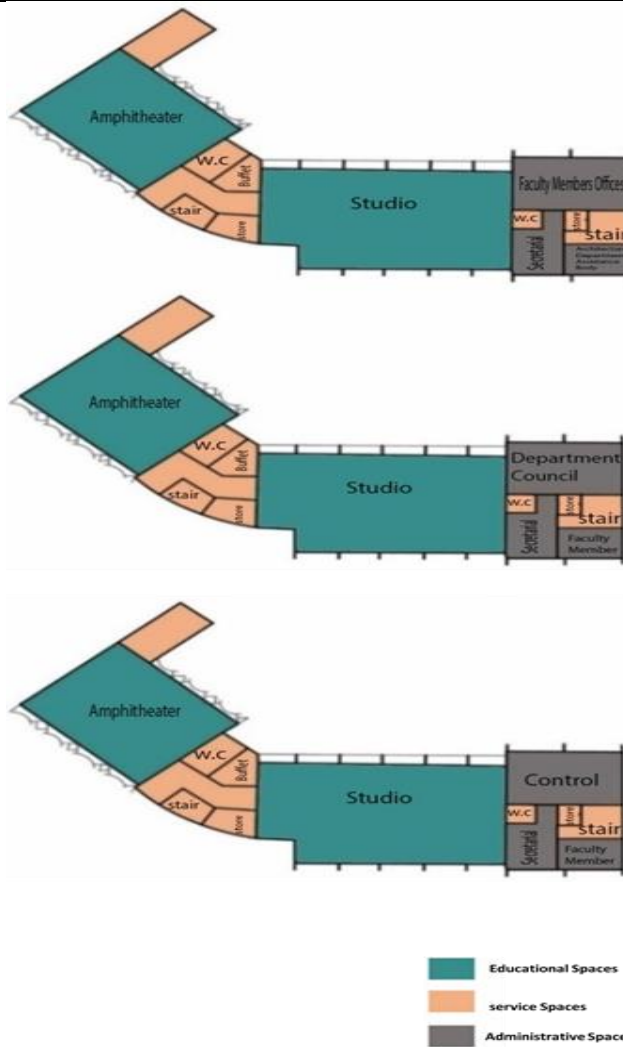



Figure 12. Plans of Architecture Department, Helwan University.
Source: (the researcher, 2019)



Figure 13. Studios of Architecture Department, Helwan University.
Source: (The researcher, 2019)

Building spaces analysis	Department surface	2817 m ²
	Educational Spaces Surface	1815 m ²
	Educational spaces percentage of total	% 64.5
	Design studio surface	1239 m ²
	Lecture halls surface	476 m ²
	Floor surface	939 m ²
	Department students Number	540 students
	student's Educational space portion	3.35 m ²
	student's design studio portion	2.48 m ²
	Ventilation	Medium (the educational spaces orientation differs, and the air conditioners absence in all the spaces)
Lighting	Very good (natural and artificial)	
Colors	Medium (walls' color isn't bright and the furniture is dark.)	
Acoustic Processors	Good (Educational spaces are in quiet places.)	
Furniture	Medium (All facilities and the necessary items are available at medium level.)	

3-5 Architecture Department, Faculty of Engineering, Al-Nahda University.

Architect	Engineering Consulting Center, Al-Nahda University
Model location	Al Nahda Road, East of the Nile, Beni Suef
Brief about the building	<p>The Architecture Department was established in 2008 in Al-Nahda University in the College of Engineering building and work began officially in the academic year 2012.the Architecture Department occupies the third floor and some voids of the second floor.</p>  <p>Figure 14. Architecture Department, Al-Nahda University Source: (The researcher, 2019)</p>

Building architectural designs



Figure 15. Plans of Architecture Department, Al-Nahda University. Source: (the researcher, 2019)

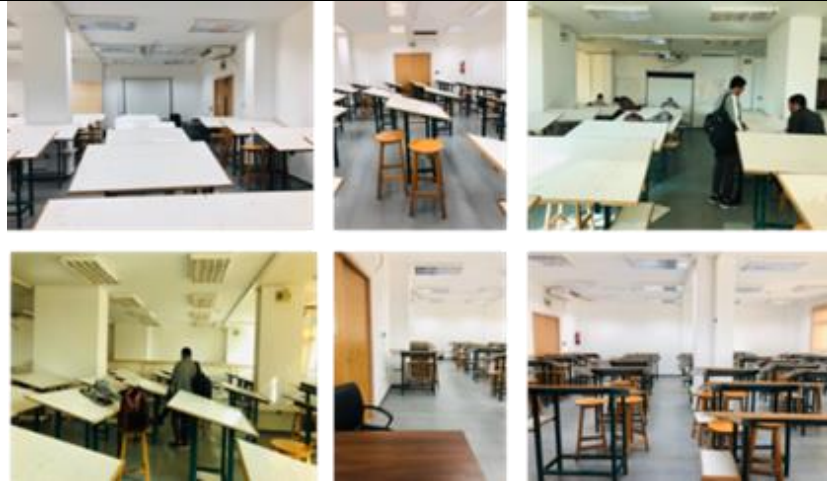


Figure 16. Studios of Architecture Department, Al-Nahda University
Source: (The researcher, 2019)

Building spaces analysis	Department surface	1340 m ²
	Educational Spaces Surface	685 m ²
	Educational spaces percentage of total	%51.1
	Design studio surface	438 m ²
	Lecture halls surface	188 m ²
	Floor surface	685 m ²
	Department students Number	110 students
	Student's Educational space portion	6.2 m ²
	Student's design studio portion	3.98 m ²
	Ventilation	Good (educational blanks orientation varies and air conditioners are available in all spaces)
	Lighting	Very good (natural and artificial)
	Colors	Very good (bright wall colors and bright furniture)
	Acoustic Processors	Very good educational spaces are in quiet places.
	Furniture	Very good (all facilities and components are available in an adequate average level)

