The Transformation of Knowledge In Urban Design Studio

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***Abstract*—** The purpose of this study is to examine how do architectural students transform their knowledge and data obtained at the design session, to form their decisions in the various design phases. For this purpose, a model that examines the transformation of knowledge by means of analyzing students representations, has been developed. This model was correlated with the data collection model about the design problem. Solutions demonstrated through time line, indicated the relationship between the two models, and were examined out if the designer was reformed data spatially, functionally, symbolically, typologically, technologically, or socially. The implementation of the proposed models has been fulfilled by a case study carried out at the urban design studio at the Department of Architecture at Mosul University which protracted for one semester, and the results were demonstrated graphically to declare the impact of each item of the second model on the various design phases.

***Keywords*—** Design Phases, Knowledge Transformation, Urban Design.

I. Introduction

SINCE architecture is created in a field of tension between reason, emotion and intuition, it is common to say that architectural design pedagogy should be viewed as training toward the manifestation of the ability to conceptualize, coordinate, and execute the idea of building. However, this mandates a comprehensive understanding of the role of knowledge in architecture while understanding how to integrate different modes of knowledge production.

In most teaching practices, architecture students are typically encouraged to conduct site visits and walkthrough the built environment in order to observe different phenomena [1]. As a result, students perceive the built environment as a set of data which positioned as a background knowledge that consider as an input into the process of producing final design.

The fundamental issue in this understanding is; how does these information translated into a design product? And is it true to say that these information are necessary to produce design solutions or the designer subjectively produce their design product with a minimum consideration to the data gathered about the design problem.

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II. Design Knowledge

The movement from modernism to post-modernism has slowly been reflected in a changing approach to design. The modernist movement has encouraged the perception of the designer as omnipotent artist and creator, making decisions based primarily on aesthetic, financial, theoretical, and political concerns. The move to post-modernism has placed a greater emphasis on issues, such as social responsibility, sustainability, environmental responsiveness, environmental integrity and human health [2].

The complexity of these issues is encouraging urban and regional planners, architects, interior designers, and landscape architects to identify data as an essential component of responsible planning and design processes [3]. The relationship between data and design has been discussed extensively in the literature [4],[5],[6] in an attempt to reconcile traditional forms of design understanding and the body of available design knowledge. In order to resolve this issue, it is important to understand how designers view and use data in their work.

III. Sources And Type Of Design Knowledge

In Knowledge Management science, it is usual to distinguish four dimensions [7]:

Data. "External sign material produced by events". Information. "Interpretation entails the production of meaning, which transforms data into information".

Understanding. "Connects and transforms information into beliefs or claims of causal or deductive insight".

Knowledge. "A meaningfully ordered stock of information and understanding, plus ability to transform it into actions, which yields performance".

Dimensions of knowledge are considered to be useful and capable of facilitating knowledge acquisition. The distinction between the explicit and implicit design knowledge also brings some clarity into the application of the natural tools and knowledge acquisition. 'Explicit knowledge' refers to knowledge that is transmittable in formal, systematic language. There is also 'implicit knowledge', which is personal and hard to formalize and communicate [8].

Goel [9] argues from his analysis of set of experimentally gathered design protocols that, the primary source of knowledge moved from being the design brief and the experimenter to being the subject of the designer. Goel broke

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the design process down into a series of stages which he called 'problem structuring', 'preliminary design', 'refinement', and 'detail design'. However, what is interesting about Goel's data is that the designer was the chief source of knowledge in all four of his stages. This strongly suggests that the vast majority of the knowledge used to solve the design problem was brought into the process by the designer. In the opposite, Lawson [10] suggest four source of knowledge which he called; legislators regulators, paying clients, users and designers makers "Fig.1".

