Assessing The Impact Of Architectural physical Models in Architectural Design Education.

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Abstract

Architectural Physical models can be defined as miniature models that are executed with different materials and different scales to emulate in their final form buildings or structures or urban context...etc, These models can produce to experiments on wind movement, sound echo… etc, and produced also in various phase of the architectural design process, The importance of architectural physical models is clearly through the history, starting from the models of the ancient battlefield until the marketing models which produced to market the various architectural projects, but what is important to this study is these models which produced during the process of architectural design for developing the design.The current conception of architectural design education in most Departments of architecture in varied universities in Egypt could be a mix between manual (freehand drawings, sketches, physical models) and digital approaches, the mix between these two ways ought to be clear by sleuthing once ought to students use the traditional or digital ways.The objective of this study is to assess the impact of Architectural Physical Models use on the quality of architectural design final product, an open-ended questionnaire was designed to measure variables related to students' preferences toward using physical models during design processes and digital modeling program

Keywords : Architectural Design proceses, Concept, models, Architectural Education.

Nomenclature :

APHMs	Architectural Physical Models.
DMPs	Digital Modelling Programs.

1. Introduction

During the last few years, alot of developments in the field of Information and Communication Technology have impacted everyday life. The internet, advanced tools and software are obvious examples of this digital revolution that has affected the process of teaching architectural design, the development of this digital tools over a relatively short time and their continuous advancement and refinement had, and continues to have, an inevitable major impact on many key pedagogical aspects of architectural education.

Although DMPs was introduced into most of the architectural design departments in Egypt, but students are not allowed to use it unless they finish their first two years of the architectural education program as they must, due to their curriculum, to learn the basic hand sketching and other hand communication skills in order to apply it in their designs.

However, in the third to the fifth years they are encouraged to us both methods in design, that are the APHMs and the DMPs, Although this transition is not clearly addressed, thus students are left unable to implement this blend of methods when needed. Moreover, some students are not able to employ DMPs tools in design different processes, for example, they cannot use DMPs to better understand their projects' different components and systems, for example the structure, electro-mechanical, heating, ventilation, and air conditioning, etc. DMPs tools and software are not taught as design or analysing tools or programs, thus students are not able to analyse the environmental aspects of the site.

As a consequence, students are not able to implement their learned skills in DMPs to their design projects in practical manner to deliver integrated designs.

This paper presents a framework to assess the impact of APHMs on the architectural design process and the quality of its product. This framework focuses on a group of indicators that were investigated: architectural program; site analysis; conceptual design development; buildability; and design presentation. This assessment

may reveal certain indicators that can help educators and practitioners to understand the impact of this rapid and radical transition on the architectural design process and thus help to redirect the future of architectural education into a more adaptive and qualitative (Figure 1).

Figure 1. sample of using freehand drawings, Physical and Digital Models.

1.1. The Research problem:

The current concept of architectural design education is a blend of the traditional method of manual use and the modern method of using DMPs in the design process. This paper argues that the transition to the new digital media has been vague and largely ill-defined, which causes several serious pedagogical problems. The introduction of these new tools into design teaching has been combined with a dysfunctional relationship between the tools and the intended end tasks, this dysfunction has resulted in a separation between architectural design and the context of the project, specifically its sense of scale and proportion, and has led to a marked decline in the spatial quality experience and a disproportionate dependence on illustrative techniques. The inappropriate use of the digital tools and the heavy reliance on them, the lack of integration among different digital tools and, more importantly, the absence of effective coordination between theoretical courses and design projects has resulted in a relatively poorer overall architectural design product.

1.2. Research Objective:

The aim of this study is twofold. **First**, this study quantitatively explores students' preferences and attitudes toward the use of DMPs tools and APHMs. **Second**, this study assesses the impact of APHMs on the quality and creativity of architectural design final product by examining design projects. The main objectives of this paper can be as follows:

- What impacts do APHMs have on the overall quality of architectural design in all of its stages (Analysis, conceptual, design development, presentation)?
- What atract student to use APHMs in the design process?
- What is the role of APHMs in an architectural curriculum and its importance?

The overall aim of the study is to examine the impact of APHMs on Architectural design education.

1.3. Definitions:

Architectural Education:

The advance of the information computer technology revolution with the accompanied digital technologies has changed the traditional context of architecture as a profession and in education.
Some studies indicated that digital technologies have been used in architectural schools to challenge the modernizing view of architectural practice (4,9).
Also indicated that digital technologies has affected both staff members and students in terms of their skills and the setting of educational and professional culture. Simultaneously, combining traditional design approaches with digital technology is effectively improving architectural practice. Also digital technologies has been used by schools of architecture to transform architectural imagination and architectural practical possibilities(4).
However, architectural schools are becoming laboratories for various digital design media, and the architectural studio itself has become a space to examine the role of computers in architectural design (3,6,7).