Table 1. Results of the comparative analytical study between the buildings of the Architecture Departments of the universities under study

Comparison aspects	Cairo University	Ain Shams University	Fayoum University	Fine Arts Helwan University	Al Nahda University
Department surface- m ²	9235 m ²	2695 m ²	3723 m ²	2817 m ²	1340 m ²
Department students Number	800 students	600 students	240 students	540 students	110 students
Student's Educational space portion- m ²	6 m ²	3 m ²	8.3 m ²	3.35 m ²	6.2 m ²
Student's design studio portion – m ²	3.75 m ²	2.5 m ²	1.5 m ²	2.48 m ²	3.98 m ²
Ventilation	Very good	Good	Good	Medium	Good
Lighting	Very good	Very good	Good	Good	Very good
Colors	Good	Very good	Medium	Medium	Very good
Acoustic Processors	Very good	Good	Good	Good	Very good
Furniture	Very good	Very good	Very good	Medium	Very good

Source: (The researcher, 2019)

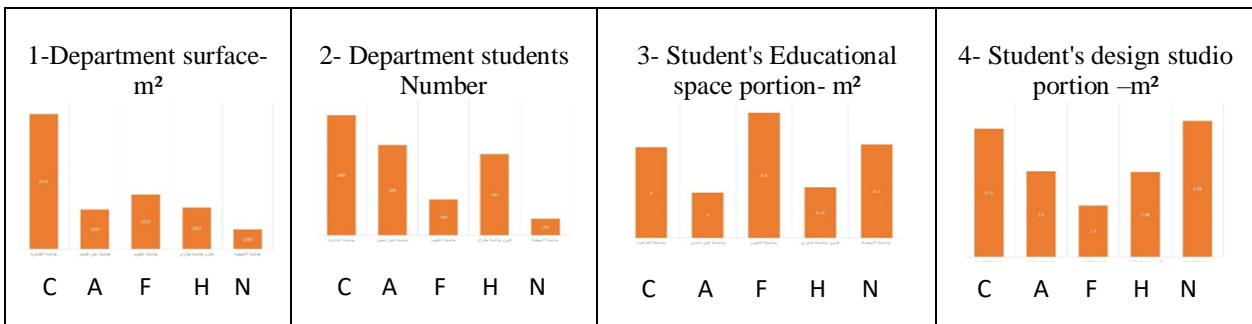


Figure 17. Comparative analytical study of the five study samples of Egyptian Architecture Departments
Source: (The researcher, 2019)

IV. APPLICATION STUDY

This part of the research is applied to determine the positive and negative impacts of educational spaces' design on Egyptian educational building performance, through a questionnaire applied for the students and faculty members to determine these impacts for the educational spaces in which they work and interact. The research relied on selecting different samples to represent most of the realistic models of Egyptian architectural education buildings. Where the study included the five models previously analyzed. The questionnaire was taken into consideration to cover all the points covered by the research in the previous axes in a logical sequence, and these models were evaluated through two main axes: **The first axis:** analyzing the questionnaire results (comparing the results questionnaire from the models under study). **The second axis:** specifying the relationship between the efficiency of building performance and the efficiency of educational spaces according to (students' opinions - faculty members' opinions - the overall average that resulted from the students' opinions and the faculty members.)

4-1 Student and faculty members Questionnaire Form: A questionnaire for students and faculty members in the architecture departments of the Egyptian universities under study:

Question number	The question	Yes	No
1- Efficiency Of Educational Spaces			
1-1	Do educational spaces provide appropriate atmosphere for learning process?		
1-2	Do the educational spaces provide the necessary technological equipment?		
1-3	Can you connect to the Internet through the department's private network?		
1-4	Is your portion of educational spaces sufficient?		
1-5	Does furniture provide flexibility of movement & multiple ways of furniture?		
1-6	Does the furniture provide comfort for you while your study?		
1-7	Drawing Studios		
	1-7-1	Does it encourage teamwork & exchange of skills & experiences?	
	1-7-2	Is advanced technological equipment available?	
	1-7-3	Are the necessary furniture items available?	
	1-7-4	Is natural lighting available at the necessary level?	
	1-7-5	Is industrial lighting available at the necessary level?	
	1-7-6	Is natural ventilation well available?	
2- Efficiency of building performance			
2-1	Do you think that architectural education buildings affect the efficiency of architectural education?		
2-2	Do the building spaces encourage teamwork, skills & experiences exchange?		
2-3	Does the building provide the appropriate atmosphere for positive interaction between students and faculty members?		
2-4	Does the building provide the atmosphere for innovation and creativity?		
2-5	Are you satisfied with the design of this building?		
2-6	Are you satisfied with the level of building facilities and equipment?		

2-7	Do you think that building colors and finishing materials are appropriate?		
2-8	Is there any interest in natural and aesthetic elements?		
2-9	Does the building create interactive relationships with the location?		
2-10	Do you think that the architectural education buildings development affect the improvement of the educational process?		

4-2 Comparing the questionnaire results out of the models under study:

The questionnaire is attached knowing that the number of the sample for each university is 130 students, 25 faculty members excluding Al-Nahda University, only 10 faculty members.

