THE ROLE OF COMPUTER APPLICATIONS IN TEACHING ARCHITECTURAL DESIGN

An Experimental Model

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Abstract:
There is no doubt that, the architectural design studio is the main core of the architectural teaching process and it plays an important role in developing this process. Despite developing importance of computer in architecture field, it concentrates in several kinds of architectural presentation. While computer architectural applications can provide several tools and mechanisms in teaching design process, so the research presents an experimental model to use one of computer applications in architectural design stages, starting with creating and developing concept to final stages of project presentation, including project environmental studies. The research methodology can be summarized in theoretical preface that explains stages of architectural design process and its relationship with computer applications in each design process stage, then it'll be submitted to the experimental model, definition of the using software and applications mechanisms with exposure to application model output which can be analyzed and evaluated.

Keywords: Architectural Education, Architectural Design Studio, CAAD

1. Introduction:

The term architecture (from Greek αρχιτεκτονική, architektonike) (Marsanu and Rusu ,2010), may refer to a process, a profession or documentation. Architecture is the art and science of designing and erecting buildings and other physical structures, ensembles of buildings, according to certain rules and proportions, depending on the character and destination of the constructions. A science that consists of functional and technical solving of the buildings. According to the previous definition of the architecture we can claim that teaching architecture depends basically on innovation.

One of the most important problems which faces architectural student specially in his first years is how to create the form and how to deal with it in other drawings, the architectural student can easily visualize the relations between the spaces in 2d drawings but he can't imagine the relation between the masses, so the research tries to answer the following question, "how can the Computer Aided Design (CAD) help to improve the architectural student's skills in Creating masses?".

The main research hypothesis is the computer aided design that can help the architectural student in creating masses and it can develop their forming skills which will affect the final product.

The research presents an experimental approach helping architectural student to improve his skills in mass forming by using computer aided design program, the research methodology contains the theoretical and the analytical approaches, theoretical approach defines the design process, the program choosing standards and the measuring indicators. The analytical approach tests the experiment of using CAD in design studio.

2. Design process:

Firstly when we speak about architecture design process we must ask an important question "What is architecture ?", and the answer related to (Belhadj,1989) is: architecture refers to both the activity of designing and the artifact. The close relationship between product and process appears in early forms of architecture, where the same person or group of people conceive, realize and often use a building. Attempts were made to meet an 'anthropology' of architecture, and there is four enumerated distinct ways of generating three-dimensional form described as Pragmatic, Iconic, Analogic and Canonic.

In this respect, there are two distinct structures in designing; a 'vertical' one of the sequential phases, fig. (1), and a 'horizontal' one of iterative cyclic processes, fig. (2). The 'vertical' structure attempts to regulate the development of a design, usually from outline to detailed proposal. Whereas, the 'horizontal' structure is usually in the form of a number of steps in a design process with frequent recycling over a number of these steps. The core of these structures frequently consists of four steps:- Analysis, Synthesis, evaluation and Decision. A design process may consist of hundreds, or may be thousands, of such sequences put together in ways that are determined not by some abstract flowcharts but by the nature of the design task itself (Mahmoud, M. F., 2004).

2.1. USING COMPUTER IN DESIGN PROCESS:

Computer aided design uses in architectural design process in every stage in this process which can be summarized in four categories:

- Computer analysis.
- Computer synthesis.
- Computer evaluation.
- Integrated system (analysis + synthesis + evaluation).

This categorization is still very visible in the large spectrum of existing CAD products, as well as in the research and development of new systems. In a recent review and evaluation of CAD systems for the construction industry, Construction Industry Computer Association (C.I.C.A.). It has been shown that computer programs are being aimed at a large variety of subjects like management, quantities and stock control, accounting, design graphics, structural engineering, services engineering, transport and communications. But there is very few systems are specially 'architectural design' oriented, however, they are largely used by architects. These would cover applications.

In consideration of the above, an appropriate introduction of programs which support designing in the education of future architects acquires particular significance. Unfortunately, it often happens that the so called (CAD) education’ is identified with learning about a chosen computer program and that makes the students passive and unaware users of tools which they are not able to use in a complete way (Walczak A.K., Walczak B.M., 2010).

Many computational tools have been developed to allow the creation and storage of textual and graphical documents. However, the introduction and usage of these tools have not resulted in the substantial and radical innovations predicted by pioneers of CAAD (Computer-aided Architectural Design). This circumstance may be simply blamed on the overtly optimistic nature of such early predictions, or perhaps on the frail creativity of the developmental work in CAAD. It seems, though, that a better understanding of the reasons for the sluggish progress could be important for the emergence of more effective computational support technologies and tools for architectural design and construction.