Students have increasing tendencies toward digital technologies and are becoming more skilled and involved in using various design media in their design processes, which, in turn, has affected the traditional design studio culture.
some authers emphasized that digital technologies, as used in the e-studio, can bring important changes to the architectural design process but might have unintended restricting effects (3).
In contrast, some warned that this transformation towards digital architecture should be reconsidered whether in term of practice or education. First, digital tools could replace, the traditional design tools, such as manual sketching that often provides the necessary direct physical link between the hand and the brain. Second, digital tools has provided an alluring, easy, and inexpensive alternative to architectural physical models and has replaced them with a set of seducing graphics that are usually designed to impress the clintes (1).

The disadvantage of using DMPs is to make the students addicted and design their projects without creativity(8), also the use of DMPs by students came as early as the conceptual stage in the investigation of specific formal themes (1). However, many staff members and practitioners have called for a combination of both physical and digital design methods rather than the use of either method separately. Breen indicated that the combination of both techniques gives the designer added insights and more "real" approaches to develop, reconsider and refine any design (Figure 2). Breen also emphasized that the combination of both techniques should be actively incorporated in the educational curriculum to prepare the students as they move toward practice (3).

Architectural Design:

Architectural design is a complex process of creating a coherent structure or system that comprises many unified elements. During the last few years, many theoreticians and practitioners have attempted to define the word "design". some defined it as: "A goal-directed problem-solving activity"(5). Others defined it as "a creative activity that involves bringing into being something new and useful that which display new physical order, organization, form, in response to function"(2). Also defined as "... the creation of a synthesized solution in the form of products, processes or systems that satisfy perceived needs through mapping between the functional requirements in the functional domain and the design parameters of the physical domain, through proper selection of the design parameters that satisfy the functional requirements (10)."

In the last few years, architecture has been influenced by the increasing use of digital technology in the process and in the final outcome of design to meet certain functional, cultural, aesthetic, environmental, and socio-economic needs.

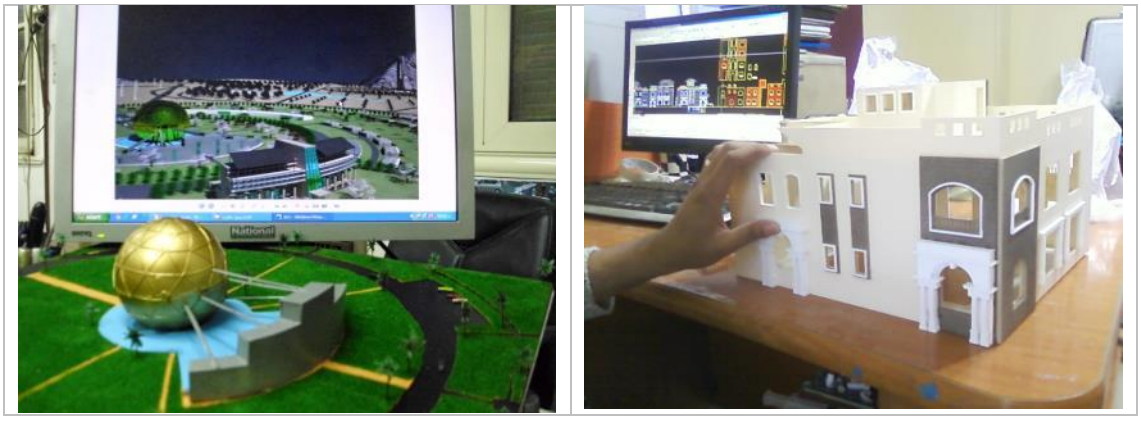


Figure 2. sample of combination of both physical and digital design methods.

2. Research methodology:

The study focuses on the impact of the APHMs use on architectural design projects in schools of architecture in Egypt. three universities in Egypt, namely, Helwan university, College of fine arts, Architecture Department - Arab Academy for Science, Technology& Maritime Transport, College of Engineering & Technology, Architectural Engineering and Environmental Design Department and Modern Academy for Science& Technology, Architectural Engineering Department were selected as the study cases. The following table illustrates the APHMs use assessment methodology which is used throughout this research.