4-2-1 Educational spaces

First: Students' opinions:

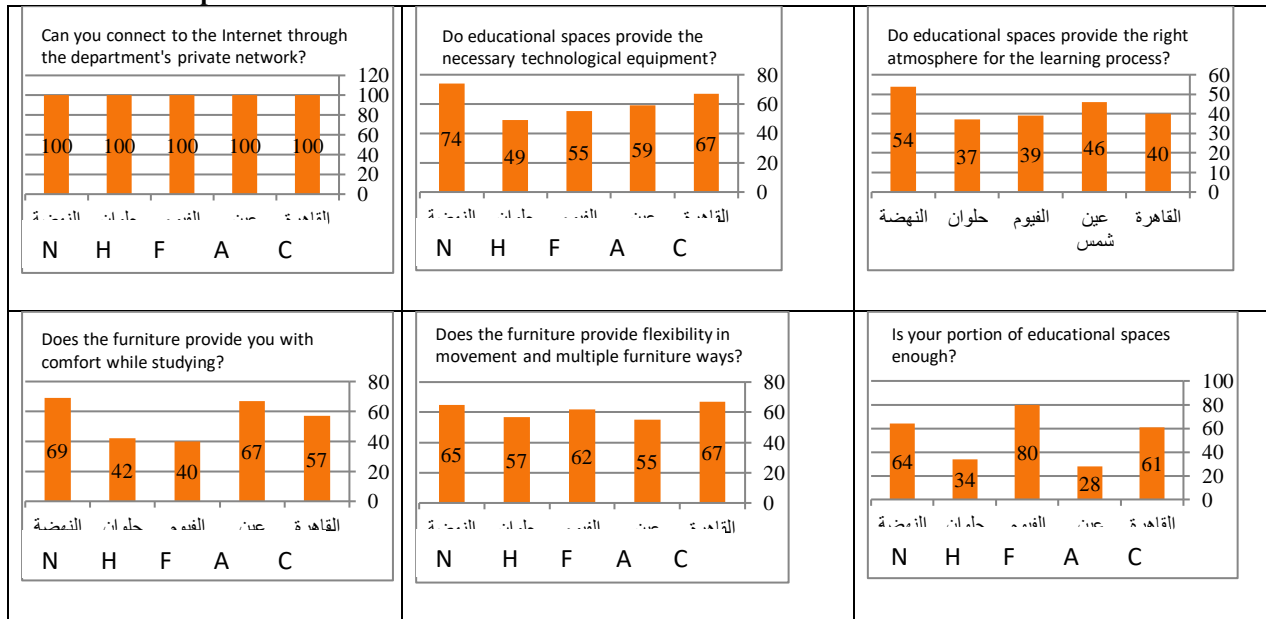


Figure 18. Questionnaire results Comparison of educational spaces of the selected five universities models. Source: (The researcher, 2019)

Second: the faculty members' opinions:

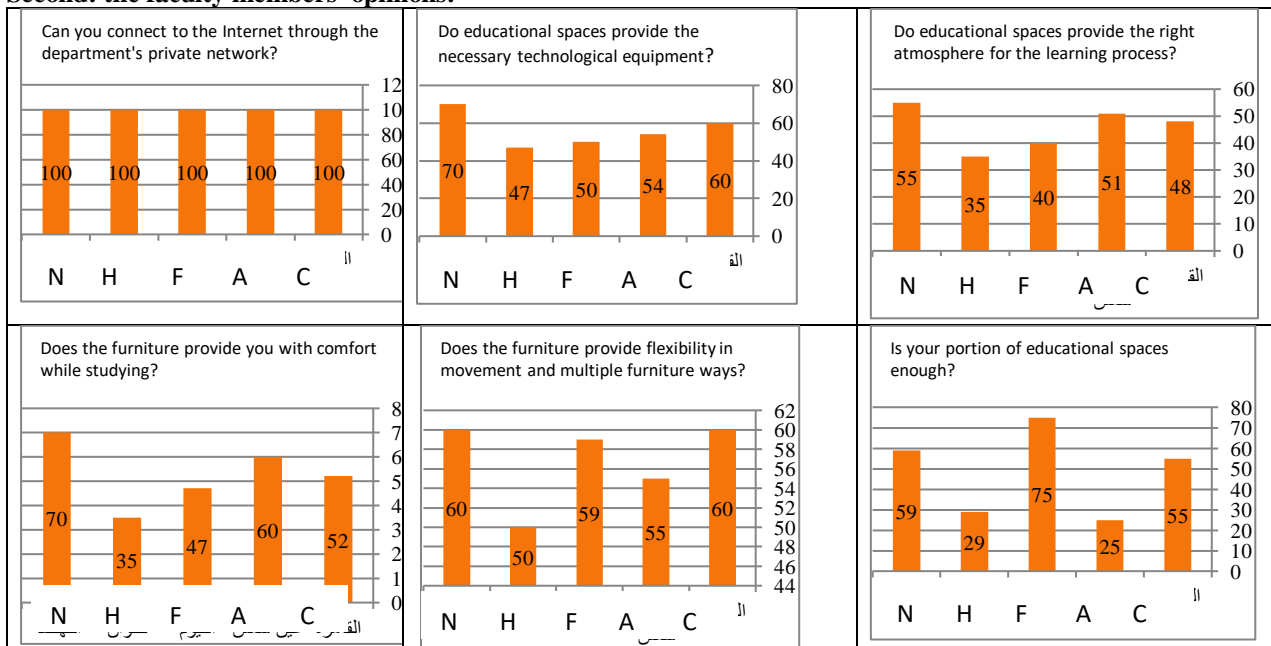


Figure 19. The questionnaires Results Comparison on the educational spaces of the universities models under study Source: (The researcher, 2019)