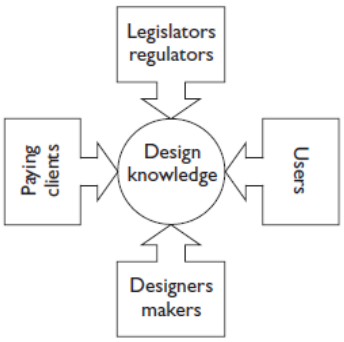

Fig. 1 Lawson's sources of design knowledge constraints [10]

Lawson affirmed that in design studio the more reliable knowledge is what students conceive implicitly, and this is one of the serious failings of the 'laboratory' gathered design protocol upon which a great deal of our understanding is based. Perhaps this is also one of the failings of the studio system in design education. Most projects done by students in design subjects are completed with little or no real contact with an actual client, a potential user, or a legislative.

Ivashkov [8] believes that as the amount of consistent knowledge increases, so the impact of the decisions taken decreases. Therefore designers have a computational support in the design process after the moment "(D)" and need to shift this moment back to an earlier moments in the design process "Fig.2".

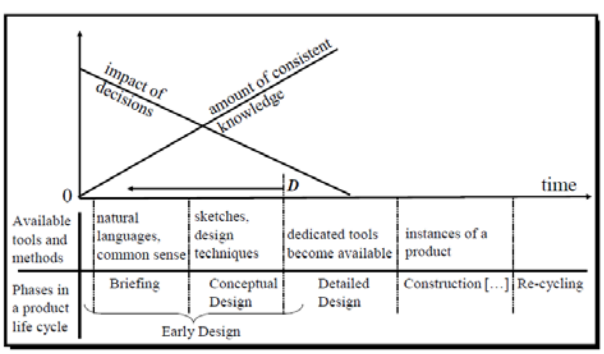

Fig. 2 The impact of decisions versus the availability of consistent knowledge. [8]

IV. Design Process And Design Knowledge

Traditional models of the creative process see the design process as a series of identifying problems and outlining solutions. Asimow describes the process as a series of loops, firstly a problem is analyzed, then synthesized before a solution is optimized and finally implemented. Although this type of model clearly illustrates the resolution of problems, Broadbent [11] describes the design process in terms of two elements, conjectures and refutations. Broadbent argues that the designer moves through a series of conjectures (ideas) and refutations (the abandoning of ideas), refutations being based on observations and experimentation.

Zeisel's [12] model of the design process is similar to Broadbent's proposition. He sees the designer accepting or rejecting ideas based on an analysis of images which he/she produces. Zeisel's design development spiral explores the architectural design process "Fig.3", illustrating how the designer through a series of 'conceptual shifts' and 'looping' structures moves through the creative process.

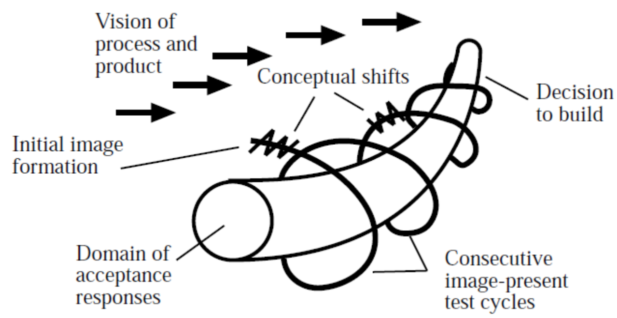

Fig. 3 Zeisel's design development model [12]

Although the models identified by Broadbent and Zeisel do not explicitly describe how designers use information sources within the design process, they do appear to suggest that information sources are used as a means of refuting ideas, or conceptually changing the focus of the design brief.

So which information resources do designers consult and why are those information resources consulted whilst others are ignored or rejected?

Powell [13] in his survey of the architectural design process has suggested that Broadbent's model of the design process is 'idealistic'. Powell concludes that within actual working design offices the process of design can be seen as a process of conjectures and confirmations and not conjectures and refutations. Powell argues that this switching of refutations to confirmations is mainly due to the lack of time within a commercial office [13]; he notes that architects 'lay greater emphasis on early and robust conjecturing, rather than what to them would seem time-consuming refutation.' Powell continues by asserting that designers 'often strongly pre-structure their views of problems given to them, in order to produce a reasonable solution within the inescapable restrictions of both time and resources.'

