The Impact of the Digital Design Process on a Traditional Design Studio

Comparative Analysis on the Impact of the Digital Design Process on a Traditional Design Studio

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Abstract: *To apprehend and apply the design concepts is directly related to the content of the education, the participation of the students in the design process and the design media facilities. The computer as a different design media affects the design process and also the design product. Accordingly, as a considerable fact, some of the courses in the architectural education program are based on the digital medium. However, enhancing the integration between the design courses, implemented in the studios, as a main part of the architectural design education and the digital media courses is contemplated as an actual requirement. In this context, regarding to the complement enclosure of this research, considering the affection of the transformations of the design pragmatics to the design educations, the traditional and the digital design methodologies are comparative underscored, and also the contributions of the digital design methodology to the traditional way of artificial manufacturing are analyzed during the development process of the design. For this purpose, the design theories, the digital design methodologies and accordingly the investigation properties about the construction of the theoretical conceptualization of the digital methodology, the approaches about the education and the design methodologies are literally overviewed. This comparative analysis had constituted the main comprehension of this inquisition.*

Keywords: *Digital design; digital model; form; architectural education; design media; interaction.*

Introduction

In the field of design and architecture the discourses of theory and practice of 1990's have encountered significant changes which have intensified with the Non-Standard Architectures Exhibition held in Paris in 2003. These changes can not be claimed as the result of an ideology or any aesthetic concerns, but rather seem to be related to a process of design and production introduced by a new design

environment which has developed around digital technologies. Computer as a new design medium paved the way to the emergence of new concepts resulting with questions on the set of assumptions about the whole design and production processes. This tangible change in the practice of architecture, which was brought about thanks to the possibilities offered by this new medium, has been described as a revolution.

It is a known fact that the act of design is a process of reasoning in which perceptions and logic are central. However, attempts to understand this mental activity and what goes through the designer's mind have not been able to disclose that activity fully and clearly, but are nevertheless meaningful in order to show the paths followed by the designer leading up to the final product. Although it is still being debated whether the process of design in architecture can be scientifically explained or not, and to what extent factors such as the mind, logic, talent and creative thought are determinative in this process, the paths followed by the designer have been formulated in various ways.

The traditional design process can be described as a process based on visualization and developed by drawings and scale models in representational medium. The designer follows a path step by step to the final form where representations in this sense are thought to play an important role. A number of theoreticians claim that representations are an indispensable aid to the designer, and that sketches in particular, by giving concrete form to the designer's ideas, make possible an interaction. Sketches, as a blur and uncertain medium, allow possibility for re-interpretation. However debates about the use of CAD highlight that the CAD medium does not ensure this uncertainty which is essential for conceptual design (Schon and Wiggins, 1992; Goldschmidt, 1994; Suwa, Purcell and Gero, 1998).

These developments and changes in the world of design are having an impact on the content of design education as well. The educational programs of most architectural schools include digital-based classes. However, this study suggests that the integration of computer-based classes with studio classes, which are the focal point of architectural education, is a subject that needs to be further developed. For this purpose, the field study compares the conventional medium and the computer medium with participants who are getting an architectural education having a certain level of computer skills.

In this framework, an empirical study is envisaged to make a comparative analysis of the paper-based medium and the digital medium in design development. The aim is to examine the potentials of the designer candidates who are engaged in the traditional educational process. Thereby, this study will discuss whether the conventional studio education corresponds with contemporary needs and what sort of a contribution can be expected from the interaction of digital design medium into the conventional studio processes in the design development stage.
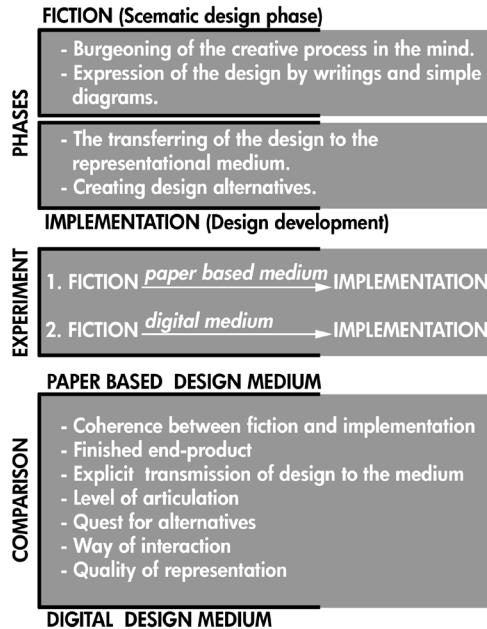
The empirical study