4-2-2 Drawing Studios
First: Students' Opinions

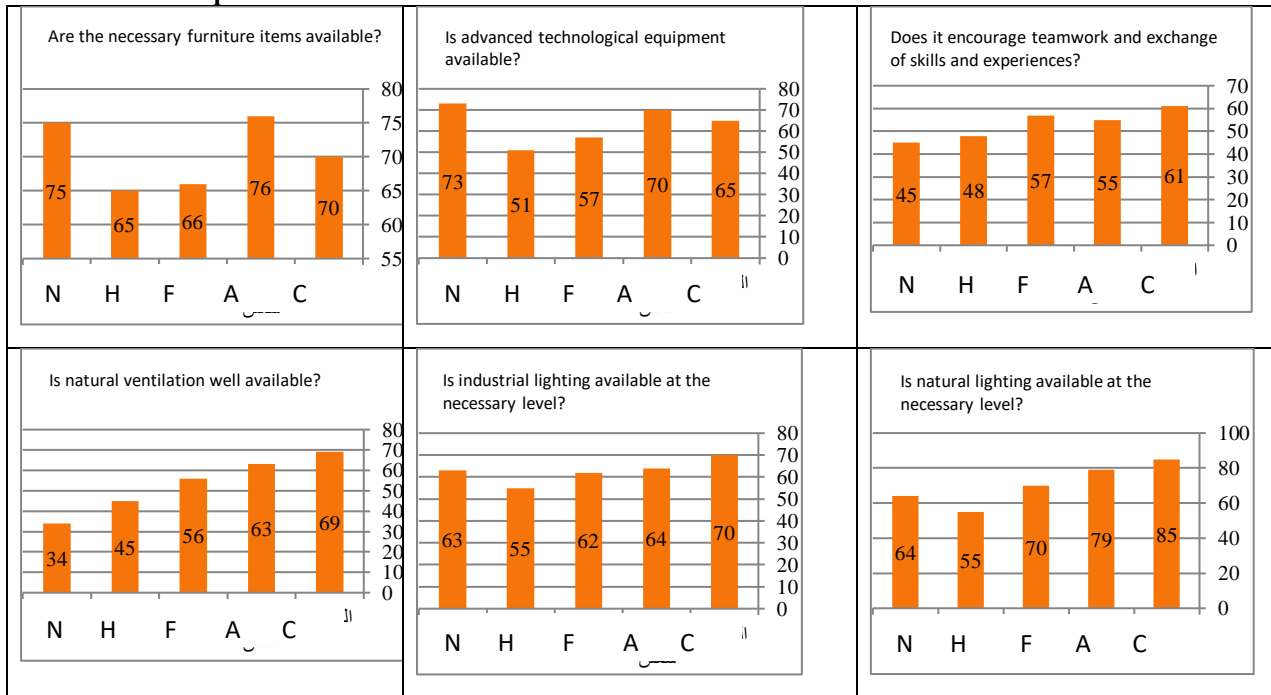


Figure 20. Questionnaires' results Comparison of the drawing studios of the universities under study.
Source: (the researcher, 2019)

Second: Faculty Members' Opinions

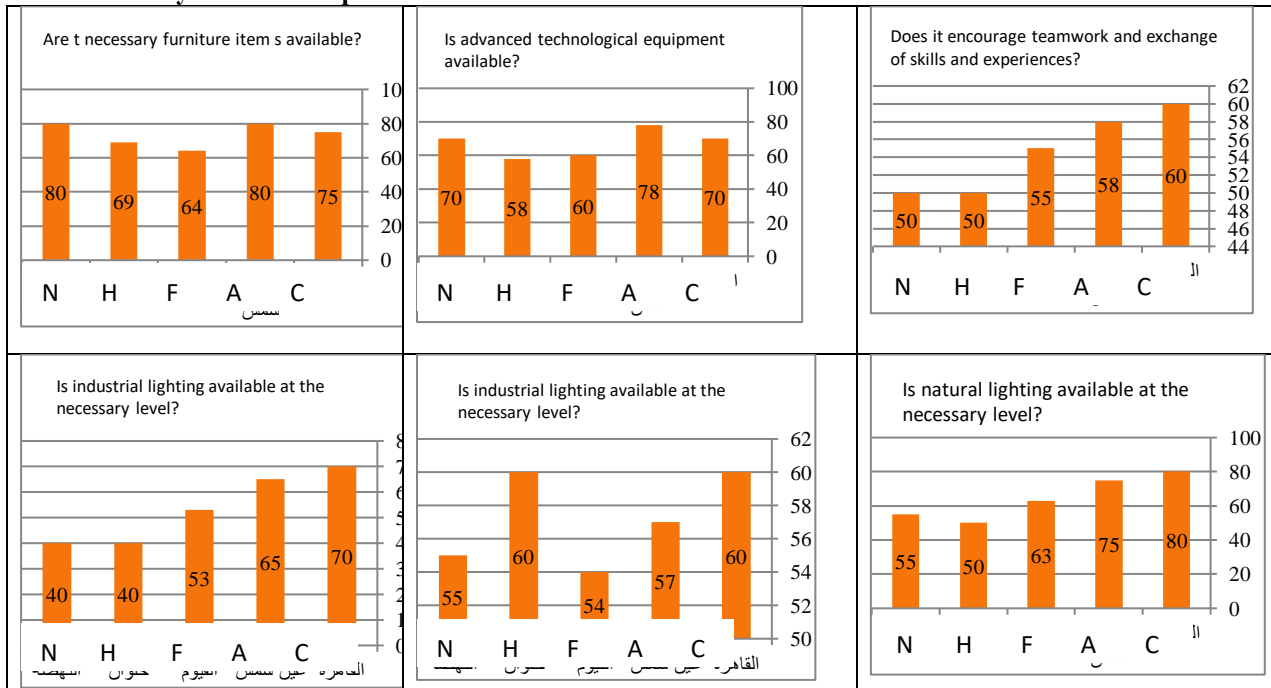


Figure 21. questionnaires' results comparison of the drawing studios of the universities under study.
Source: (the researcher, 2019)

4-2-3 Building Performance Efficiency:

First: Students' Opinions

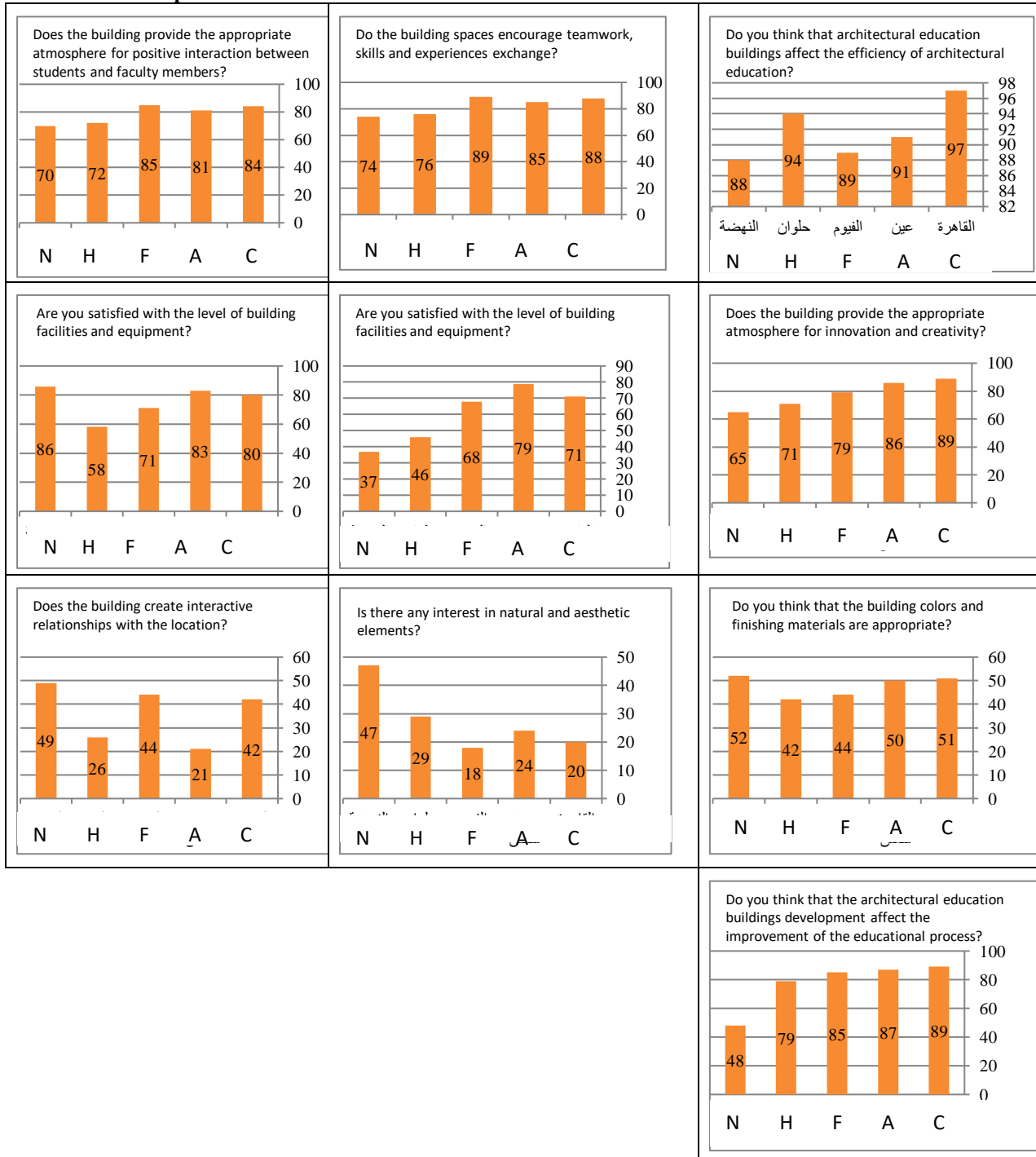


Figure 22. Questionnaires' results Comparison of building performance efficiency to the university models under study.
Source: (The researcher, 2019)