Russell [14] uses a similar argument when he writes that 'style is at the root of expressive interaction' and that designers work within a 'private frame of reference'. Powell actually notes that designers do not seek alternative solutions, but desire reinforcement of their ideas.

MacKinder & Marvin [15] reach a very similar conclusion and note that 'designers relied (instead) on previous personal experience and only used technical references as a means of finding solutions to ideas that had already been generated.' In a recent study of design students.

Durling [16] identified that although designers are noted for ideation and divergent thinking, intuition plays a large role within the creative process. Durling indicates that certain types of information, not necessarily different mediums, are preferred by design students within the design process. He notes several information characteristics which designers look for in their information sources [16]:

A. *information which begins with the big picture, concepts and then gives details;*
B. *information which has a light overall structure;*
C. *information with a guided explanation that allows intuitive inquiry;*
D. *information that gives alternative viewpoints;*
E. *information which emphases objective data;*
F. *information which is presented in a logical and analytical format;*
G. *information which is based on product exemplars.*

Although these characteristics are useful, it is important to remember that Durling's study was based upon student responses and not practicing designers [16]. However when comparing Durling's conclusions with the observations made by Powell [13], there is at least one similarity; designers have a preference for trade literature (product exemplars). In reaching this conclusion, Powell notes that designers use this type of material for several reasons, firstly; because this material is presented in an 'easy to understand' format, it could be argued that it uses the same 'language' as that used by the designers themselves (note the use of diagrams, illustrations, color charts, etc., rather than scientific or theoretical writing), and secondly; the information resource is considered by the designers as reliable, having been produced by a reputable manufacturer [17].

In his analysis of trade literature, Powell however identified several problems with this type of information with regard to providing the right type of information for designers. He noted that 'trade literature' rarely presents a 'holistic understanding' of a whole project. It normally identifies only a partial solution and does not permit the designer to make subtle design alterations, not allowing the designer to make new design strategies. The findings of Powell [13] appear to suggest that the 'ideal' design process is at conflict with the reality of the pressures of the design studio; where time and resources do not permit the designer to explore all possibilities.

However we can argue that design knowledge consulted by the designer plays a significant role in the design process, for it is on the basis of this material that the designer moves from initial conception to complete design.

V. Research Objectives And Methodology

A. *Objective*

This paper seeks to conduct the type and the way that knowledge could be adopted into design session at the urban design studio, to do so it is necessary to break down the design session into four phases: Pre-elementary design (concept generation); elementary design; evaluative design, and final design (product).

This model of the design sequence is allocated through timeline last for twelve weeks (Fig. 4). Prior to the design session there were a four weeks' time for students to conduct the site and collect data about the design problem. These data were classified according to the following categories:

Pragmatic inquiries (e.g. land use, functions, traffic flow, pedestrian paths,….etc.).

Visual analysis (e.g. building heights, landmarks, visual axis, ….etc.).

Typological survey (e.g. spatial arrangements, façades, styles… etc.).

Finally the collected data report submitted to the instructors as a partial fulfillment of the design assignment.

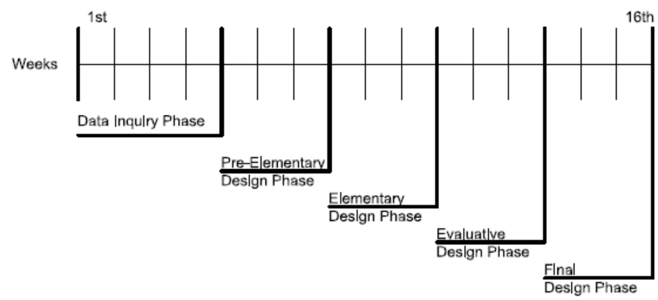

Fig. 4 Design session timeline

B. *Design Assignment*

The case study consist of (30) fifth year students sample who participated at the urban design studio at the Department of Architecture at Mosul university. The design assignment consist of urban infill project located at one of the main nodes at Mosul city. Instructors shortly explained the assignment and instructed students to the main objectives of the design problem which were:

To solve the traffic flow at the node and support adjacent uses with sufficient parking and transportation facilities.

