Digital Photography to Enhance Creative Thinking in The Education of Architectural Design

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Abstract

One of the goals of contemporary design education, in particular, is to guide students to tools that can stimulate the search for creative solutions. Concepts such as innovative ideas and creativity have become very important in recent years. The use of Creative approaches in the architectural design process within design studios has become the backbone of architectural education.

This study seeks to explore the impact of the digital photography as a visual tool on the architectural student's thinking and creativity during architectural design education, and the importance of using it as a course within architectural design education. The study included examples of digital photography tool used by students in the architectural design process, and the extent of their impact on their design results. 120 Arab universities and the top 10 international universities were analyzed within the university ranking for the year 2020-2023, that use the photography curriculum during architectural design education were presented. In addition, a questionnaire was conducted to survey the opinions of 23 students and graduates of the Architectural Department - Arab Academy for science, technology and maritime transport - Alexandria who studied the optional photography course and analyze the results of this questionnaire. To confirm the findings of previous studies, a practical application was carried out using a photographic tool for 40 students of specialized scientific program, department of architecture within the faculty of engineering, Alexandria University. The results were that the art of digital photography is important and influential in the development of the student's architectural thought and creativity, and this visual tool contributes to achieving better design results. The results suggest recommending the use of the photography tool as a mandatory course during architectural education; because of its impact on the student's architectural thought, and on the architectural product.

Keywords

Digital Photography**,** Creative Thinking**,** Architectural Design.

1. Introduction

One of the general goals of the current education systems is to educate students as creative individuals, and to make them acquire talents to produce creative ideas in order to be able to solve problems (Hürsen et al., 2014). Although creativity is considered very important in the architectural design process, there is little research on creativity in the education of architectural design (Cho, 2017). Therefore, recent efforts are interested in developing the architectural education process and providing them with techniques that help to develop thought and creativity of students of architecture in the architectural design studios. Daemein (2018) indicated in his study that visual references and images affect the students' creativity in the architectural design process (Baghaei Daemei & Safari, 2018). The need to use visual methods in architectural education was emphasized (Uwajeh et al., 2016).

This paper reviews the importance of creative thinking in architectural design education and ways to develop it. Not only that, it also explores digital photography, the recipient's perception of that visual image and its effects, and the influence of visual skill in the development of creative thought. It includes examples that used the digital imaging tool in the process of architectural education, and the result of its influence on the creative thinking of students. It also deals with the analysis of 120 Arab universities and the top 10 international universities within the university ranking for the year 2020-2023, and photography curricula were presented within universities that use it during architectural design education. In addition, was conducted to survey the opinions of 23 students and graduates from the Department of architecture – the Arab Academy for science, technology and maritime transport – Alexandria, who studied the optional photography course. To confirm the findings of previous studies, a practical application was carried out using a photographic tool for 40 students of specialized scientific program, department of architecture within the faculty of engineering, Alexandria University. The results were that the art of digital photography is important and influential in the development of the student's architectural thought and creativity, and this visual tool contributes to achieving better design results. The results suggest recommending the use of the photography tool as a mandatory course during architectural education; because of its impact on the student's architectural thought, and on the architectural product.

2. Architectural Design process

The architectural design process is defined as a fundamentally integrated thought system with a predominant visual aspect (Hürsen et al., 2014). The process of architectural design is the procedure of extracting ideas from the unconscious mind, where an abstract idea arises from a person's thought and gradually develops into a new concrete topic mediated by creativity (Baghaei Daemei & Safari, 2018). The architectural design process is a means of building capacity to solve problems, it involves various cognitive abilities, including many intangible elements such as intuition, imagination and creativity (Cho, 2017). Meyer describes the design process as a problem-solving process in which creativity plays a pivotal role (Baghaei Daemei & Safari, 2018).

3. Creativity in Architectural Design

Creativity is very important to architecture, and sometimes architecture is used as a meaning instead of creativity (Danaci, 2015). Creativity is the cornerstone of architecture, as it is considered one of the most important and fundamental factors influencing the architectural design process (Baghaei Daemei & Safari, 2018). Creativity and innovation are important throughout the life of the project (Idi, 2015). It was pointed out that creativity is a powerful tool for solving problems through innovative solutions (Baghaei Daemei & Safari, 2018). Creativity is a feature present in every individual, as it is a pattern of thought, behaviour, or a special talent of the individual that others can achieve (Hürsen et al., 2014).

3.1. Creative Thinking in Architecture Design

"If our schools want to encourage creativity and display creative intelligence, they should include in their tests and assignments at least some opportunities for creative thinking," says Sternberg, as thinking is a major aspect of the

creative process (Adams, 2005). The process of thinking in architectural designs is used as a basic concept for success, and designers also use thinking in solving architectural design problems as a tool for achieving a creative result. The process of thinking is among the activities in the stages of preliminary design, development of the design process and the stages of embodiment of architectural design. Architectural design thinking processes represent the ability of the designer to produce new and functional ideas that contribute to solving the architectural design problem (Idi, 2015).

3.2. Methods to Enhance Creative Thinking in Architecture Design

Promoting student creativity is a goal that everyone seeks. It is important to identify factors that play an effective role in developing students' creative thinking in the architectural design process (Baghaei Daemei & Safari, 2018). some factors as follows:

- Artistic activities promote creativity, artistic expertise is considered to have a significant impact on creative inspiration (Lee & Lee, 2017). The integration of art elements into education is useful for the development of creativity(Peng & Chen, 2016).

- The use of visual methods is one of the academic tools for inferring ideas and knowledge, they are particularly understood in architectural design workshops. The visual tools used to guide students towards discovery allow them to know and interpret the environment around them, which develops their thinking and skills in solving design-related problems (Jiménez-Montano & Ortiz-Rivera, 2014).

- Creating links between different topics is one of the best ways to support creative design thinking. The focus of creative thinking is not only on differences, but also on the similarities between ideas in various fields to generate new ideas (Hasirci & Ultav, 2012).

- Retaining what is perceived and transformed into intellectual images can later become support for creative thinking and ideas (Marotta & Pavignano, 2019).

After showing the importance and methods of developing the student's creative thought during architectural design education, we find that visual aids are important in the education of architectural design and photography

as a visual tool is a direction of art and science, it includes social images, education, architecture and culture; therefore, the power of digital photography can be seen everywhere and it is difficult to forget (Shafie et al., 2018).

4. Digital Photography in architecture education

Visual media are now very dominant (Farran, 2018), and nowadays our environments are filled with thousands of digital photographs (Shafie et al., 2018).

Digital photography is becoming increasingly available and affordable through smartphones and digital cameras, the process of taking photos is simple, everyone has an instant camera, which makes the individual able to instantly shoot, present and share (Peng & Chen, 2016). This means that we are faced with a reality in which it is necessary to focus on the value and impact of a visual photograph. This has been confirmed by scientists who have discussed the dominance of photographs, where photographs are closely related to education, imagination and creativity (Farran, 2018).

Digital photography is mainly used in architecture as a visual reality recording tool. Using photographs as a visual tool will build a better opportunity for students to enhance their creative thinking and design. Digital photography can be used in architecture education through the methodology of interpreting and deciphering a photograph (Uwajeh et al., 2016). It is possible to extract ideas from the art of digital photography, as it produces an unwritten message that travels through it; therefore, it is used as an inspiration for our daily lives. It takes imagination from the photographer while capturing objects in the surrounding environment; This is to accommodate ideas that can arise from this digital photograph (Shafie et al., 2018). Everyone sees the photograph with a different vision than others (Farran, 2018).

4.1. Visual perception of digital photography

Visual perception is the most important senses, where 80% of the clear information in our brains is perceived visually through Vision, which accounts for the majority of the cognitive activities of the brain (Farran, 2018). It makes the designer able to read the visual sentences provided by the surrounding environment, and thus be-

comes more creative and able to solve design problems. The architectural designer uses visual perception during the architectural design process. The visual designer's thinking basically depends on what his sense of vision extends, to move in turn to short-term memory or long-term memory, so this visual knowledge come together to formulate the visual perception of the designer. The development of both the perception and visual thinking of the architectural designer makes him able to think creatively, and solve design problems. This is considered a refinement of the designer's design abilities, which qualifies him to create architectural designs that include visual symbols belonging to the surrounding environment, which makes the average recipient able to read them, and directly link them to his civilization and environment (Mohammed Mohammed, 2018).