Second: the faculty members' opinions

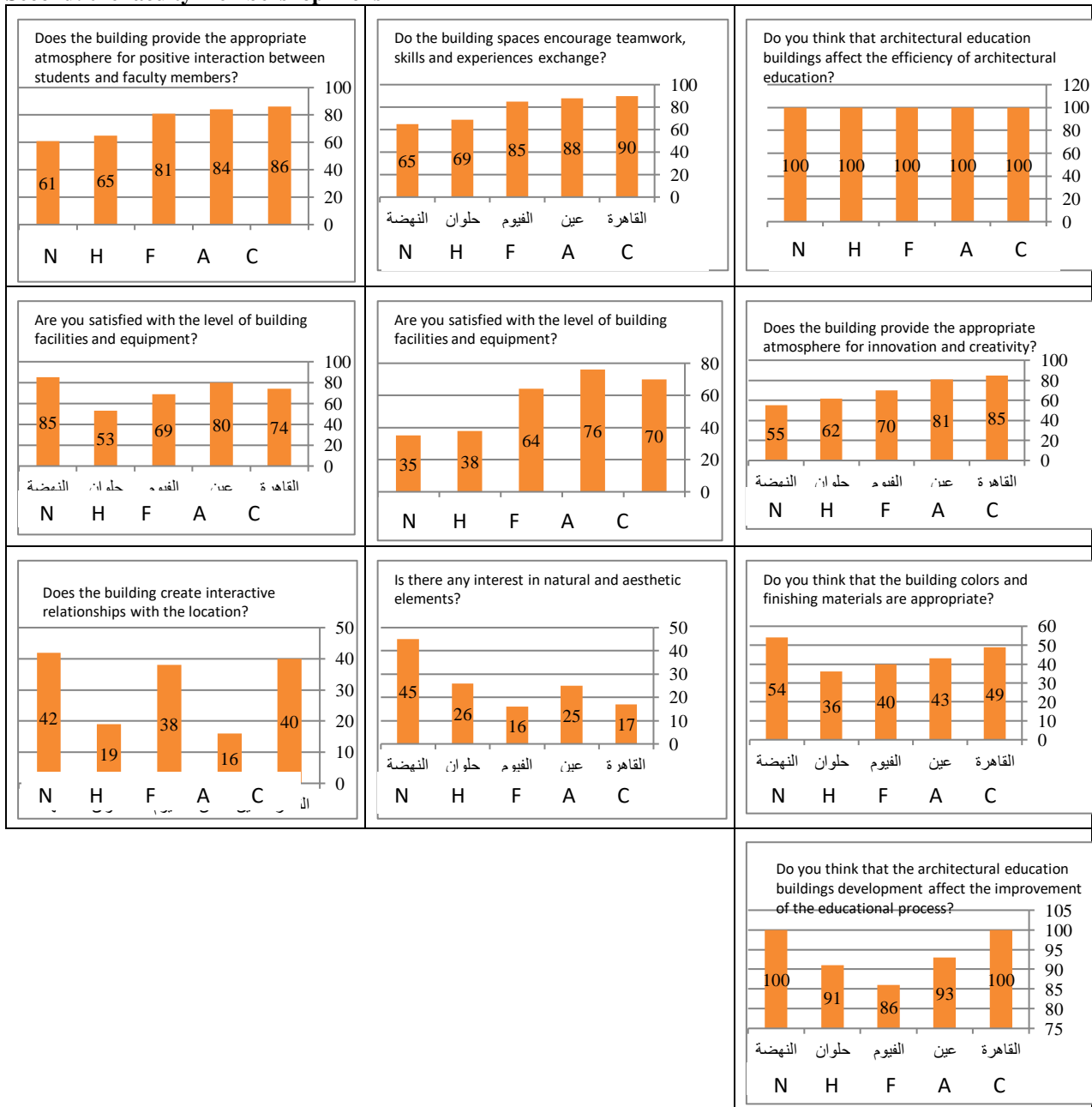


Figure 23. Questionnaires' results Comparison on the efficiency of building performance for the universities models under study. Source: (The researcher, 2019)



4-3 Studying the relationship between building performance efficiency and the educational spaces efficiency according to (Students’ Opinions - Faculty Members’ Opinions - the total average that resulted from the students’ opinions - faculty members’ opinions)

4-3-1 According to the Students’ Opinions

Table 2. Results values of the questionnaire main points according to the students’ opinions

Students' opinions	Cairo University	Ain Shams University	Fayoum University	Helwan University	Al-Nahda University
Building efficiency	%71.10	%68.70	%67.20	%59.30	%61.60
Educational spaces efficiency	%63.83	%54.49	%60.12	%45.32	%58.07

Source: (The researcher, 2019)

Table 3.The correlation coefficient values and correlation strength demonstrated by the graphical analysis of the correlations, according to students’ opinions.

Students' opinions	Educational spaces efficiency
Building efficiency Correlation coefficient (R)	0.95
Building efficiency Correlation Strength (R2)	0.903

Source: (the researcher, 2019)

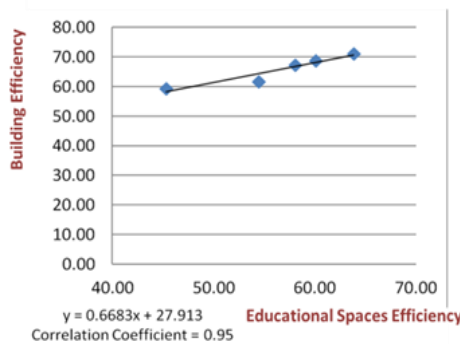


Figure 24. The relationship between building efficiency and space efficiency, according to the students’ opinions, the correlation coefficient = 0.95
Source: the researcher, 2019

4-3-2 Faculty Members’ Opinions

Table 4. Results' value of the questionnaire main axes according to the faculty members' opinions

Faculty members' opinions	Cairo University	Ain Shams University	Fayoum university	Helwan University	AL-Nahda University
Building efficiency	%71.10	%68.60	%64.90	%55.90	%64.20
Educational spaces efficiency	%62.34	%53.70	%58.90	%43.50	%57.43

Source: (the researcher, 2019)

Table 5.The correlation coefficient values and the correlation strength revealed by the graphical analysis of the relationships according to the faculty members' opinions.

Faculty members' opinions	Educational spaces efficiency
Building efficiency Correlation coefficient (R)	0.984
Building efficiency Correlation Strength (R2)	0.968

Source: (the researcher, 2019)

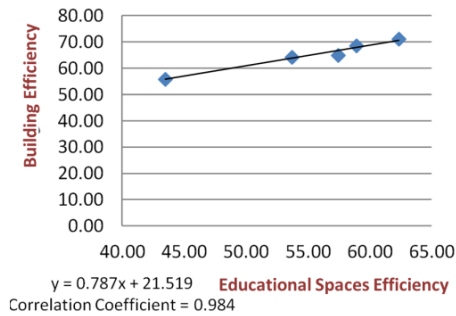


Figure 25: The relationship between building efficiency and educational spaces efficiency according to the faculty members' opinions. Correlation coefficient = .98

Source: (the researcher, 2019)

4-3-3 According to the overall average results of both the opinions of students and faculty members

Table 6. The results value of the questionnaire's main axes according to the overall average

Total average	Cairo University	Ain Shams University	Fayoum University	Helwan University	Al-Nahda University
Building efficiency	%71.10	%68.65	%66.05	%57.60	%62.90
Educational building efficiency	%63.09	%54.10	%59.51	%44.41	%57.75

Source: (the researcher, 2019)

Table 7. The correlation coefficient values and the correlation strength revealed by the graphical analysis of the relationships according to the total average

Total average	Educational spaces efficiency
Building efficiency Correlation coefficient (R)	0.987
Building efficiency Correlation Strength (R2)	0.974

Source: the researcher, 2019

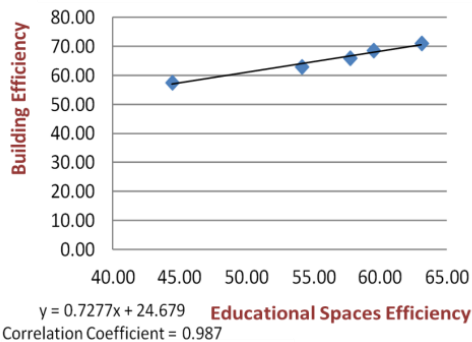


Figure 26. The relationship between the efficiency of the building and the efficiency of the educational spaces according to the total average, the correlation coefficient = 0.98

Source: the researcher, 2019

Comparing the questionnaire results from the models under study revealed the following:

- Cairo University is the most effective studied university to achieve the educational spaces efficiency, followed by Fayoum University, Al-Nahda University, then Ain Shams University, while Helwan University is the least effective studied university to maintain this axis.