To revitalized and renew existing tradition and valuable buildings.

To create vital and adequate buildings integrated with the existing.

To be aware of the deferent building styles at the district.

The above objectives should be confirmed by design concept, improved gradually through time line and the instructors consulting to reach the final design proposal.

Procedure

Data collection phase were judged through time consuming spend by the students at each item of the information and were converted in a form of percentage ratio corresponding to the total time "Fig. 5,6,7".

Each design phase (as mentioned in *A*, above) last for three weeks and was assessed by a jury consist of (6) senior teachers at the studio to confirm if the student reformed data spatially, functionally, symbolically, typologically, technologically, or socially. The judgments were transformed in a form of units with (0-10) score corresponding to those items and distributed according to the design phases.

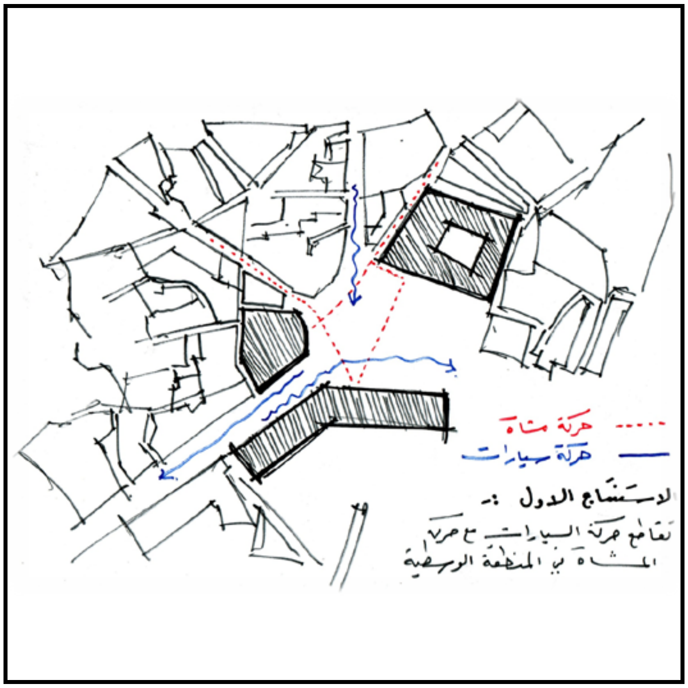

Fig. 5 A sample of traffic and pedestrian flow analysis.

Fig. 6 A sample of visual analysis.

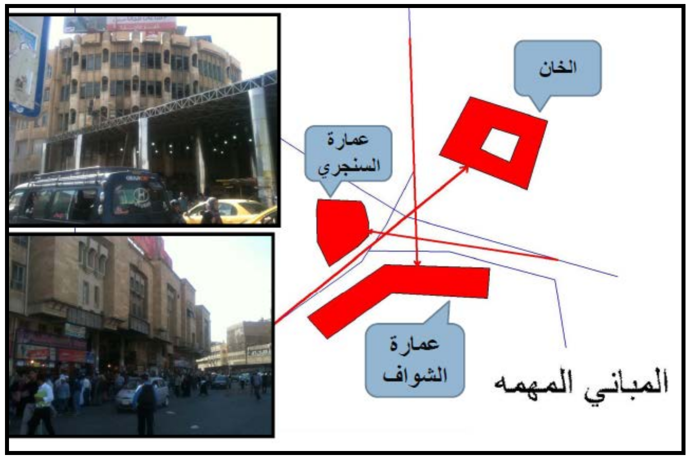

Fig. 7 A sample of typological study.