2.2. CAAD AND RESEARCH GOALS:

The working environment of building designers as well as most of the core activities in the AEC-sector became digitalized during the 1990s (Samuelson, 2002). So the research main goal is to find how CAAD can raise the architectural students' skills in forming, skills of mass forming can be one of synthesis stage of design process, hence the research will deal with the second category computer synthesis which contains several software like (3D AutoCAD, 3D max, Sketch-Up, Cinema 4D), these software programs are samples of available software but The chosen software must take better care of some standards deal with two levels:

1- Students level.
2- using software.

3. Program standard:

Program standard can de dived into two levels of standards first one deals with software program users which must care for their skills in forming and design, it also must be easy in use and modification, has a great ability in forming mass and transfer between 2d& 3d sketches. Second standard deals with the software program itself, it must be easy use, simple enter face, can import and export files from 2d or 3d files and deals with many files extensions.

The researchers have found that the program which meets the previous criteria is (Google Sketch-Up) because of its simplicity in use, widespread , it's sketchy program which makes it suitable for first stage of thinking in design process, it can import and export files from auto cad and deals with 2d&3d drawings, and it has many (plug-ins) containing many architectural details.

4. Indicators:

The research suggests a group of indicators which can help measuring experiment efficiency in raising mass forming students' skills, this indicators can be summarized in:

1- Forming skills.
2- Site analysis.
3- Environmental treatments.
4- Integrated drawings.

4.1. FORMING SKILLS:
Raising forming skills for architecture students is the main goal of the research therefore it is the most important indicator. This indicator measures the mass development and how the program affects the mass concept progress, evaluates mass alternatives, appropriation to the site.
4.2. SITE ANALYSIS:
The program can help students to choose the most appropriate form and helps them to know site determinations, this indicator will show how the student can deal with the proposed site.
4.3. ENVIRONMENTAL TREATMENTS:
This indicator will show the interaction between the form and the environment and how the student understands effects of the environmental treatment on his mass and how to develop it.
4.4. INTEGRATED DRAWINGS:
This indicators show how the program helps students to understand the relations between different drawings and how the mass development can have an effect on the other drawings.

5. The design model

The main idea of the proposed model is to enable the student to allocate the project site using the program (Google-Earth) to place it in the Sketch-Up program, then converting the areas program for the design project to a group of main spatial elements (3-6 key elements), each element has a certain volume of space (as opposed to the traditional idea that depends on flat areas), in the next step the student converts these volumes to vacuum masses using the computer (Sketch-Up Program) and then tries to set these masses into the site as a simple spatial composition to achieve the major functional relations among them and appropriate to the circumstances of the project site and its determinants, and then he starts to develop the emerging mass composition using the various processes of converting masses to reach a suitable configuration that reflects the requirements of the project and highlights design concept of the student. After settling the appropriate mass composition, the student applies the appropriate design module which is balanced with the spatial functions zoning, in order to develop the floor plans in accordance with internal functional relationships and then converts this spatial distribution into the third dimension in integration with the mass that had already been built and makes the necessary adjustments on it. Then the student studies the different treatments for the outer envelope of the mass and applies them directly to the mass to produce integrated spatial mass with all arch. details, fig. (3).
Providing an easy tool for student to help him develop his ideas to 3D models in the early stages of the design process, the student can use such a simple tool to form the mass and unleashes his imagination in creating vacuum formations freely and without the limitation of his physical capacity (skill) in three-dimensional composition process, and without the limitation of his low-capacity of imagination in the third dimension. Then he can review the masses in a 3-d configuration. He can change the mass composition easily by making different 3D compositions then makes many adjustments in the mass by subtraction, addition, integration and all mass conversion processes simply and easily. And with such an easy tool that gives him a wider area to generate and develop ideas, fig. (4).
For sitting the building in the site, the student can (since the first steps) choose the location easily using the (Google-Earth) program and then begins to create its own building within the site. Data and climatic factors will appear on the real site as well as showing the environment surrounding the site, and also he can obtain altitudes of land contours, then he puts his building and begins to originate it due to the surrounding circumstances in a realistic way. Here the student can see the influence of the surrounding environment on its building physically, he can see the effect of the mass which was formed part by part on the site, he begins to see the effect of the heights and spaces and outer envelope of the mass, he can adjust the positioning of the

building in the site and redirects it appropriately, and then he can choose the appropriate form matching with the site boundaries. All that can be seen by the student in 3D and realistic to imagine his building and how it is affected by and on the urban environment, which helps him to achieve integration and coherence of his building within the configuration and the built and natural environment, and helps him to introduce physical and Visual solutions for urban vacuum properly and studies its impact, which helps increasing the ability of the student to make changes in the built and natural environment positively, fig. (5).