4.2. Visual Thinking for Digital Photography

The basis of the visual perception process is visual thinking, where the human mind depicts shots from different places and then stores these shots, summons them later and connects them with each other through clear links (Farran, 2018). The concept of" visual thinking " in the most common sense arises through two relative terms: the first is related to mental perception, and the second is related to the visual perception of the world that surrounds us (Marotta & Pavignano, 2019). Visual thinking makes the designer able to read and translate visual elements, and it also includes creative thinking skills, because the visual language develops the thinking of the architectural designer (Mohammed Mohammed, 2018).

Using visual thought processes through image insight is a step out of the design from stereotypical space to new designs based on imagination and creativity, it is an attempt to open the human imagination so that the designer can go free outside the stereotypical range. This makes the human mind of the designer able to deal with the connotation of the image and decipher it, so as to extract the invisible meaning of the idea and turn it into a mental image (El Derdery, 2018).Visual language creates connotations within the image, incorporating colors, shapes and stripes into a picture that is understood by its previous connotations. For example, the presence of red is reflected in its connotations as opposed to its physical presence among other colors. What

applies to colors applies to geometric shapes, they also have connotations other than merely being geometric configurations covering spaces divided by an infinite universe. The image carries multiple meanings, the message it carries cannot be deciphered immediately. This ambiguity in the visual message is often an advantage, as it makes the image rich in meanings and indications (Farran, 2018).

5. Examples of case studies that using digital photography in architectural design education

An analytical study of case studies using photography in the process of architectural design education will be carried out through comparisons between them in terms of Digital photography, Architectural design process, Student Results; This is to understand and analyse the different technologies and strategies that have been used to teach digital photography to architecture students, and to know the extent to which the digital photography tool affects students' thinking and creativity to achieve an effective and more creative design.

5.1. Example 1

Faculty at the University of Puerto Rico School of Architecture used one of the optical art products, the digital photography tool, to develop students' visual vision of the surrounding environment. Digital photographs taken by students produce new visual explanations, it is expected that this visual record develops students' skills to make sound decisions during the architectural design process (Jiménez-Montano & Ortiz-Rivera, 2014).

- **Digital photography**

The number of students participating in this experiment consists of eleven students. Before undertaking this task, the students attended lectures on the principles of digital photo composition and graphics editing software. The second part of the assignment, students use a digital photography tool to record objects, situations and subjects while walking around the urban landscape on Luisa Street in Puerto Rico, the city. After that, students select five images that correspond to the criteria set by the lecturer: composition, volumes, main lines, brightness and Contrast, Color, focus, framing of camera shots.
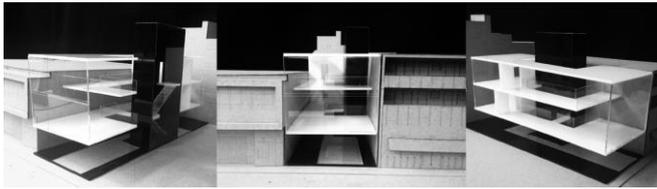
Figure1: The student's architectural design proposal based on its original developed theme

Figure2: It shows the photographic sequence of one of the students, in which he observes the contrast of day and night on Luisa Street

- **Architectural design process**

The final part of the mission focuses on the creation of an architectural design on Loisa Street, where students assume the needs of a fictional client, and the importance of this activity in the life of a fictional client. After completing the design process, the professors evaluate the photographic sequence and how it relates to the design process. This assessment is based on some of the criteria imposed by the professors according to the assessment model containing the general picture, visual narrative of photography, and spatial installation of the architectural component.

- **Student Results**

The results of the students showed that the photographic image was a link to the final product of architectural design. Student sequences of photographs are an example of visual expression of elementary design problems. The students demonstrated their experience in creating balanced compositions using the lines in the image, the brightness and contrast technique to express the atmosphere according to the purpose of the image.

For example, Figure 1 shows the photographic sequence of a student, where the spaces of Louisa Street are recorded by day and night. Figure 2 shows the design suggested by that student, it can be noted that the sequence of photographs helped to determine the design attribute based on variability and variability. This process, in turn, facilitated the definition of problems and the formulation of design solutions.

5.2. Example 2

The purpose of this study was to analyze the effect of using photographs as a visual reference during the process of learning about architectural design (Uwajeh et al., 2016).

- **Digital photography**

This study used two groups of first-year students of 22 and 16 students respectively as a case of study, and these students watch a film as a prerequisite. The first group (a) takes digital photographs of the scene that inspired them from others in the film, where emotions are translated and ideas are inferred from these images and analyzed to help them develop their architectural design. The second group (b) was an observer group, making notes only while watching the film without taking photographs.

- **Architectural design process**

Students design a garden at a site proposed by the department's doctors And through what was taught to students about design principles, they were asked to apply this knowledge that they acquired in their design of the garden from the interdependence of elements, spatial relationships, color, texture and human dimension, In addition to addressing new problems affecting design such as climatic, topography and other environmental factors associated with the site from inside and outside, the main concept of the design client must be linked to the film chosen.

Students are expected to be able to make better use of the spaces in the site, combine buildings with the slopes within the site, and be able to translate the feelings and ideas extracted from their photographs into a design that meets the standards required for the legislator. Four criteria have been developed for classifying students' work: architectural design, spatial organization, outer space relationship with buildings, color concept and optimal use of spaces, and each criterion is estimated at 25%.

According to these criteria, each group's students are classified into three types:

• Students have achieved less than 50% of the required standards for the project.

• Students managed to achieve 50% of the required standards for the legislator.

• Students who have achieved more than 50% of the required standards for the project.

• **Student Results**

According to the criteria established for evaluating students' work, it was found that:

In the group (a) many students understand the design summary clearly and can also extract and interpret ideas from images that inspired them in the films. As shown in figure 3, (11) out of (22) students received more than 50% of the required standards, the main objectives of their project, and five (5) out (11) 50% of the required standards. The remaining six (6) were below 50% of the required standards. These standards included a clear understanding of the spatial organization in their design, a strong understanding of the architectural design in the film they saw, the internal and external spatial relationships in the context of their film, the concept of colors and textures, and the types of facades used in buildings that appear in photographs that affected them most.

(a) Less than 50% of the required criteria

(b) 50% of the required criteria.

(c) More than 50% of the required criteria.

Figure 3: Pictures (a), (b), (c) of student's design in group a (Source: (Uwajeh et al., 2016)).

In Group B, students clearly understood the design summary, and many were unable to extract ideas from the films and interpret them. This can be seen clearly as in figure 4, where only three (3) out of sixteen (16) students received more than 50% of the required standards, which are the main objectives of their project, and one (1) student's performance averaged 50% of the required standards. The remaining twelve (12) were less than 50% of the required standards used in group A.

(a) Less than 50% of the required criteria

(b) 50% of the required criteria.

(c) More than 50% of the required criteria.

Figure 4: Pictures (a), (b) ,(c) of student's design in group b (Source:(Uwajeh et al., 2016).).

5.3. Example results

After presenting examples of case studies used as a photography tool for students during architectural design education, students initially attend a lecture on photography, and before giving students the required exercise, teachers give instructions on how to use this tool in the design process in terms of depicting the environment and extracting the ideas and meanings of its inspiration to help them in the architectural design process.

The teachers evaluate the students' work according to the criteria they set for the architectural product. The results of the students who used this tool in the design process were better and more creative than others. This demonstrates the relevance and impact of the photography tool on the thinking and creativity of students during the teaching of architectural design.

6. Analysis of photography courses within Arab and international universities in 2020-2023

The Author researched 120 Arab universities classified as Arab rank universities in the field of architecture for 2022. These universities announced on their website that they taught photography during the education of architectural design. The results are:

• The number of Arab universities that incorporate the photography course during the process of architectural design education is 13 out of 120 Arab universities. The percentage of these universities that use the photography curriculum in architectural design education is 10.8% of Arab universities, which is a small percentage, as shown in figure 5. These universities are Beirut Arab University, Beirut Arab University American University of Beirut, Qassim University (Saudi Arabia), Prince Sultan University (PSU) (Saudi Arabia), An Najah National University (Palestine), Arab Academy for Science, Technology and Maritime Transport (Egypt), German Jordanian University (Jordan), Nile University (Egypt), Pharos University (Egypt), October University for Modern Sciences and Arts (MSA) (Egypt), University of Benghazi (Libya), Delta University for Science and Technology (Egypt), University of Petra (Jordon).
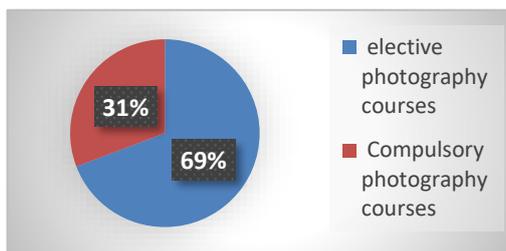

Figure 5: percentage of Arab Universities that use photography course (Source: Microsoft excel 2021 software, by Author).