- Cairo University is the most effective studied university to achieve the building performance efficiency, followed by Fayoum University, Al-Nahda University, then Ain Shams University, while Helwan University is the least effective studied university to maintain this axis.
- There is a direct relationship between the building performance efficiency and the educational spaces efficiency both of them are at high degree of correlation. According to the questionnaire results, the students' opinions and the faculty members' opinions agreed to demonstrate that direct relationship.
- The graphical analysis of the relationship between the building performance efficiency and educational spaces efficiency based on the opinions of both the students and the faculty members and the overall average, showed that the most distant point with respect to the regression line expressing this relationship was Cairo University.

V. EXPERIMENTAL RESULTS

- The general requirements for educational spaces in architectural education buildings are (ventilation, lighting, colors, acoustic processors, furniture)
- The design studio designing standards: taking into consideration the presence of spaces and corridors that allows movement and group participation during the projects' presentation and discussion, the lighting is northern, the space is unobstructed, the student's area must be at least 3.5 square meters, and the natural lighting surfaces must not be less than 15% of the total surface.
- **The comparative analytical study for the models under study and those models with the design requirements of the theoretical study showed the following:**
 - o The Architecture Department at Cairo University is the largest department under study in terms of both space and number of students while the Architecture Department at Al-Nahda University is the smallest.
 - o The Architecture Department at Fayoum University is the largest department under study in terms of the student's portion of the educational spaces while the Architecture Department at Ain Shams University is the smallest.
 - o The Architecture Department at Al-Nahda University is the largest department under study in terms of the student's portion in the Design Studio while the Architecture Department at Fayoum University is the smallest.
- **Comparing the questionnaire results from the models under study revealed the following:**
 - o Cairo University is the most effective studied university to achieve the educational spaces efficiency, followed by Fayoum University, Al-Nahda University, then Ain Shams University, while Helwan University came as the least effective studied university to maintain this axis.
 - o Cairo University is the most effective studied university to achieve the building performance efficiency, followed by Fayoum University, Al-Nahda University, then Ain Shams University, while Helwan University came as the least effective studied university to maintain this axis.
 - o There is a direct relationship between the building performance efficiency and the educational spaces efficiency both of them are at high degree of correlation. According to the questionnaire results, the students' opinions and the faculty members' opinions agreed to demonstrate that direct relationship.
 - o The graphical analysis of the relationship between the building performance efficiency and educational spaces efficiency based on the opinions of both the students and the faculty members and the overall average, showed that the most distant point with respect to the regression line expressing this relationship was Cairo University.



VI. CONCLUSION

Scientific Contribution

Design Guidelines	1-Direction and Ventilation	<ol style="list-style-type: none"> 1) The building should be oriented towards the north or northeast. 2) The temperature of the spaces should be at the average of 22 ° C, and can be reached using thermal treatments. 3) The necessary external air vents should be calculated taking into consideration providing natural light. 4) The vents should be optimally oriented to get much fresh air, supplying the conditioned air must be carried out in a regular vertical way through the roof. It is preferred to reduce the use of air conditioning in order to save energy and reduce the load on the building. 5) The walls and ceilings treatment methods should be selected to endure, resist and keep the temperature inside.
	2-Lighting	<ol style="list-style-type: none"> 1) In educational spaces, it is necessary to rely on the natural light as a primary source for light because it helps improve the psychological and mental level of the students. If this isn't available, the artificial lighting comes next as the second option. 2) Natural lighting standards within educational spaces: <ul style="list-style-type: none"> • The maximum benefit from sunlight must be achieved. The wall colors should be light in order to reduce the need for artificial light, taking into consideration not to be exposed to direct sunlight. • The minimum surface of the vents should not be less than 15% of the educational space to provide a natural level of illumination through the ventilation vents. 3) Artificial lighting standards within educational spaces: <ul style="list-style-type: none"> • The artificial lighting must be good and appropriately distributed. The walls and ceilings should be of light colors in order to avoid dazzling and strong lighting. • The absorption and reflection rates of light in finishing materials should be taken into consideration while selecting the degree of quality and color. As the optical reflection rate from the walls is 80% and from the floors and tables 20%. • It is recommended not to rely on regular tungsten bulbs and to rely on fluorescent bulbs because they give appropriate and distributed lighting. Their light is much close to the natural light and shows the degree and characteristics of colors. • The dust over the lamps should be removed regularly because it reduces the lighting intensity by 15-40%. • When viewing the projects, the light projection should be from the top and at an acute angle so as not to produce light reflections for the viewer's eye, the light also, must be strong to give saturated colors. • The light source should not have a shadow located in front of the student on the work surface in order to avoid weakening his or her vision. Besides, it is recommended to direct the artificial light inside the library reading halls into the same direction of natural light. • The appropriate lighting levels for each space are as follows: studio 250 lux, board 250 lux, lecture halls 180 lux, exhibition 200 lux, labs and workshops 200 lux, library reading hall 180 lux.
	3-Colors	<ol style="list-style-type: none"> 1) Light colors are preferred in educational spaces. 2) The front wall inside the lecture halls should be painted in a darker color than the other walls. The board color should be the same degree as its wall or at least close to it in order to reduce eye strain among students. 3) It is recommended to select furniture and tools with bright light colors taking into consideration any light reflection. It is also preferred to select a darker color for the entry door than the colors of the walls since the color difference gives a sense of renewal and lack of boredom.