The second part related to environmental factors is the ability of the student to easily follow the effects of various environmental solutions used in the design, for example he can notice (building heights – solid and void – extrusions and grooves-...) and study the impact of each of these elements on the shades and shadows of the building or its surroundings, as well as the impact of surrounding buildings on the movement of the Sun and shadows on the project site and he can choose the appropriate places to place mass/masses of the project and choose its appropriate forms. He can study the effect of his building on the formation of internal and external urban spaces. And he can also for example study using a set of sun-breakers (which is available in the program through a set of data associated with the form, dimensions and angles of tilt) and then continues following the impact of using it on the spatial environment configuration (both inside and outside the building), so that any environmental element or treatment that the student wants to use can be chosen and design controlled with ease by following-up to the results of the use of these profiles. So the student can choose the appropriate environmental solutions that lets him achieve more effectiveness and efficiency without the complexities of using the necessary mathematical calculations and design especially in primary design phases of the project, fig. (6).

Using computer in building mass composition from at the early stages of the design process helps to take care of one of the major problems facing the students, where a large section of students go through the process of architectural design in successive stages semi-detached and in one direction (the student begins to think about the site and the building mass then turns to study the floor plans and then moves on to design elevations and the study of the section, and in each one of these stages, the student is totally engaged in the current stage and almost interrupted from the rest of the stages, leading to a weak sense of the effect of lines and designs on the other dimensions of the building, which increase the possibility of the need for frequent adjustments to the work done in the other phases). This frequency between stages doesn't constitute a problem in itself but while increasing separation between stages which increases the frequency of movement between stages and frequently needs to make radical changes, which represent a negative factor affecting student progress in the design project and limits his creative abilities. But when the student starts (since the initial stages) in design mode as a three-dimensional configuration which works on verifying the impact of what was drawn by the designer in the three dimensions, which means the emergence of influence in the plans, elevations and sections simultaneously , increasing coherence between the different stages and makes the student able to link between all the dimensions of the building as he deals with real building. We make the student build the building not draw it, we can call this as building the design concept in three dimensions to occupy the space, here we try to make the student deal with the architectural design process like designing a set of spatial spaces and not as a set of lines, it might replace the design with lines by the design with areas and spatial space.

6. Remarks and Recommendations:

By using application of the proposed model for several times and the students' practice ,we have noticed a number of observations worth highlighting to declare the positive side of the experiment and where we can focus on developing the experiment, we have noticed the evolving capacities of students to create distinct spatial forms more rapidly than their peers who did not use the model, as it turns out significantly increasing in their capacity to develop spatial configuration, and the comparison looks clearly positive for the designs that have non-traditional masses, also we have noticed the evolution of these capacities for students who have experienced the model several times, as well as students who have dealt with computer Software used in architectural design in their early study stages, also a significant positive impact is found on the design phase of elevations as well as section studies and architectural details. In contrast, we have noticed that the use of the computer and its simplicity may attract students to the formative aspects, irrespective of functional or spatial requirements aspects (areas and volumes of spaces), a point that still requires further study, and the problem of that architectural design studios is not ready enough to use the computer during the studio.

While taking our comments on the model into consideration we propose some recommendations which can work on the development of the model in the future, we can focus on:

- The importance of integrating teaching the program in primary courses related to Visual Studies and studies of architectural composition taught to the student in the early stages of his study.
- The importance of providing more recent software that helps students in the design process, such as 3D aerial photos.
- The need of studying how to develop the work environment within the architectural design studios to fit the requirements of using computers in the design process into the Studio.
- The need to include programs for the study and development of architectural structures.

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Figures:

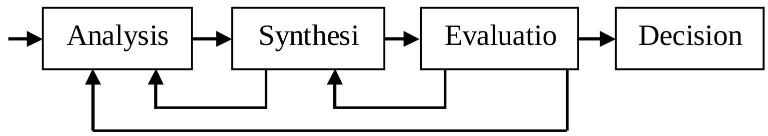

Figure 1. stages of design process (The Linear Model)