This study introduces the paper-based medium as the conventional medium and the computer medium as the digital medium and compares the two. Ten 3rd and 4th year design students studying at various schools were taken as a studio group. The participants were given 60 hours of Autodesk MAYA classes focused on NURBS and polygon modeling. The experiments were carried out on their design development in both the paper-based and the digital-based medium.

The purpose
The purpose of the experiment is to make a comparison between the conventional design medium and the computer medium by the schematic design thorough the design development stages. In studies on how the designer thinks, great importance has been given to the sketches by being an interaction tool of the designer in the early stages of the design. However it is claimed that the nature of the interaction

FICTION (Scematic design phase)

PHASES

- Burgeoning of the creative process in the mind.
- Expression of the design by writings and simple diagrams.

- The transferring of the design to the representational medium.
- Creating design alternatives.

IMPLEMENTATION (Design development)

EXPERIMENT

1. FICTION *paper based medium* → IMPLEMENTATION

2. FICTION *digital medium* → IMPLEMENTATION

PAPER BASED DESIGN MEDIUM

COMPARISON

- Coherence between fiction and implementation
- Finished end-product
- Explicit transmission of design to the medium
- Level of articulation
- Quest for alternatives
- Way of interaction
- Quality of representation

DIGITAL DESIGN MEDIUM

fertile potentials can be obtained through hybrid processes. In the experiment, an exchange between two media is not envisaged. Nevertheless, the participants were not deprived of the paper medium in the schematic design stage, and engaged in production in different media in the design development stage. In this context, as a higher goal, the experiment is expected to find out clues on how these two media could be used together in architectural education, in order to set forth the relative advantages and disadvantages.

Format

The schematic design stage of the experiment is the transfer of the imagery created in the mind through writing and simple diagrams. The design development stage on the other hand can be regarded as the transferring of the design to the representational medium and development of the design through interaction. Figure 1 shows the format of the experiment.

Evaluation

The given assessments compare the processes, rather than discussing the aesthetics of the final products. 4 design problems were given on different scales, ranging from the design of an object to the design of the envelope of a complex structure.

The experiments form the essence of the empirical study which is the basis of this research. 40 products were obtained for each of the two media, known as the 'conventional medium' and the 'digital medium', and analyses were then made from a set of data for a total of 80 products. These analyses are used to evaluate unique criteria of both two media, and compare the two through the 5 criteria as defined, "**formation strategy"; "formal geometry"**; "**finished end product"; "generation of design alternatives**" and "**level of articulation".**

The thing to do in the field study is to evaluate and compare the questionnaires and experiments collectively in order to be able to reach conclusive judgements. The experiments that are made in this

has now been altered by the incorporation of the computer into design and by the emergence of the phenomenon of 'digital design'.

The field of study

This study focuses on the transformation of design practice within the fields ranging from physical production to a shift in the conceptual paradigm, and argues the change in the design process through experimentation by a data-based method.

The study is concerned with change in the architecture practice and its effects on the educational process in the context of the design studio. By using an experimental method the study aims to collect concrete data on the contribution of the new medium to the design process, through a qualitative assessment based on observation and protocols obtained from the participants.

Instead of considering digital and conventional medium as independent, it is suggested that more

study form the substance of the empirical study. Four experiments have been specified in terms of content, and the participants developed designs both in the paper based medium and also in the digital medium. For each experiment the heading has been specified. Therefore, there are two similar questions in each experiment (e.g: designing a "table lamp" and designing a "street lamp"). The experiment headings so specified are as follows:

- **Experiment 1.** Object Design
- **Experiment 2.** Design of a Crust that Defines a Single Function Location
- **Experiment 3.** Design of a Crust that Incorporates Multifunctional Locations
- **Experiment 4.** Design of the Crust of a Building Complex Incorporating Multifunctional Locations.