Interviews and Questionnaire Surveys		Students & Staff Members	Criteria to Assess the Impact of APHMs Use		Design Projects
	1	Questions that determine preferences and attitudes toward the use of APHM?		1	Analysis
	2	Questions on the advantages of using APHM compared with DMPs?		2	Architectural Concept
	3	Questions regarding the integration of APHM with other subjects of the Architecture Curriculum?		3	Design Development
				4	Final Presentation
Architectural Design Education Quality					

Table 1. the APHMs use assessment methodology.

This study also used a case-study approach to assemble the main data through the following:

2.1. Interviews and Questionnaire Surveys:

A. **Qualitative interviews:** The data used for evaluation were based on qualitative in-depth interviews that were conducted with a sample of architecture students, and staff members.

B. **Questionnaire survey:** an extensive survey questionnaire was completed by 30 students and 15 staff member in the study area.

The conducted interviews and questionnaire involved open ended-questions based on collected qualitative data from the students, such as students' preferences and attitudes toward the use of APHMs, the types of APHMs used by students, APHMs learning methodology, proficiency level in APHMs, the frequency of using APHMs in different design phases, and the advantages of using APHMs (Table 2).

Main questions	Sub-questions
determine preferences and attitudes toward the use of APHM.	**Q1.** Attitudes toward the importance of APHM compared with DMPs.
	Very Positive
	Positive
	Neutral
	Negative
	Very Negative
	Q2. Priority of using APHM or DMPs
	APHM
	DMPs
	Both
	Others
	Q3. Type(s) of APHM used by students?
	Primary models
	Study models
	Test models
	Detailed models
	Q4. APHM Learning?
	Self-learning
	Architecture Curriculum courses
	Private classes
	All of this
	Q5. The using of APHM in different design phase?
	Analysis

	Conceptual
	Design development
	Final presentation
	Q6. Proficiency level in APHM?
	Very High
	High
	Average
	low
	Very low
Q.7 advantages of using APHM compared with DMPs.	accuracy
	neatness
	speed
	Save money
	Masses impact
Q.8 the integration of APHM with other subjects of the Architecture Curriculum.	History
	Theory
	Environmental
	Structural

Table 2. questionnaire to measure variables related to students' preferences toward Architectural Physical Models (APHM) and Digital Modelling Programs (DMPs)

2.2. Criteria to Assess the Impact of APHMs Use:

Four essential criteria were chosen to assess the quality of the projects with the same score weights that totalled 100. These criteria were:

A. Analysis (25 points).
B. architectural concept (25 points).
C. design development (25 points).
D. final presentation (25 points).

The criteria are basically self-explanatory, but the architectural concept criterion needs some elaboration as follow (Table 3):

(Phase A) shows that project analysis was subdivided into 4 main points according to their responsiveness to their: (1) direct urban context, (2) environmental context, climate, topography, etc.; (3) plot's shape, area and location, and finally Appropriateness of the use of APHMs to develop the overall site design.

(Phase B) shows that architectural concept was subdivided into 6 main considerations. First (1), a philosophical and intellectual basis is adopted to explain the concept and conceptual development and shows how students arrived at their final solution and whether any design reference or precedent was adopted. Second (2), aesthetic and creative considerations refer to the overall formal, spatial and sculptural aspects of the project, including proposed materials, colors, patterns and textures. Third (3), regional and cultural factors refer to how the student responded to the sense of place and whether cultural influences such as local and/or regional architectural heritage had any role in the overall design or architectural trend that was adopted. Fourth (4), environmental considerations include the student's response to the question of sustainability, energy consumption, climatic factors, such as orientation and solar shading devices, etc. Fifth (5), the appropriateness of the adopted trend refers to what degree the design approach has succeeded in being relevant and workable with the overall function of the project. The final Sixth (6) consideration is the degree of use of the APHMs, to develop the final solutions.

(Phase C) shows that design development was subdivided into 3 main points according to their: (1) Use of appropriate structural systems, (2) Submission of full drawings & details , staircases, opening, joints, etc.; (3)

Conform The architectural designs to the building codes applicable in the area, and sure for detected if APHMs assist in to the overall design development.

(Phase D) shows that Architectural Presentation was subdivided into 4 main considerations. First (1), Overall poster design theme and clarity. Second (2), Compliance to 2D minimum submission requirements (plans, elevations, sections, site plan, etc.). Third (3), Compliance to 3D requirements (3D perspectives (exterior & interior), details, etc.). Fourth (4), APHMs: Compliance to submit several study models showing design development at different stages.