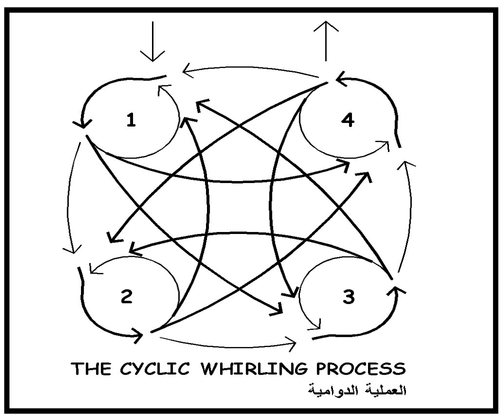

Figure 2. Integrated stages of design process

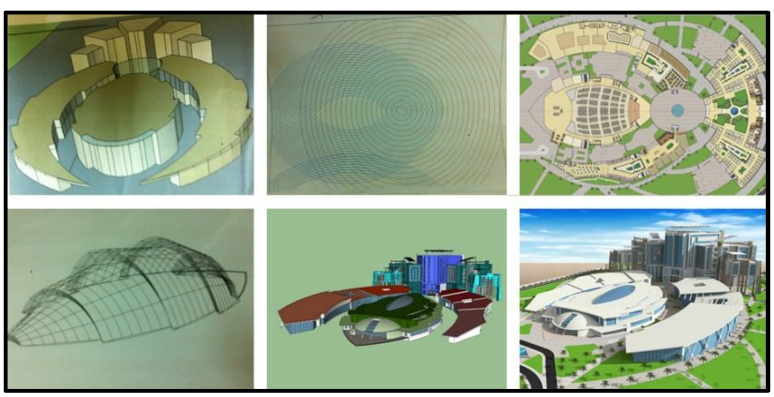

Figure 3. Development stages of a student's project

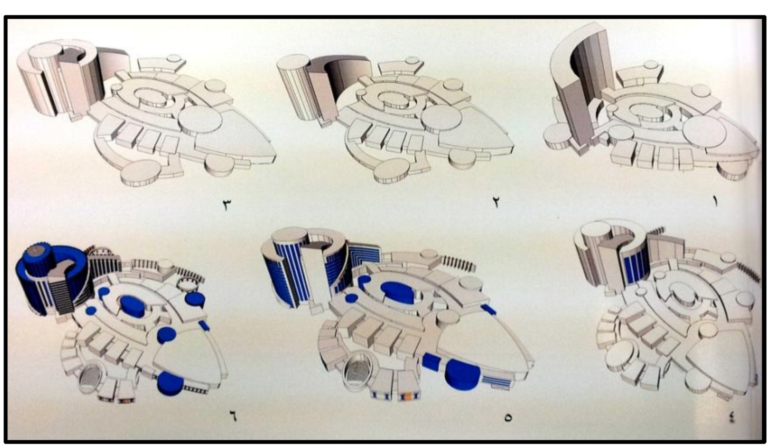

Figure 4. Development stages of form generation

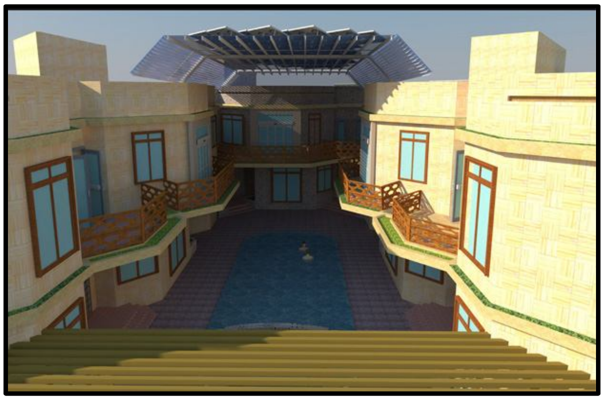

Figure 5. Study of Environmental effect on internal space

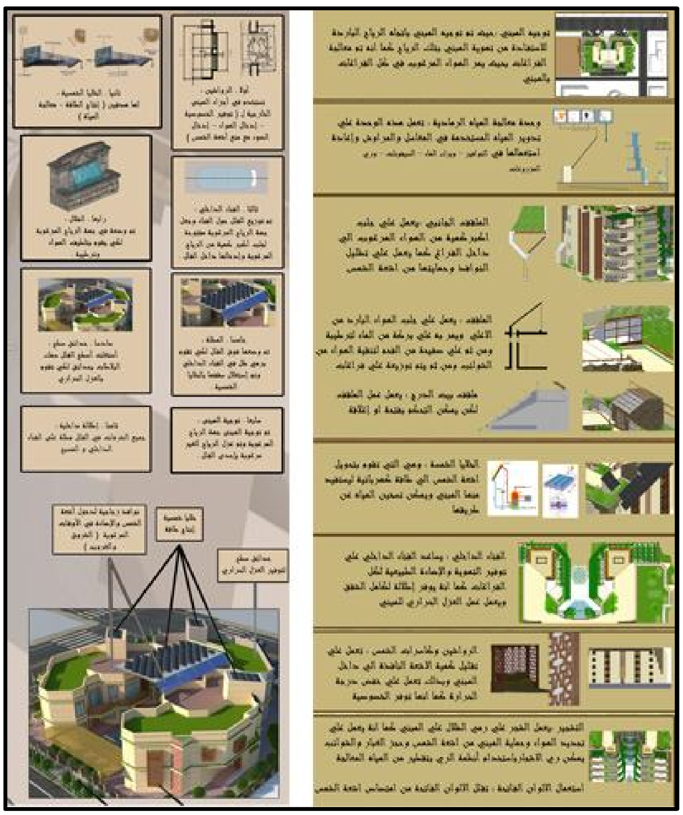

Figure 6. Samples of environmental studies