• Number of Arab universities using the photography curriculum as a mandatory decision in the architectural design education process 4 out of 13 Arab universities, as shown in figure 6.
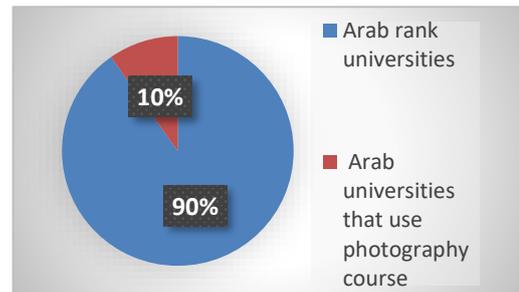

Figure 6: percentage of elective and compulsory photography courses in 13 Arab Universities (Source: Microsoft excel 2021 software, by Author).

• The years of academic students studying the compulsory course of photography is the first year of architecture, while the elective course is in the last years of architectural design education.

• 6 different types of photography curricula used in 13 Arab universities, they are digital photography, architectural photography, principles of photography, photography studio, photography workshop and laboratory, and photography for architecture.

• The number of hours of the photography course is two hours within 6 Arab universities, while 6 other universities have a course duration of 3 hours, and one university has a photography curriculum duration of one hour.

• The content of different digital photography curricula within 13 Arab universities contains an explanation of the principles of photographic composition, the types of cameras and lenses, light and lighting, how to capture the image and angles of photography, processing and editing images, and how to link photography to architecture.

The first 10 universities of the world university ranking in the field of architecture for the year 2022-2023 were also analysed, and the results are as follows:

• The first two of the top ten universities in the world have announced on their website that they are using the photography curriculum in architectural design courses.

• Harvard University (United State) used the pho-

tography curriculum independently in 2014 within architectural design education, but is now using it within more than one course in architectural education.

• Massachusetts Institute of Technology (MIT) (United State) uses photography as an elective course, while Harvard uses it as a mandatory curriculum.

After presenting the results, we find that international and Arab universities use photography education during the architectural design education process, but a small percentage of universities use this curriculum in the architectural education process as a mandatory course, so a questionnaire will be made for students and graduates of the Department of architecture to reach the importance and impact of the digital photography tool on architectural student's thinking and creativity during the education of architectural design.

7. The questionnaire: (Case study: Department of architecture and Environmental Design-Faculty of engineering-Arab Academy for science, technology and maritime transport - Alexandria)

The author conducted a questionnaire for a number of students and graduates of the Department of architecture and Environmental Design –(Arab Academy for Science, Technology and Maritime Transport (AASTMT))– Alexandria, to explore the importance of the art of photography during the education of architectural design and its impact on the thought and creativity of the architectural student. The researcher found a number of students and graduates who participated in the questionnaire and their number was 23. This questionnaire discusses a number of questions related to the opinions of students and architecture graduates about the optional photography course they studied at Arab Academy for Science, Technology and Maritime Transport. The questionnaire shows the following:

7.1. Questionnaire results

• The number of students of (AASTMT) participating in the questionnaire for (2023) 12 students, including 4 first year students, one second year student, 4 subsequent year students, three fourth year students, and the

number of graduates of (AASTMT) participating 11 a graduate, the proportion of students and graduates participating is close, as shown in figure 7.
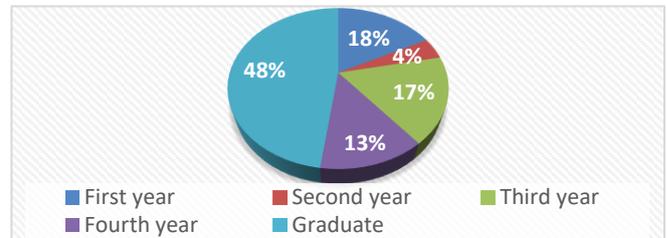

Figure7: Academic years for students and graduates who participated in the questionnaire (Source: Microsoft excel 2021 software, by Author).

• Number of students who studied Elective photography course 9 out of 23, with a small proportion, as shown in figure 8.
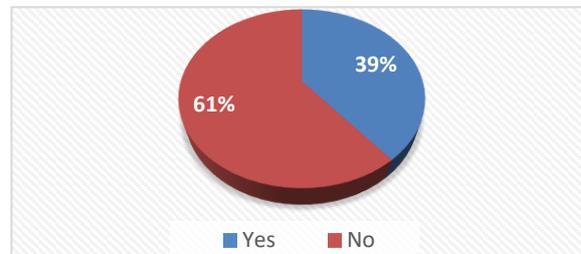

Figure8: Students who studied Optional Photography Course (Source: Microsoft excel 2021 software, by Author).

• Number of Students Who Will Choose Elective Photography Course 13 Students, Their Proportion Is Large, as shown in figure 9.

Figure 9: Students who will submit to study Optional Photography Course (Source: Microsoft excel 2021 software, by Author).

• Number of graduates who wish to choose optional photography course 9 graduates, and their proportion is also large, as shown in figure 10.

Figure 10: Students and graduates who wish to study photography course (Source: Microsoft excel 2021 software, by Author).

- The academic years for students who have studied optional photography are students from the third year and the second year. These school years are considered to offer students the choice of photography subject without any other years, as shown in figure 11.
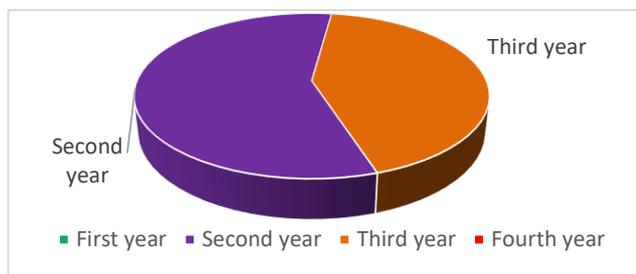

Figure 11: Years of Students Studying Optional Photography Course (Source: Microsoft excel 2021 software, by Author).

- The following figure12 shows the answers of students and graduates who studied photography about the importance of this tool and its impact on their vision, thought and creativity to achieve a better architectural design. The results indicate how much they agree with the importance of photography while teaching architectural design.
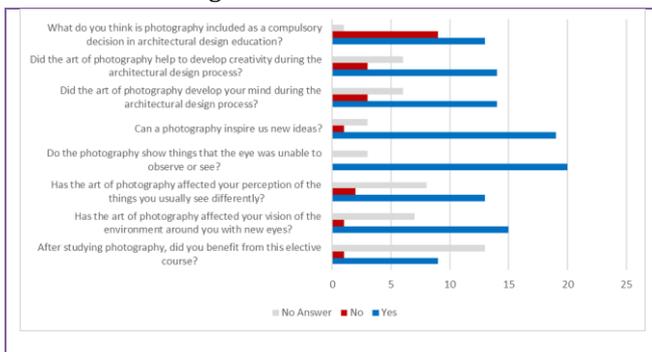
Figure12: Students' and graduates' opinion of the importance of photography (Source: Microsoft excel 2021 software, by Author).

- Through the questionnaire, students were asked to share their opinions about the impact of photography on their thinking and creativity during the architectural design education process, and these were some of their opinions:

– Photography has influenced the extraction of three-dimensional images for projects, and how to choose distinctive and comfortable shots for the viewer, whether in interior or exterior design.

– The photography course taught me during the study how to adjust the camera angles during the design process on modeling programs, in addition, it is a process of documenting what the human eye sees in integration, the eye may see every detail separately, but the camera sees all the details integrated and integrates what the human eye cannot integrate, besides photography made a kind of mental innovation to complete what is missing and realize some architectural details and their correct proportions.

– I see that the photography course did not have much impact because it was not integrated with the architectural art sufficiently during the course, but I think if taken from this perspective it can help during the stages of massing and designing the vantage points and others, especially in the design of buildings such as museums, exhibitions and cultural buildings.