	4-Acoustics	<p>1) Acoustic measurements must be considered to maintain noise control, whether internal or external.</p> <p>2) Educational spaces' locations should be in quiet places.</p> <p>3) It is necessary to rely on afforestation inside the building, and to separate quiet places from noise places.</p> <p>4) Insulation materials on walls and ceilings should be used to prevent noise, taking into consideration the walls' thickness when constructing, especially in spaces with open horizontal projection</p> <p>5)The noise resulting from the friction of the space, such as feet and chairs friction on the floor, should be taken into consideration, thus, it is recommended to use wooden furniture because it is less to create noise.</p>
Design Guidelines	5-Furniture	<p>1- Study tables:</p> <ul style="list-style-type: none"> - The level of space between the student's seat and the table top should be appropriate to accommodate the student, and it is recommended to use durable and resistant materials in manufacturing the surfaces of those tables. - For the spaces that can be furnished in multiple ways, it is preferred to use separate tables since they are easy to transport or move. - The minimum dimensions of the student's table top inside the hall or amphitheater are 60 x 90 cm, however inside the library the surface area of the table for the reader should not be less than 1.1 m². - The surface of the architectural drawing tables should be a smooth with a flat end board. Add to this that the surface area should be suitable for the dimensions of the drawing boards, mostly 80 x 120 cm. <p>2- Seats:</p> <ul style="list-style-type: none"> - The seats that are used in the educational halls are divided into several types, including the seat that has a backrest that helps to sit properly and provide comfort, as well as the seat with a backrest that has a simple curve in line with the shape of the backbone, and the seat that does not have a backrest which makes the student lean forward. This last type of chairs is not preferred to be used because of the damages it causes. - It is recommended to use a seat with cylindrical front end, and that the distance between the back of the chair and the seat behind it not less than 30 cm. - The height of the regular seats for reading and writing should not exceed 45 cm. - It is recommended to use painted metal seats in the laboratory and workshop space. They must have a rotating base and multiple levels of height, made of durable materials such as polypropylene, and it is preferred to place a rubber piece at the end of the seat in order to prevent noise. <p>3- Professor Stage:</p> <ul style="list-style-type: none"> - It must consist of a special office for the professor, drawers, a seat, preferably 15-30 cm above the blank, and the stage should be in front of students to maintain communication, and also be near the teaching aids, such as the board and the projection screen. <p>4- Board:</p> <ul style="list-style-type: none"> - The oldest and best explanation method is the board. It comes with a soft texture to write on it using markers and there is another metal type that is used for magnetic teaching aids. <p>5- Graphics Display Board :</p> <p>It is a board used for displaying pictures and drawings. Its surface should be smooth made of cork or pressed sheets. Usually, the height of its lower edge is 0.90 m and the upper edge reaches its height at the doorsteps and can be placed on the side wall.</p>

	<p>6- Projection screen:</p> <ul style="list-style-type: none"> - It is a screen with a light reflective surface, and does not require space's complete darkness to operate. It can be controlled and moved from one place to another, and is used to display and present slides. - The angle between the screen and the projector must be a maximum of 45 degrees in both directions. - It is preferred to have a trolley to be used to move the projector when necessary.
<p>2- Drawing studios Design</p>	<ul style="list-style-type: none"> 1- There must be corridors that allow movement and group participation during the projects' discussion. 2- The lighting should be northern. 3- The student's space inside the design studio should not be less than 3.5 square meters. 4- The natural lighting surface must not be less than 15% of the total surface. 5- Artificial lighting must be distributed in a balanced manner among the studio elements, including the furniture. 6- Main elements should be available such as a proper sized board for explanation, drawing tables and chairs and all equipment.

Recommendations

Architectural Design Recommendations

- Architectural education buildings should maintain the optimum utilization of spaces with providing advanced technological equipment in all spaces.
- Maintaining flexibility within the spaces should be a priority.
- Maintaining calmness and acoustic processors to help students to focus and be creative.
- Paying attention to the maintenance operations periodically.
- Paying attention to the level of service spaces and ensuring their quality and maintenance continuously and quickly.
- Providing all the necessary furniture elements up to a good level provides a feeling of comfort during work.
- Providing natural and artificial lighting at the necessary level for each space according to the nature of the activity inside it.
- Providing good natural ventilation is necessary.
- Paying attention to the natural and aesthetic elements within all spaces.
- Taking into consideration the finishing and its colors to suit the nature of the place.
- Taking into consideration the student's portion in each of the different educational spaces, according to the nature of the activity.

Country-specific Recommendations

- It is recommended to establish an Egyptian specialized organization to track the development of the architectural education buildings at Egyptian universities according to the standards.
- It is recommended to choose conscious and qualified architectural personnel to supervise the development of architectural education buildings in Egypt.
- It is recommended to find practical ways to develop the architectural education buildings as they are in light of the available capabilities.
- It is recommended to provide the necessary budgets to develop these buildings, for their direct impact on the efficiency of architectural education, as they are the space where the educational activity occurs and the architect's intellectual formation is shaped.

Recommendations for Academic Research

- It is recommended to study the possibility of the architectural education independence from engineering education by establishing architecture colleges, as in the developed countries.
- It is recommended to provide an accurate information database about the architectural education process in Egypt.
- It is recommended to provide a communication network for the different architecture departments and colleges to help coordinate the admission, graduates, the improvement plans for the buildings, tools and equipment.

- It is recommended to use the methodology proposed by the research to evaluate and improve the architectural education buildings at the Egyptian universities.

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