The design problems that are given in the experiments are comprised of various scaled objects that increasingly become complex. It was observed that this difference was not a factor that caused important changes in the process of the students particularly at the level of digital design development. Nevertheless, it was seen that some of the participants found it difficult since the concept of scale does not exist in the digital modelling environment in an accustomed way. A similar situation occurred when the point capture tools called as snaps were found insufficient. These are understood from the verbal and written expressions by which the participants expressed their expectations and criticisms regarding the software used.

The data that were acquired as a result of the experiments conducted were analysed and compared both in terms of the characteristics that are specific to the design development used and also in terms of the contents of the common headings specified. In the figuration strategy from among the common headings, it was observed that the two environments did not generate a difference that will cause superiority of any of the environments in respect of deduction and induction approaches. When the figural geometry or in other words the figuration
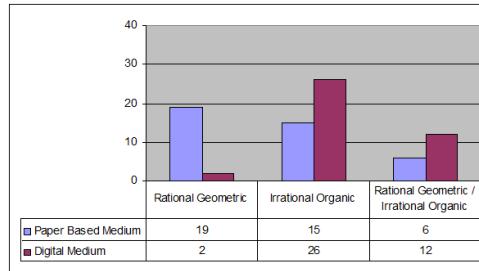

Figure 2
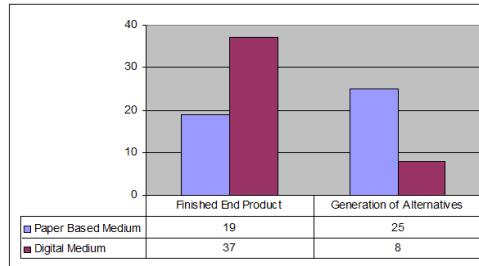*Influence of the design development environment on formation approaches*

	Rational Geometric	Irrational Organic	Rational Geometric / Irrational Organic
Paper Based Medium	19	15	6
Digital Medium	2	26	12

Figure 3
Comparison of products generated as a result of design development in terms of completeness and generation of alternatives
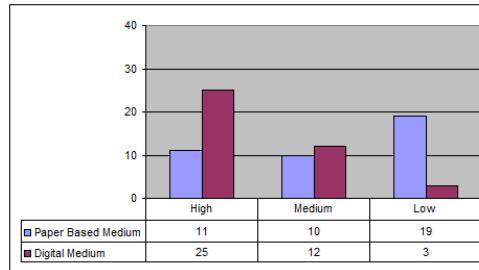
	Finished End Product	Generation of Alternatives
Paper Based Medium	19	25
Digital Medium	37	8

Figure 4
Comparison of formal detailing (level of articulation)

	High	Medium	Low
Paper Based Medium	11	10	19
Digital Medium	25	12	3

structure was assessed, it was determined that in the traditional environment, rational geometric shapes, whereas in the computer environment, irrational organic shapes were mostly used. Within this context, it is opined that when working in the traditional environment, participants prefer using simpler geometric shapes instead of hard-to-represent forms; in the digital environment, however, the same participants feel more encouraged to formulate and represent complex shapes as shown in Figure 2.

As to achievement of completed products which is another analysis heading, it was observed that the digital environment created an important difference

as shown in Figure 3. This may be due to the characteristic of the digital environment to give shapes which are almost complete with only a few instructions or it may as well be related to the fact that the traditional environment which is thought of as a medium in which the initial ideas are expressed faster by the participants is not used actively.

Another heading in Figure 3 is the creation of alternatives. In the experiments that have been conducted, it was understood that the obscure structure of the traditional environment which does not give the prompt result was more influential in the search for alternatives, while the computer environment made it possible to conduct more detailed research on the fast achieved result.

Another difference that drew attention in the experiments was encountered on the subject of formal detailing. It was observed that the samples generated in the computer-based environment were more detailed and processed in the formal sense compared to those generated in the paper based environment as shown in Figure 4. It is opined that the quick achievement of the form in the computer environment resulted in entering into quick interaction with the form and directly focusing on the form that has been reached and the concentration shifted to the detailing of the resulting form instead of formulating new alternatives.