VI. Data Analysis

"Table I" express the rated ratio of time spend by the student to each type of site inquiries. The average indicated that the most inquiries focused on the pragmatic matters, the less was the ratio related to the typological survey, that is related directly to the type and location of the design problem, and consequently to the nature of assignment objectives.

TABLE I
TIME RATIO OF THE ASSIGNMENT INQUIRIES

ID.	Pragmatic inquiries ratio	Visual analysis ratio	Typological survey ratio
1	57.14	21.43	21.43
2	38.64	38.64	22.73
3	34.62	46.15	19.23
4	37.14	22.86	40.00
5	54.35	26.09	19.57
6	39.62	22.64	37.74
7	46.88	28.13	25.00
8	63.64	18.18	18.18
9	63.64	18.18	18.18
10	65.71	22.86	11.43
11	54.29	37.14	8.57
12	43.75	43.75	12.50
13	64.71	17.65	17.65
14	43.75	43.75	12.50
15	54.55	31.82	13.64
16	55.56	27.78	16.67
17	47.37	34.21	18.42
18	52.27	20.45	27.27
19	53.85	20.51	25.64
20	51.35	33.78	14.86
21	41.38	22.41	36.21
22	46.48	22.54	30.99
23	33.90	30.51	35.59
24	45.24	38.10	16.67
25	54.35	30.43	15.22
26	48.84	30.23	20.93
27	34.72	41.67	23.61
28	38.89	47.22	13.89
29	44.07	40.68	15.25
30	34.88	27.91	37.21
Avg.	48.18	30.25	21.55

"Table II" indicates the various average scores given to each student by the jury according to his/her design

TABLE II
A SAMPLE OF UNITS GIVEN TO STUDENT ACCORDING TO SENIORS JUDJEMENT DURING EACH DESIGN PHASE

ID.	Spatial	functional	symbolical	Typological	Technological	Social	Pre–Elem.	Spatial	functional	symbolical	Typological	Technological	Social	Elementary	Spatial	functional	symbolical	Typological	Technological	Social	Evaluation	Spatial	functional	symbolical	Typological	Technological	Social	Final
1	8	5	2	8	3	4	30	7	6	6	5	3	6	33	8	8	7	5	4	7	39	7	6	5	4	3	5	30
2	8	9	9	9	5	8	48	9	9	9	9	7	8	51	9	9	9	9	8	9	53	10	9	9	9	9	9	55
3	4	3	2	4	2	3	18	7	6	5	5	2	5	30	8	7	6	6	4	5	36	8	7	6	6	4	5	36
4	6	5	4	3	2	4	24	8	8	7	6	5	6	40	9	8	8	6	6	7	44	9	8	8	7	6	7	45
5	8	7	7	5	4	5	36	8	7	5	5	4	4	33	8	7	6	5	4	5	35	8	8	6	5	4	5	36
6	6	4	4	5	3	2	24	8	7	6	5	4	6	36	8	8	7	6	5	7	41	8	8	7	6	5	7	41
7	8	6	5	6	4	4	33	8	8	7	6	5	6	40	9	8	8	6	5	6	42	8	8	7	5	5	6	39
8	5	4	4	4	3	4	24	7	6	5	5	5	5	33	8	8	6	6	5	6	39	7	7	4	4	5	6	33
9	5	4	4	3	2	3	21	7	6	5	3	7	3	31	8	7	5	5	7	5	37	8	6	5	5	7	5	36
10	5	4	3	3	4	5	24	7	7	5	5	4	4	32	7	8	5	5	4	4	33	8	8	6	6	5	6	39
11	5	4	4	3	2	3	21	7	7	5	5	4	6	34	8	8	6	6	6	7	41	8	7	5	6	5	5	36
12	6	5	5	4	3	4	27	7	7	5	5	4	5	33	8	8	6	5	4	6	37	8	7	6	5	4	6	36
13	8	5	7	4	3	3	30	8	8	8	7	5	5	41	8	8	8	7	5	5	41	8	7	7	7	5	5	39
14	8	5	7	4	3	3	30	8	8	8	7	5	5	41	8	8	7	7	5	6	0	7	8	7	6	5	6	39
15	8	9	7	7	5	6	42	9	9	8	8	6	7	47	9	9	8	8	6	8	48	9	9	8	8	6	8	48

performance during each design phase, and corresponding to design items mentioned in (*C*) above.