– Photography has influenced me in several aspects, as it made me look at all things from a deeper perspective and that nature in another form and perspective where I can create different ideas through photos, this is evidenced by a certain lighting or color, besides photography made me go deeper into studying color theory and the effect of each color on the psychological state, it is easy to communicate ideas and feelings quickly, and sometimes even express emotions through photography.

Table 1 - A questionnaire of students and graduates of (AASTMT) and their opinion about the elective photography course

Questions	No.	%
What is your gender?		
Male	19	82.6
Female	4	17.4
What is your academic year now 2022-2023?		
First year	4	17.4
Second year	1	4.3
Third year	4	17.4
Fourth year	3	13
Graduate	11	47.8
Did you study photography as an elective course during architectural design education?		
Yes	9	39.1
No	14	60.9
If your answer is no, will you choose a photography subject?		
Yes	13	56.5
No	2	8.7
(No answer)	8	34.8
If you are a graduate, would you like to study photography?		
Yes	9	39.1
No	3	13
(No answer)	11	47.8
If you are a student and your answer is yes, in what academic year did you choose photography?		
First year	0	0
Second year	4	17.4
Third year	3	13
Fourth year	0	0
(No answer)	16	69.6
After studying photography, did you benefit from this elective course?		
Yes	9	39.1
No	1	4.3
(No answer)	13	56.5
Has the art of photography affected your vision of the environment around you with new eyes?		
Yes	15	65.2
No	1	4.3
(No answer)	7	30.4
Has the art of photography affected your perception of the things you usually see differently?		
Yes	13	56.5
No	2	8.7
(No answer)	8	34.8
Do the photography show things that the eye was unable to observe or see?		
Yes	20	87
No	0	0
(No answer)	3	13
Can a photography inspire us new ideas?		
Yes	19	82.6
No	1	4.3
(No answer)	3	13
Did the art of photography develop your mind during the architectural design process?		
Yes	14	60.9
No	3	13
(No answer)	6	26
Did the art of photography help to develop creativity during the architectural design process		
Yes	14	60.9
No	3	13
(No answer)	6	26
What do you think is photography included as a compulsory decision in architectural design education?		
Yes	13	56.5
No	9	39.1
(No answer)	1	4.3

7.2. Questionnaire conclusion

From the questionnaire, conclude that the students who studied the elective Photography Course range their academic years between the second and third year, that is, so that the student is able to design the architectural process, as well as to realize the visual arts and the extent of their impact during the architectural design process. There is also an interest in studying the photography course from students and graduates who did not study the elective course. From the students ' opinions about the impact of the photography tool during the architectural design process, conclude that it helped to develop their vision of the environment around them, to be inspired by meanings and ideas from it, and to develop their mental innovation; therefore, the following will be a practical application for using the digital photography tool for students of specialised scientific program (SSP), department of architecture, at Alexandria University during the architectural design process, and discovering the extent of its impact on the development of their thought and architectural product.

8. Practical Experiment: (case study: specialised scientific program (SSP)- department of architecture- faculty of engineering- Alexandria University)

Three groups of 40 students were used in the H41 architectural design studio in the building for students of specialised scientific program (SSP), department of architecture, at the faculty of engineering, Alexandria University as a case study. In Group A, students were asked to do the required design, while Group B and Group C were taking a course on digital photography, and Group C was doing digital photography, and using images during the architectural design process. Surveys and participatory observations were conducted during this process, and the students of the groups would finally submit their designs, and then the professors would evaluate them. The data was analysed using Microsoft excel 2013. The purpose of this study was to find out the impact of the photography tool on the development of students ' thinking and creativity

during the architectural design process, and below we review the steps of the experiment and the results.

8.1 Experiment outline

• Academic year: the study case is done on second-year students in the first semester of specialised scientific program (SSP) - Faculty of engineering - Alexandria University, the student must have the knowledge and theories that enable him to practice the architectural design process. The students of the Department of specialised scientific program were also chosen, as their study programs do not contain a photography course, unlike the Department of Architecture at the Faculty of engineering – Alexandria University.

• Duration of the case study: the case study was conducted during a student's school day, it took 7 hours, where Group A does the required design work within 3 hours, while Group B and Group C attend an hour – long digital photography course, then Group B does the exercise without using digital photography, while Group C does photography inside the courtyard of the Faculty of Engineering at Alexandria University-where students photograph the environment around them with a different the specific time frame is as shown in Fig. (13) After the completion of Group A of the required design, students attend the photography course in order to benefit as well.

The content of the lecture: the researcher gives the lecture, and this through the presentation of power point includes some titles of photography courses taught within the Arab universities that have been limited, and as followed from previous case studies, the principles of photographic image formation, types of digital photography tools, lenses and lighting, how to take a picture and angles, and the relationship between photography and architectural design through the presentation of common elements such as balance, rhythm, repetition and other elements related to architectural theories, besides connotations of some architectural elements, such as the use of lines and shapes from nature and their connotations.
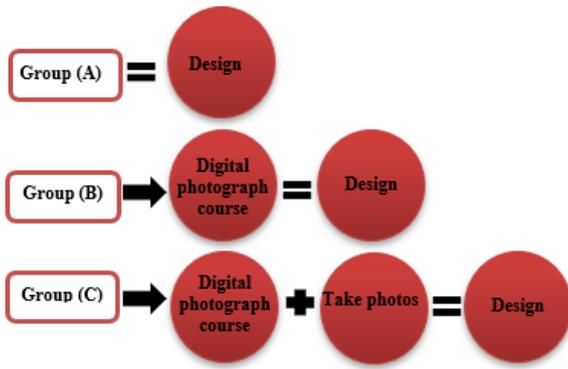
Figure 13: a figure showing the design input of the three groups(A), (B) and (C) respectively (Source: author).

• Required exercise: it is part of the design of their project for this semester, as their project deals with the design of a residential house on a proposed site in the north coast. And one of the designs required by the students in this project was to design the facades and draw a perspective of the building, and these designs were the required exercise.

• Students are expected to apply the knowledge gained through the digital photography course, and relate it to what they studied during the architectural design education and architectural theories in terms of the relationship of the elements used and linking them together, poise and repetition, visual composition, aesthetic values, forming vocabulary, etc. Besides extracting meanings, symbols and connotations from the surrounding environment by defining the vision using digital photography, and projecting it during their architectural design process.

8.2 Stages of experiment

- Initially, the professors who taught the students in this class were hired, and they have a good knowledge of their performance in the architectural design class, so that each group contains different levels of students as in the figure (14), and the groups are close in the performance of their students during the architectural design process, in order to be measured in a neutral way, and reduce any external influence on the experience.
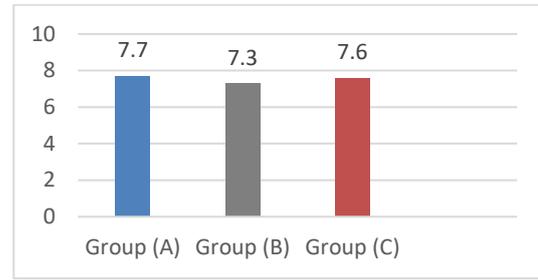
Figure 14; A graph showing the convergence of the levels of students in each group respectively (a), (b), (c) before the experiment (source: author).

- In the next step, one of the professors gathered all the students inside the architectural design studio41, and told them the stages of the experiment as shown in Picture (15), where they will be divided into three groups(A), (B), (C) consisting of 14, 13, 13 students, respectively, and were informed of their names according to the division of professors. Besides, the students were explained the role of each group, where Group (A) will remain inside the design studio doing the required exercise during the specified period of time, while Groups (B) and(C) will go to attend a course on digital photography and then return to the design studio H41 to draw the required exercise.

Figure 15: shows the grouping of students inside the H41 design studio, dividing them and telling them the design steps (source: author).

- Students of Groups (B) and (C) attend a course on digital photography as a figure (16), where it deals with the introduction of the digital photography tool, the principles and rules of photographic image formation from image balance, repetition and rhythm, simplicity, and many of the elements that make up the digital image, which are related to the theories of the architectural design process – as dealt with by photography courses within international and Arab Universities -, the connotations and meanings that the photographic image can suggest to us, and how it is used during the architectural design process.

Figure 16: A photo showing the attendance of Groups (B) and (C) of a lecture given by the researcher on digital photography (source: author).