(Section A)


(Section B)


(Section C)


(Section D)

Figure 3. sample of using Physical Models in Architectural designs at different Phases.

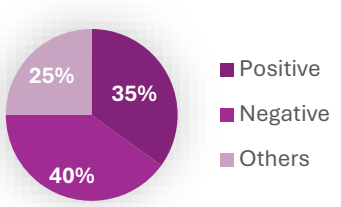
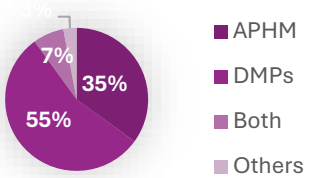
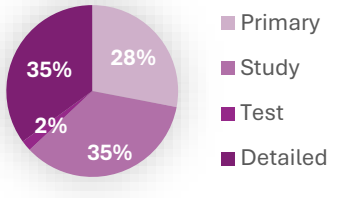
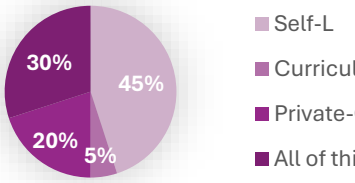
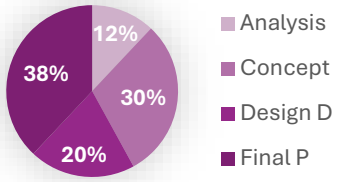
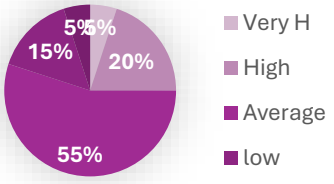
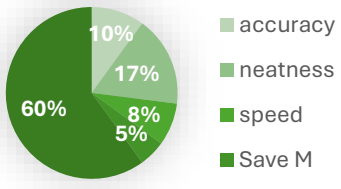
A	Analysis	25 points	1	2	3	4	5	Total A
1	Response to urban context, surroundings and accessibility							
2	Site layout, topography and overall landscape design							
3	Appropriateness of plot's shape, area and location							
4	Use of APHMs to develop the overall site design							
B	**architectural concept**	**25 points**	**1**	**2**	**3**	**4**	**5**	**Total B**
1	Philosophical and intellectual basis adopted to explain the architectural concept to client							
2	Quality of conceptual development and evolution of main design theme							
3	Aesthetic and artistic considerations							
4	Regional/cultural/environmental considerations							
5	Appropriateness of adopted design approach to overall function and context							
6	Appropriate use of APHMs in generating design?							
C	**design development**	**25 points**	**1**	**2**	**3**	**4**	**5**	**Total C**
1	Use of appropriate structural systems							
2	Submission of full drawings & details							
3	Conform The architectural designs to the building codes applicable in the area							
d	**final presentation**	**25 points**	**1**	**2**	**3**	**4**	**5**	**Total D**
1	Overall poster design theme and clarity							
2	Compliance to 2D minimum submission requirements (plans, elevations, sections, site plan, etc.)							
3	Compliance to 3D requirements (3D perspectives (exterior & interior), details, etc.)							
4	Physical models: Compliance to submit several study models showing design development at different stages							
	Total score	**100 points**						

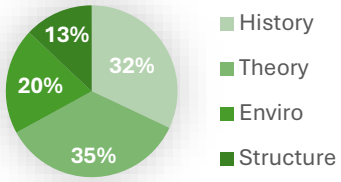
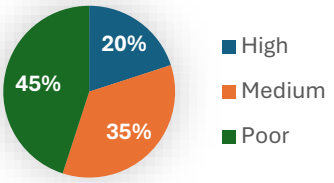
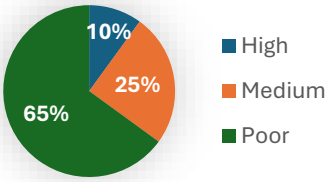
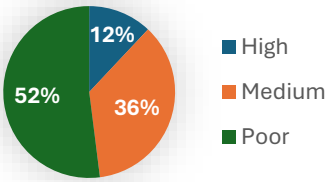
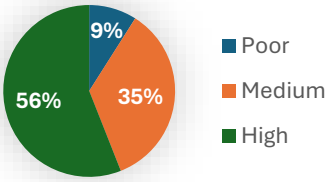
Table 3. Matrix of main criteria assessed for the impact of APHMs on the quality of architectural design product. (scores 1 poor to 5 high)

3. Results of questionnaire & matrix:

The interviews and questionnaire Surveys completed by (50 architecture students, who have acquired and developed various design skills and practices and whose studio work incorporates traditional and new architectural design methods; and 15 staff members from three universities in Egypt (Helwan university, College of fine arts, Architecture Department- Arab Academy for Science, Technology& Maritime Transport, College of

Engineering & Technology, Architectural Engineering and Environmental Design Department and Modern Academy for Science& Technology, Architectural Engineering Department).