Using (SPSS Ver.11.5) package, data inquired items allocated into a multiple regression equation as a dependent variables, with respect to the student performance credit at each design phase as an independent variable, to investigate its correlation with this item, and the results were tested statistically to declare its significance in these phases.

Using enter regression method each equation declare the correlation between variables and remove variables that does not have enough weight to interpret the variance in the dependency.

To use these regression equation efficiently, we focused on the (Beta-Weight) coefficients (Table III), which were indicating the relative effect of the variable into the overall regression.

We also pay attention to the (R Square) correlation coefficient which stated the strength of the regression equation and indicated if the correlation between variables could be found reliable or not hence the efficiency of the causality interpretation between these variables.

It is reasonable to confirm that the excluding of the regression equation done due to the purpose of our research, since there is no need to predict the behavior of the dependent variable in the regression equations, so that we had to adjust these equations to be most reliable, instead the most vital is to induce how does each data obtained from the inquiry affected the output of design phase.

It is also important for us at this stage to declare were the "Explicit knowledge" obtained during design session, is the most important to generate design product, or that the designer depends mostly on his/her "Implicit knowledge" which is very personal and hard to formalize and communicate.

TABLE III
BETA WEIGHT FOR EACH VARIABLE INTO THE REGRESSION EQUATIONS

Dep. Variable	Beta weight for pragmatic	Beta weight for typology	Beta weight for visual	R. Square
Pre-elementary design phase				
Spatial	0.00	0.32	0.39	0.24
Functional	0.00	.0.04	0.04	0.73
Symbolical	0.00	0.22	0.02	0.64
Typological	0.00	0.22	0.10	0.15
Technological	0.00	0.21	0.28	0.31
Social	0.00	0.10	0.20	0.32
Elementary design phase				
Spatial	0.00	0.01	0.03	0.73
Functional	0.00	0.18	0.27	0.13
Symbolical	0.00	0.82	0.61	0.58
Typological	0.00	0.69	2.00	0.13
Technological	0.00	1.86	2.59	0.24
Social	0.00	0.22	1.73	0.45
Evaluative design phase				
Spatial	0.15	0.92	1.02	0.45
Functional	0.17	2.52	0.49	0.77
Symbolical	0.30	0.17	1.53	0.51
Typological	0.30	1.80	2.30	0.55
Technological	0.29	0.79	0.68	0.67
Social	0.29	0.03	1.28	0.57
Final design phase				
Spatial	0.17	0.38	3.05	0.17
Functional	0.19	0.86	3.89	0.66
Symbolical	0.25	2.08	4.19	0.81
Typological	0.32	0.05	2.99	0.82
Technological	0.30	0.95	0.23	0.66
Social	0.30	0.82	0.83	0.66

VII. DISCUSSION

It is clear from the results above, that the data obtained by the designer during the inquiry phase was useful to conduct the site and to understand and close the design problem, in addition we can notice the followings:

1- The ratio of the time spend at data collection decreased starting from pragmatic inquiries to the visual analyses and finally to the typological survey, which means that the pragmatic analysis of the site is the most important issue in the data collecting.

2- Most of the inquired pragmatic data are with zero beta weight correlated to the various pre-elementary and elementary design phases items. But both typological and visual inquired data are presents in the correlation to the various items at all design phases.

3- At all design phases the sum of beta weight of the pragmatic inquired data is 3.03, the sum of beta weight of the visual inquired data 16.26, and the sum of beta weight of the typological inquired data is 30.74.