-After Groups (B) and (C) attended the photography course, Group (B) was asked to return to the H41 design studio and do the required exercise within the specified period of time. While Group (C) goes down to the College Square and photographs the environment around them, drawing inspiration from the meanings and elements of the photograph, and projecting them on the architectural design process inside the H41 design studio. Besides, they were asked to print the photo that they took and inspired them the most, and put it on the design board, design and write how influential and important this photo is on their designs.

- The students of Group (C) were involved and discussed about their photos and their purpose of photographing them, and how to draw inspiration from them, and add them to the architectural design process. In the end, all the students handed over their designs to the professors for evaluation, and the students ' design work was photographed, data was collected and analysed.

8.3 Student results

Below are the photos and results of the designs of each group, where the estimates of the groups contain good, very good and excellence.

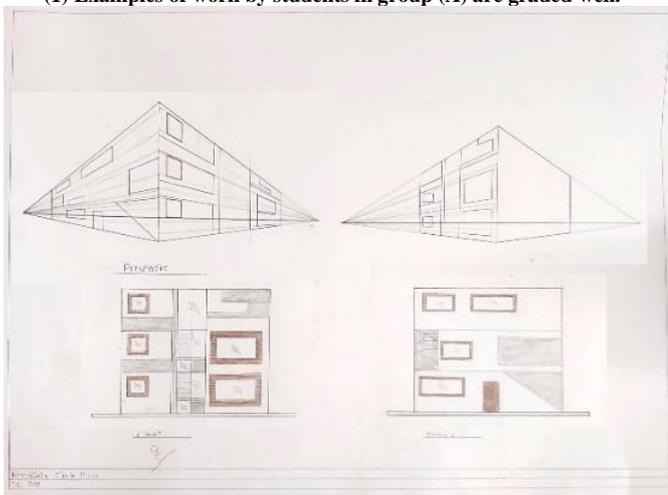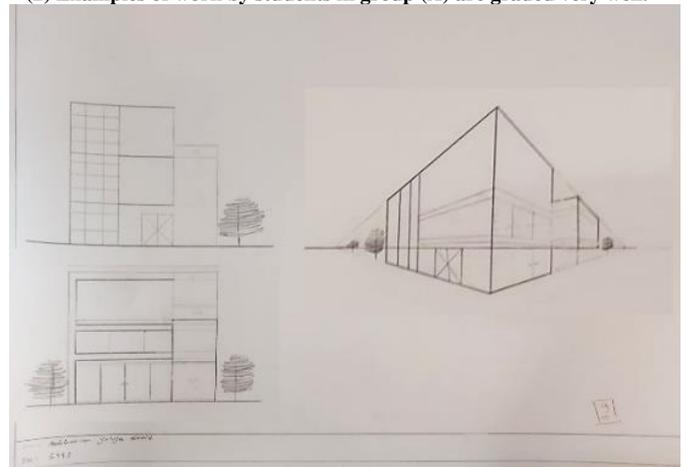### 8.3.1 Group (A) student design results

•Photos of some sample designs of Group (A) students as shown in Figure (17).
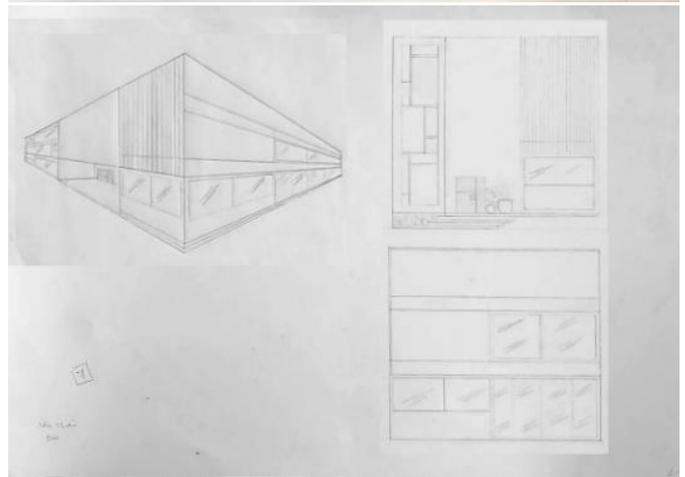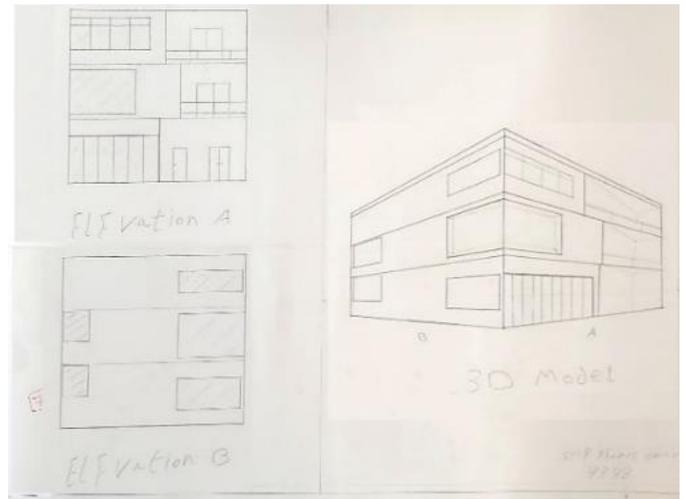
(1) Examples of work by students in group (A) are graded well.
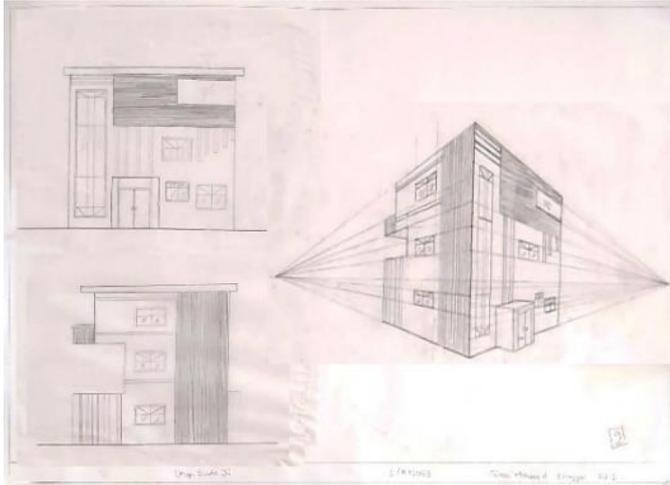
(2) Examples of work by students in group (A) are graded very well.
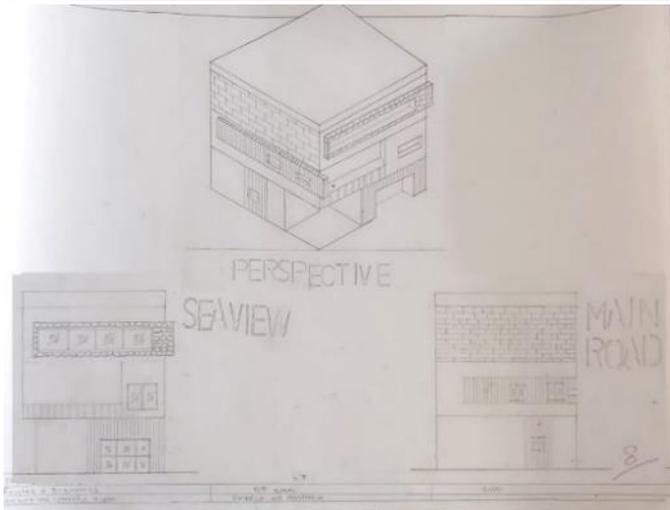
(3) Examples of work by students in group (A) are graded excellent.