Interviews and Questionnaire Surveys	Questions that determine preferences and attitudes toward the use of APHM?	Attitudes toward the importance of APHM compared with DMPs?		40% of case study described their attitudes positively for DMPs
		Priority of using APHM or DMPs?		55% of case study preferred to use DMPs over APHMs
		Types of APHM used by students?		70% of case study usually use study & final detailed model in their projects, 28% use primary models for analytical study and very limited ratio use test models
		APHM Learning?		45% of case study gained proficiency in APHMs by self-learning, and 30% by combination of self-learning, Architecture Curriculum courses & Private classes
		The using of APHM in different design phase?		38% of case preferred to use APHMs in final presentation with full detailed physical model, and 30% preferred to use APHMs in concept phase
		Proficiency level in APHM?		55% of case study evaluate their proficiency level in producing APHMs with average level, however 20% evaluate their proficiency with high level
	Questions on the advantages of using APHM compared with DMPs?			60% of case study seen that APHMs highest advantage is for masses design

	Questions regarding the integration of APHM with other subjects of the Architecture Curriculum?		67% of case study confirmed the importance between APHMs and the subjects (theory& history).
Criteria to Assess the Impact of APHMs Use	Analysis		Only 20% to 35% of the 2nd, 4th year architecture projects had used physical models in analyzing or planning the site
	architectural concept		Only 10% to 25% of the 2nd, 4th year architecture projects had used physical models in creating their concept
	design development		Only 12% to 36% of the 2nd, 4th year architecture projects developed by using APHMs for masses& skins pattern, with little or no attention paid to regional, cultural and environmental or artistic considerations.
	final presentation		Only 9% to 35% of the 2nd, 4th year architecture projects had used physical models in final presentation

4. Conclusions:

This study assessed the impact of APHMs on the design process and on the quality of the architectural final product at differnt architecture schooles in Egypt, which mixes traditional design methods with digital methods, The Analyses revealed that although majority of students were found to have a strong tendency to use DMPs for its various advantages, such as: accuracy, neatness, speed and lower cost, etc. And also teaching architectural design in most of the architectural departments in Egypt does not encourage the use of DMPs in early phase of the design.

Analyses of some of design projects showed that digital models has become very essential, so that other physical models and sketches that address better sensible aspects of design, are excluded. Degital modelling in most of the analysed projects were replacing the physical model. Thus, students' designs were neither realistic nor comprehensive and there were no compatibility between the different set of drawings.

This should be resolved by integrating both: physical and digital methods in design. This integration would increase students' experience of inquiry, discovery and representation and this leads to creativity.

Also we as staff members have the responsibility to teach APHMs courses in creative way, as extension to our creative possibilities.

Finally, physical models and other digital technologies shall be engaged within the architectural design in early phases so that such tools would be used to provide creative design. Moreover, digital technology should be utilized as an essential part of the new design studio culture that integrates with other design subjects and courses in the

architectural education curriculum. Integrating physical& digital technology into architectural design education help to create more responsive designs in terms of: structural, environmental, urban, and other components.

5. References:

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6. Appendix:

P. N	001	Project: **Welling Center in Helwan**
Date	June 2017	

Final Grade: Very Good

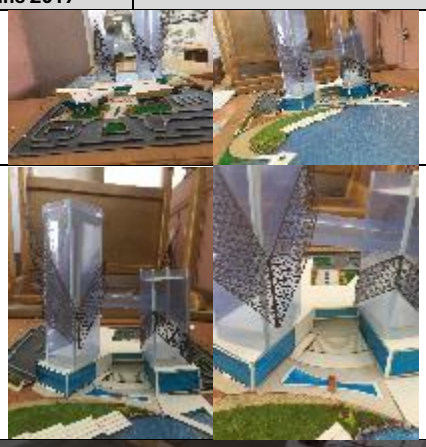
Architectural Phyaical Model

Final poster

P. N	002	Project: **Terminal Gate at Jezert El-Dahab, Giza, Egypt.**
Date	June 2017	

Final Grade: Very Good

Architectural Phyaical Model



Final poster

Sample of student's project in models lap in architecture department College of fine arts, Helwan university.