At the time of the experimental implementations, an important assessment was made concerning the usage of the time given. When the participants were observed in general, it was seen that the whole period granted to the participants was not used at the time of development of designs in the traditional environment. In the computer environment, in almost all the experiments, the participants used the whole of the time granted. This leads to the thinking that firstly the students cannot achieve an intense interaction with the environment in which they feel they cannot Express their ideas well and lose their concentrations in such environments in a shorter period of time and deliver their products without using their time fully. Secondly, it is thought
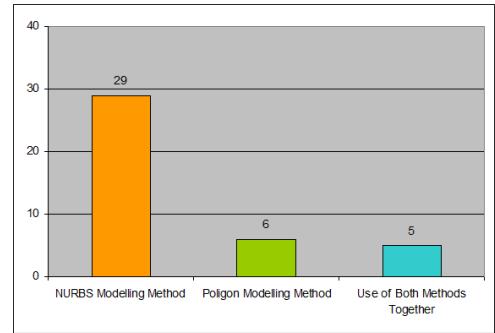

		NURBS	Poligon
Design Thoughts	Intutional	■	
	Algorithmic		■
Formation Structure	Geometric		■
	Organic	■	■
Design Strategy	Deductive	■	
	Inductive		■

that since they have not become fully competent in using the program in the computer environment, they spend their time with trials until they reach the result they want to achieve. However, it has been reached to the conclusion that in the computer environment, loss of concentration is at the minimum level, the students focus on the completed product, they can see the resulting product, they enter into more intense interaction with the environment which they think they can Express themselves better and they are more enthusiastic in working with this environment.

When the characteristics that are specific to the design development environment were analysed, it has become possible to make certain assessments. In the analyses concerning the digital environment, as shown in Figure 5 it was observed that the participants chose the NURBS modelling method based on a more abstract thinking, that is used to achieve three dimensional forms from especially two dimensional curves instead of polygon modelling which is

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8	Subject 9	Subject 10
Paper Based Medium	64,33	52,83	51,88	75,29	37,58	44,33	53,08	91,75	58,33	33,83
Digital Medium	86,67	75,08	82,83	92,13	83,42	80,58	89,17	80,83	74,08	84,00

mostly more visual. It is thought that this situation is, in addition to the purpose to quickly generate a form, part of the habit of the design students, who are used to work traditionally on the plan and segment platforms, to perceive the three dimensions from the two dimensional lines.

There is the belief that the NURBS modelling method makes intuitial interaction with computer possible. When the visual and written records of the participants were analysed all together, it was observed that if in the imagination they think they are close to achieve a net from the polygon modelling method may be preferred, and if a net form has not been imagined yet and if the search for it is still continuing, the NURBS modelling method is mostly preferred. At this point, it is thought that the participants tried various section curves and different instructions to form three dimensions and received more feedback on the generated forms and continued with these tries until they become satisfied. In addition, it was observed that, frequently, searches directed at the environment and materials such as the light, shadows, permeability were used in the products in the digital environment. The matrix in Figure 6 shows the utilization of NURBS and polygon modeling techniques in terms of design thoughts, formation structure and design strategy.

In the traditional environment, at the stage of design development, three dimensional researches were demanded, and it was observed that although two dimensional plans, sections and viewing works were left free, two dimensional expression habit was continued. In addition, except for certain samples, when observed generally, findings that effects like light, shadow and materials were not taken into consideration and that no attention was paid to the manner of using papers and composition led to the belief that the participants were not at the anticipated level in terms of knowledge and skills for active use of the traditional environment.

It was seen that computer environment comes to the forefront in the evaluation ability/success with the criteria specified within the context of use of design development environment. Figure 7 shows that nine out of ten participants were more successful in the computer environment. This evaluation is
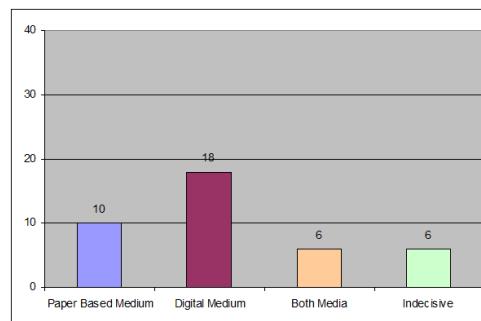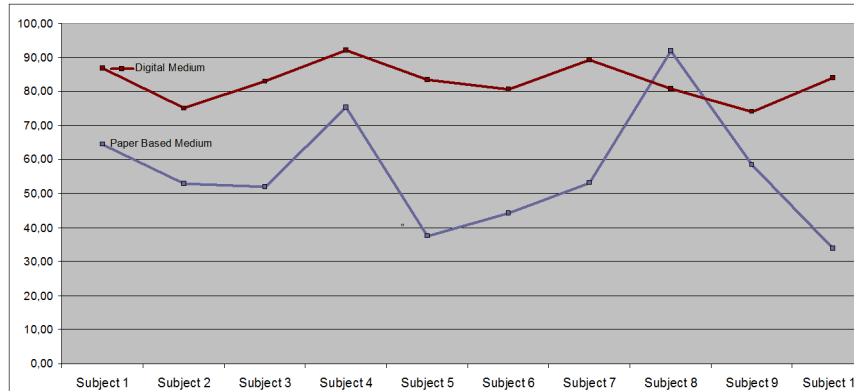
consistent with the self-assessment of the users as seen in Figure 8.