Figure 17: (1)، (2) & (3) photos of some models of Group (A) students ' designs and their estimates

- After showing some models to the students of Group (A), we find from the graph figure (18), that the students ' performance is close to their level in the previous designs of the project, there was no development in the performance of their designs, they did not attend the digital visualization course or do photography. The results are also indicated by the following graph.
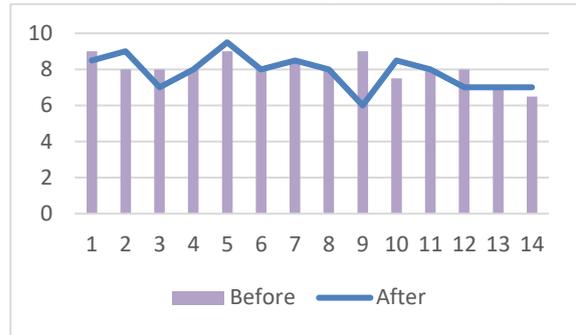
Figure 18:diagrams showing the results of the students of Group (A) before the case study and after the case study (source: author).
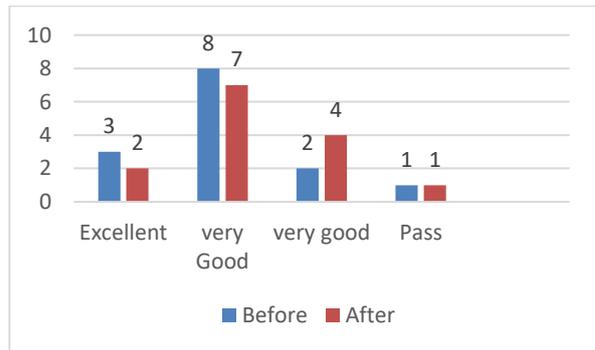
Figure 19: diagrams showing the estimates of students of Group (A) (source: author).

8.3.2 Group (B) student design results

•Photos of some sample designs of Group (B) students as shown in Figure (20).
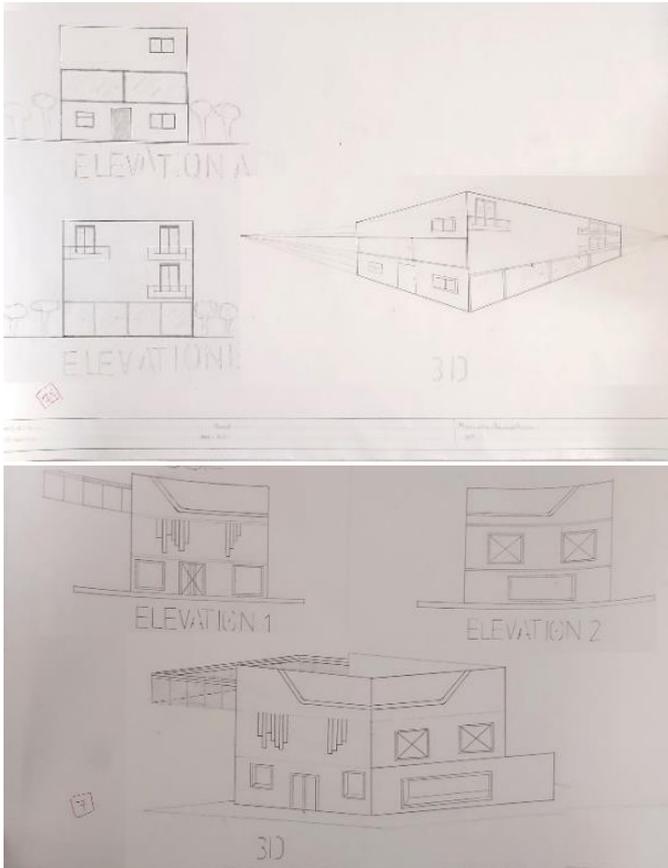
(1) Examples of work by students in group (A) are graded well.
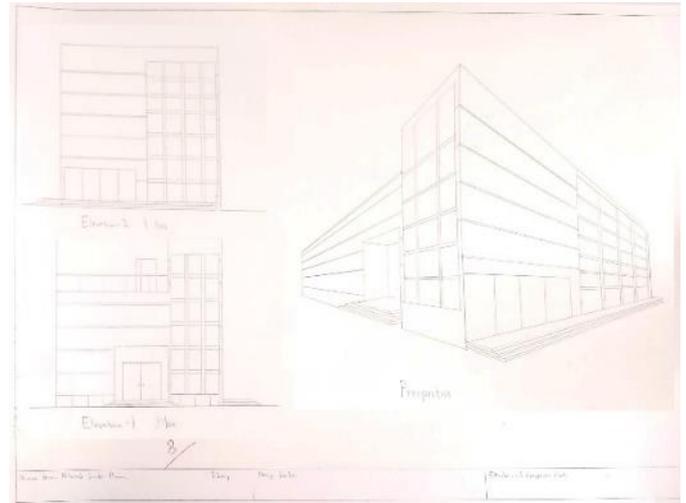
(2) Examples of work by students in group (A) are graded very well.

(3) Examples of work by students in group (A) are graded excellent.

Figure 20: (1), (2) & (3) photos of some models of Group (B) students ' designs and their estimates

- The results of the students of Group B are shown through the graph figure (21), with an increase in the level of students from before, as in Figure (22) shows the estimates of students before and after attending the digital photography course.
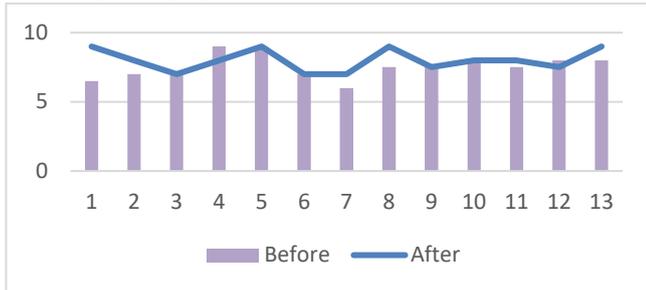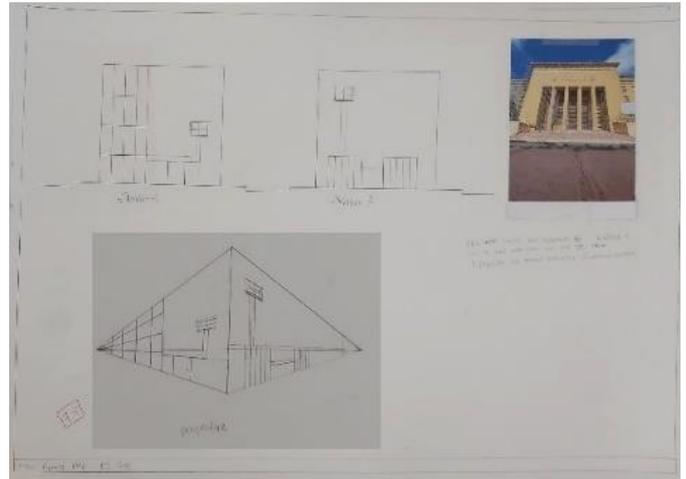

Figure 21:diagrams showing the difference between the results of Group (B) students before and after the case study

Figure 22:diagrams showing the estimates of students of Group (B)

8.3.3 Group (C) student design results

•Photos of some sample designs of Group (C) students as shown in Figure (23).

(1) Examples of work by students in group (A) are graded well.

(2) Examples of work by students in group (A) are graded very well.

(3) Examples of work by students in group (A) are graded excellent.

Figure 23: (1), (2) & (3) photos of some models of Group (C) students ' designs and their estimates

- Through the graph in figures 24 and 25, the results of the students of Group (C) show that the students 'level has increased from their level before with a clear difference, but also the students' estimates are more advanced than the rest of their colleagues, as shown in figures 26.
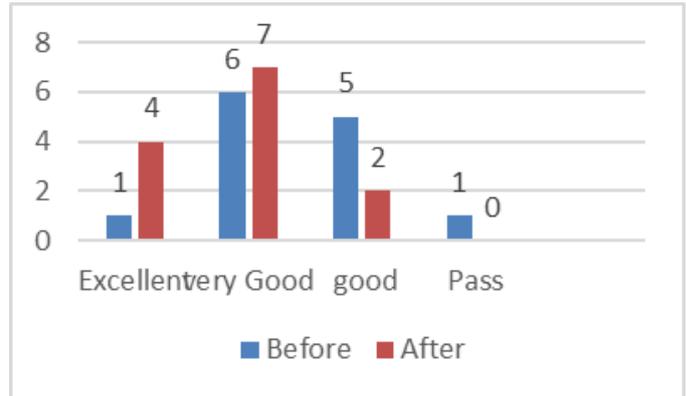