An important finding in this respect is that the graphic created in the computer environment is more stabile, whereas the graphic created in the traditional environment is wavier as seen in Figure 9. This means that when the use of the traditional environment where hand skills comes to the forefront is analysed in terms of design development, a significant difference was observed among the participants. Thus it was observed that easily-acquired computer skills made students better masters of media, and hence increased equity among them.

Discussions and results

This study considered the design as a problem solving process and it is thought that the design environment used during this process play a significant role in shaping the ideas through the interaction in terms of technique, technology, and tools used in the formation and development of the design. The representation environment is the environment where architectural thought is given a form; the technical and technological possibilities of this environment are tools that help development of architectural thoughts. Therefore, changes and developments that are experienced in the representational environment or technique create new vision, perception and comprehension of shapes relating to design and thus becomes the agent of the new ideas created.

In this study, the results have been reached by way of a qualitative assessment based on protocols (questionnaires and experiments) gathered from the participants who are currently undergoing traditional design education.

It is evident that the participants have a certain degree of knowledge on design, act of design and design process. Nevertheless, –perhaps as the reflection of the education program of the departments they are currently studying at- it was observed that the traditional environment is seen as an environment for design development whereas the digital environment is mostly seen as an environment for drawing and presentation. In the assessment made after the experiments, it was determined that the participants showed progress in terms of awareness and knowledge in respect of design development and interaction with environment, and that they showed progress positively in using both environments for design development purposes at the early stages of the design. It is understood from the preferences made by the participants that they benefited from this study on issues such as shape forming; three dimensional perception, ability to work more comfortably on rational geometric and irrational organic shapes; ability to setup location and shape relationships.

When the statement of Nigel Cross (1999) that "the ability to design is a part of human intelligence, and that ability is natural and widespread amongst the human population" and his definition that "designing is something that all people do; something that distinguishes us from other animals, and (so far) from machines" are considered, the following question may evoke in minds: while the traditional environment which brings to the forefront the hand skills that make the designer distinct from others in terms of the design, does the digital environment which can be taught in a systematic way contribute to making the design something which can be done by everybody and make the design anonymous? Is the thing, which renders a designer distinct from others, the knowledge and experience of the designer as well as his hand skills in the traditional environment and his competence in using the software in the digital environment? In this study, although we achieved having a certain impression, since the setup of the study was not formulated for the competent designers but for candidate designers, it has not been possible to make and it has not been aimed to make any inferences. However, this may be beneficial for subsequent researches to be conducted in this respect.

As Bermudez states (1997), "The architectural practice and education of tomorrow is not *ahead* in the digital but *between* the analogue and the digital; and not in *one* medium/approach but in *many* media/approaches. In other words, *hybridity* and *multiplicity* share the road to the future". In the design education environment, the student, the instructor and the tools used in education are components that mutually influence each other in cause-effect relationships. In such an environment, in which design problems and solutions take an infinite variety of forms and approaches to design differ due to different individual perceptions and psychologies, it is believed that the representational media and choice of tools in a studio class-centered, application-oriented educational model such as design education in particular need to be variable and flexible in structure

and that both teacher and student need to be able to adapt to this flexible structure. As a conclusion this study supports that the traditional design studio needs to be transformed into mentioned conditions of design practice, which ensures the possibility of using multiple media and in which the requisite physical conditions and computer hardware are provided as well.

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