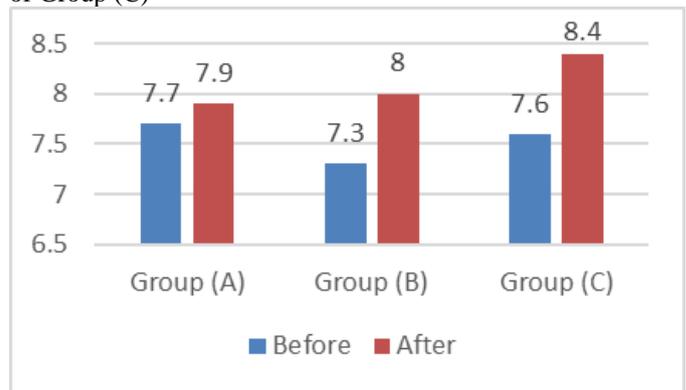**Figure 25:** diagrams showing the estimates of the students of Group (C)

Figure 26: a graph showing a comparison of the levels of students before and after the case study of the three groups respectively (a), (b), (c)

8.3.4 Results of opinions of students and supervising professors:

Before the students of Group (C) carried out the architectural design process, the supervisors directed the students to write their opinions about the extent of inspiration of the photography tool on their architectural design, and that on their paintings after the completion of the design process and before evaluating their works and the results were as follows:
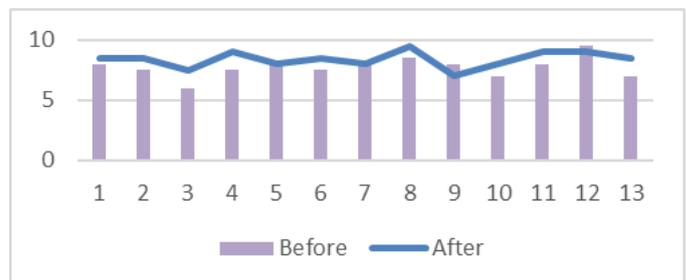

Figure 24: diagrams showing the impact of the photography tool on the results of Group (C) students.

8.3.4.1 Group (C) student opinion results:

The opinions of some students of Group (C) will be presented, how to draw inspiration from their photos, the extent to which they achieved the rules of formation in digital photography, and the evaluations of professors for their design, mention some of these opinions, photos and designs as follows:

• One of the students took a photo from inside the College of engineering yard near the college playgrounds as shown in Figure(27), where the student's vision was to use a tree element in the middle of high-rise buildings, that this gives a beautiful visual shape, she was inspired in her design of the house as shown in Figure(27), using a tree element surrounded by the cube of the house to give the user a sense of seeing a beautiful and comfortable view from the inside, in addition to the view of the sea on the north coast.

- The student's image has achieved the rules of image formation in terms of balance, lighting, and the use of guiding lines for the element to be focused on, besides using the third rule.

- The evaluation of the Doctors for this design was very good, the inspiration contributed to the formation of the building block, and improved the client's feeling and vision of the sea and nature.
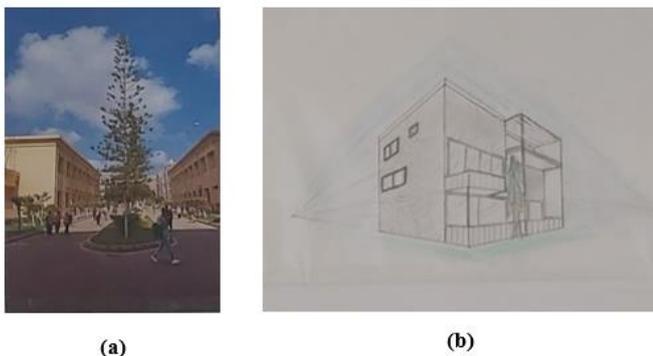

(a) (b)

Figure 27: (a) the figure shows the photo taken by the Student, (b) the inspiration of the tree element in the design process of the House.

Another photo of one of the students of the entrance to the Faculty Administration Building as shown in Figure (28), she saw the use of a decorative element repeated on the windows of the facades of the entrance to the building - the lotus flower element -, and this with the refraction of lighting from the outside to the inside of the building, where the varied shade with the use of afforestation gives a good feeling to the eye, she was inspired by the decorative element and added it as it is on the facade of the house, besides adding elements of planting on the windows of the facades.

- During the shooting of the building from the inside, the student used the base of the angle of view of the Ant's eye, so that the image can contain many elements such as shadows and facades.

The student tried to draw inspiration from the surrounding environment, but she deduced an element from a different civilization and time as it is without putting it and using it in a way commensurate with the idea of the project, it is not suitable for the design requirements of a residential house on the north coast.
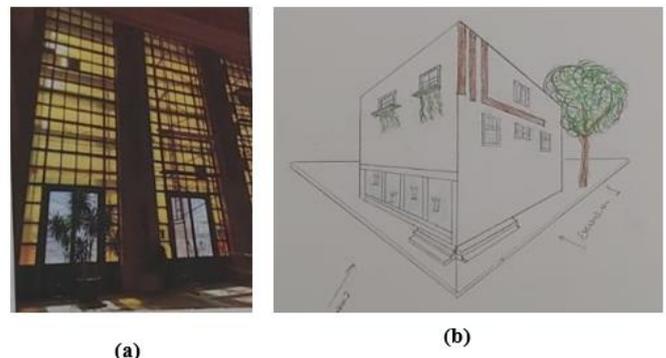

(a) (b)

Figure 28: (a) photograph of one of the female students in the entrance and windows of the administration building at the Faculty of engineering, and (b) the design of this student using the lotus flower element on the facade and the use of planting on the windows.

• One of the students took a photo of the entrance to the administration building of the faculty of engineering as shown in Figure (29), and found the use of steel grids with glass facades gives a more attractive appearance, with the height of the building gives a feeling of the greatness of the building, besides the use of plants and with the refraction of light and the formation of Shadows gives a perfect shape. The student was inspired by the idea of designing the facade of the house using a forming design of glass with steel, and using the forming elements along the facade to give a sense of grandeur. Next to the formation in the building block to confirm the entrance, such as the administration building block.

- The student used the rule of directed lines to direct the eye on the element to be focused on.

- This student got a very good rating, he used the glass element along the length of the facades, which gives the user a better view of the sea, besides the formation using steel in the building block.
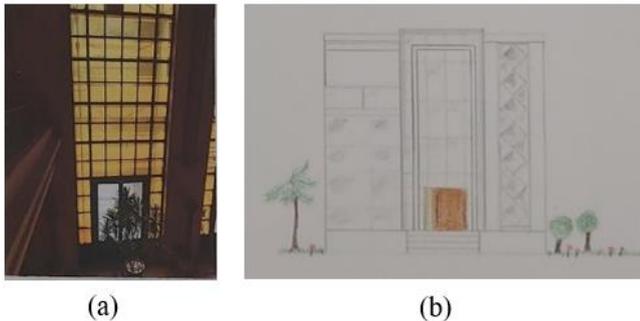

Figure 29: (a) a picture of the glass with steel inside the administration building of the Faculty of Engineering, (b) a facade showing the projection of the composition inspired during the architectural design process.

• After a student walked around the college square, he photographed the entrance to the building (SSP) inside an engineering college as in form (30), where the photo shows a complementary structural element to the building courtyard, and also searched for the works of architect Richard Meier as shown in Figure (31), extracted one of his designs, and took one of the similar structural systems to complement the formation of the cube shape during its design process.

- The student used the rule of balance and the rule of directed lines.

- The professors evaluated the design of this student with an excellent assessment, where the student did the research and Conclusion, and the optimal application on the building block commensurate with the requirements of the project.
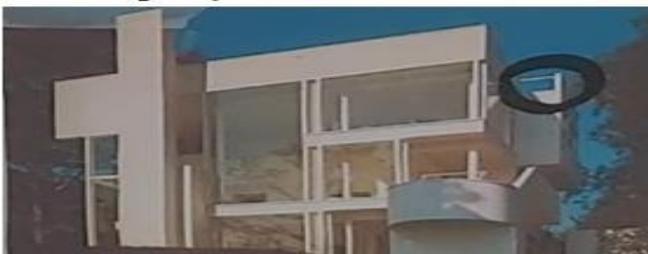

Figure 30: one of the works of architect Richard Meier.
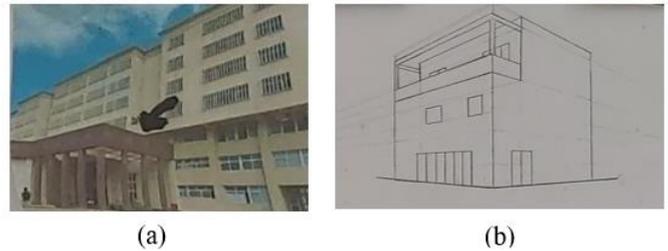

Figure 31: (a) a photo of the (SSP) building from the outside, (b) its design project in which the projection of the inspiring composition element is evident in its design

One of the students, after taking a photo from outside the building of civil engineering and mechanics as shown in Figure (32), indicates that green spaces can change the vision of the building completely, and give it a warmer feeling to the eye, although the function of the building is much more difficult than it seems. The addition of green spaces was inspired in the formation of the facades of the residential house block on the north coast.

- The student achieved the rule of balance in the image, besides using the rule of directed lines, in addition to the rule of third.

- The valuation of this work has received a privilege. It has added green spaces in front of the windows of the glass facades. This gives the customer a better feeling besides seeing the sea view.

One of the students ' comments was after photographing the entrance to the Faculty Administration Building as shown in Figure (33), that the facade of the building contains a duplicate element of the lotus flower, the student was inspired by the corrugated shape of the flower and added it on the facades of the residential house on the north coast in a way that harmonizes with the environment.
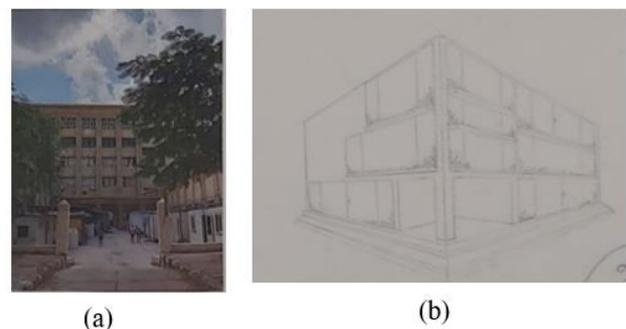

Figure 32: (a) a photo from in front of the mechanical engineering department building, and (b) a perspective containing the design of green areas of plants on the windows of the building's glass facades.

• - The student achieved the rule of balance in the image, the rule of repetition for Windows on the facade of the building, and the rule of the frame to guide the eye to the element to focus on without dispersion.

- Professors value this design with excellence. The student formed the facades in accordance with the nature of the project.

Figure 33: (a) a photo from inside the administration building of the Faculty of Engineering, (b) a perspective designed by the student whose facade contains ripples inspired by the lotus flower, fits into the project environment

• One of the students, after taking a photo of the facade of the mechanical engineering building as shown in Figure (34), indicates that he was inspired by the image of the repetition of the elements on the facade within the architectural design process.

- The student has achieved the rule of Third and balance in the photographic image.

- The student's assessment was very good, he designed some formations on the facade by repeating the elements used.
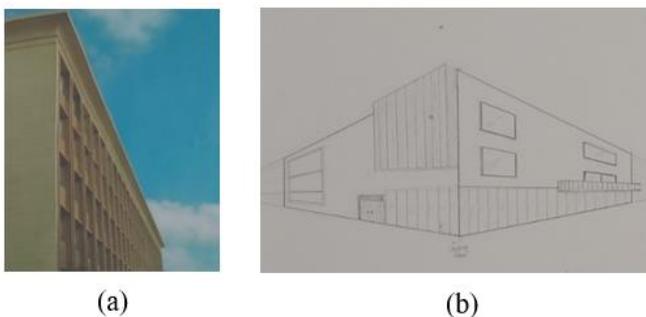

Figure 34: (a) A picture of the facade of the mechanical engineering building of the Faculty of Engineering, and (b) a perspective showing the student's inspiration for repeating elements from the facade of the mechanical engineering building and dropping them during the architectural design process.

8.3.4.2 Results of opinions of supervising professors

• After the professor evaluated the designs of the students of Group (C), the professors noticed the intellectual development of many students, where some students had a poor level during the architectural design process, but after the experiment they found a development in their thought and creativity, how to inspire elements and meanings of the environment, hire them and drop them on the architectural design process according to its requirements.

• Besides, Professor Supervisor's opinion that some of his students have limited thinking, as the element is derived from the environment as it is, and dropped it within the architectural design process without functioning in a way that fits with the design such as the student who inspired the lotus flower and used it on the front of the residential house on the North Coast.

• The supervising professor also noted that if students photograph projects similar to the same nature and environment of the project, this will be the most inspiring during the architectural design process. As one of the students did by looking for the designs of the architect Richard Meier, and drawing inspiration for elements from his designs close to the idea of designing their architectural project.

8.3.5 Experiment conclusion

After a group presentation of some sample designs of the students of groups A, B and C, and by analysing their estimates according to the evaluation of the professors, we find that the photography tool had a positive effect on the students of Group C. Their results improved significantly from their performance before using the photography tool, in addition to the improvement of the level of the students of Group B after they only attended the photography course without taking photographs. This confirms the ability of the digital imaging tool to develop students ' creative skills and thinking during the architectural design process, and its impact on the architectural product.

The students of Group (C) achieved the skills they acquired during their attendance of the photography course, where they took pictures more evenly, seeing buildings at different angles, such as the angle of capturing the building from below to maximize (Ant's eye angle), besides using the lines inside the image from the environment to direct the vision to the element to be

focused on, in addition to seeing elements in the facade of buildings related to the rules of image formation and the foundations of architectural design, such as repeating an element on the facade of buildings.

The students ' vision of the environment around them has evolved, some students took photos of the surroundings of the Department's building (SSP), and were inspired by elements of the environment that added to their architectural design, although they visited the building almost daily, but the vision through a specific digital image had an impact on their vision of visual and invisible elements and meanings inspired during the architectural design process.

9. Conclusion & Recommendations

Visual aids help in the development of the architectural student's thought and creativity during the process of architectural design education. The results proved that photography is an inspiring visual tool that helps students develop their thinking, draw inspiration from the surrounding environment, extract meanings and ideas from photographs and use them during the design process to achieve better results. This was found out from the analysis of examples using the photographic tool of students during the architectural design education. In addition to the opinions of students and graduates of the questionnaire on the extent to which they benefited from studying the photography course at the Department of Architecture at the Arab University for science, technology and maritime transport. After analyzing the results and evaluations of the students of specialised scientific program (SSP) at the faculty of engineering, Alexandria University, by the supervising professors before and after the experiment, the results were positive in the development and progress of their designs and creativity, but their level was higher and advanced than the students who were content to attend the photography course only without photography, and also higher than the students who did not participate in attending the course or taking photographs. As the digital photography tool helped to see the environment around them with different eyes, the purpose is not to make students better photographers, but to develop their vision of the meanings, connotations and symbols inspired by the environment around them through digital photography. Where

the students interpreted and read the digital images of the faculty of engineering, and realized and linked the elements and rules of the formation of digital photography with the theories and foundations of architectural design, through repetition of elements and poise, the use of lines and their significance through digital images, and extracting inspiring ideas and meanings from them. This indicates the importance of including the digital photography course within the architectural education curriculum because of its impact on the development of the student's architectural thought and creativity.

Therefore, the researcher recommends some recommendations to the competent authorities of the Department of Architecture:

- **Recommendations for those responsible for developing the regulations for the Department of architecture**

The photography course should contain the rules of photographic image formation that are related to the foundations and theories of architectural design, such as the rule of poise, visual weight, symmetry, rhythm, repetition, and the rule of viewing angles. In addition to addressing the course various concepts related to artistic expressions, focusing on visual perception and thinking, how to read and analyse an image and extract tangible and intangible meanings and meanings, practical application and analysis of their results, it is easy for students to take pictures anytime and anywhere, knowledge will expand the scope of students to see and interpret the environment around them in a way that contributes to the creation of more creative formations and designs.

- **Recommendations for professors in the Department of architecture**

Professors should familiarize themselves with the different tools of digital photography and digital cameras, as it is possible to make configurations with them more creative than digital cameras in mobile phones. Besides the knowledge of photo editing and editing programs, this makes students able to make combinations with editing programs, it may lead to more process of inspiration for ideas inside the photo.

- **Recommendations for students**

Using the cameras of their phones, students can photograph inspiring elements, symbols and connotations as

they walk around the urban environment between people and streets, this adds visual vocabulary and compositions that help him in the process of inspiration and creative thought during the architectural design process. Besides photographing projects close to their project, designing and analysing ideas and design through digital image, this adds stability to the information inspired by existing projects, as well as developing their thinking and vision of invisible elements that are not clear through Focus, analysis and interpretation using digital photography.

Acknowledgements

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