4- The distribution of design items beta weight correlated to the various collected data augmented gradually starting from the pragmatic data, "Fig. 8", to visual data, "Fig.

9", and finally to typological data "Fig. 10", which means that the typological issues

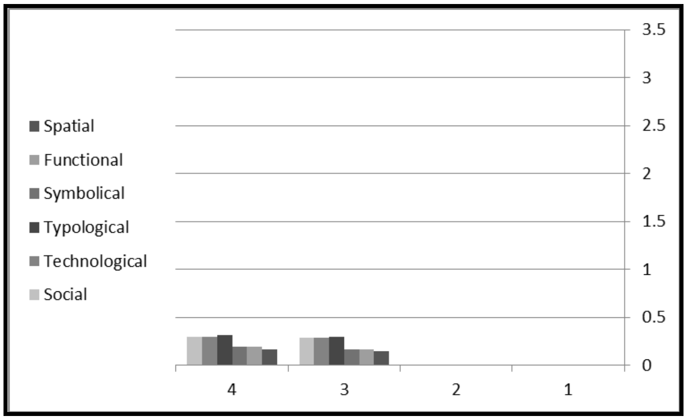

Fig. 8 The distribution of design items beta weight correlated to pragmatic data at the design session.

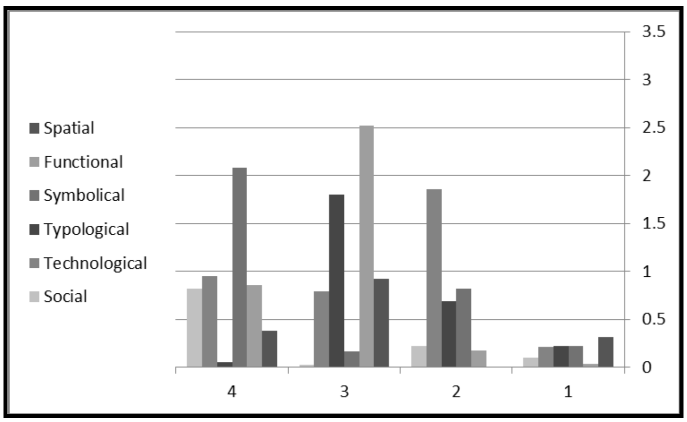

Fig. 9 The distribution of design items beta weight correlated to visual data at the design session.

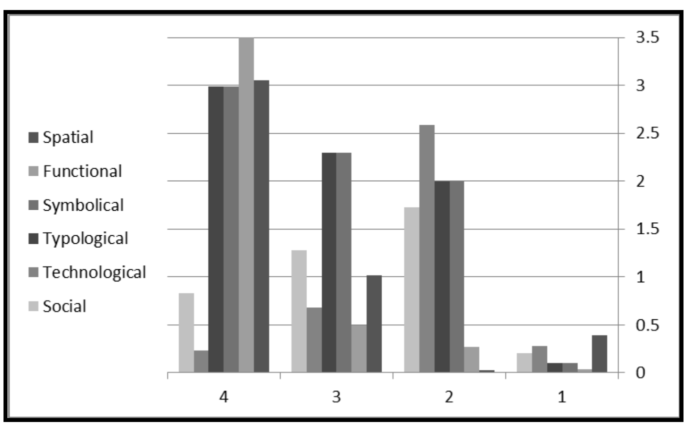

Fig. 10 The distribution of design items beta weight correlated to typological data at the design session.

5- The average value of (R square) at pre-elementary design phase and elementary design phase is below 0.5 which refer to the weakness of the regression equation at these phases, and means that the knowledge gained by the designer seldom affected the concept generation.

6- The average value of (R square) at evaluative design phase and final design phase is above 0.5 which refer to the strength of the regression equation at these phases.

VIII. Conclusion

It is clear that although the designer get benefit from the data collected into pre-design phase (since they are approximated in their average ratio in the time spend to collect each type), but it seems that there is a different advantage of using each type of data to produce design solution "Fig. 11,12,13,14".

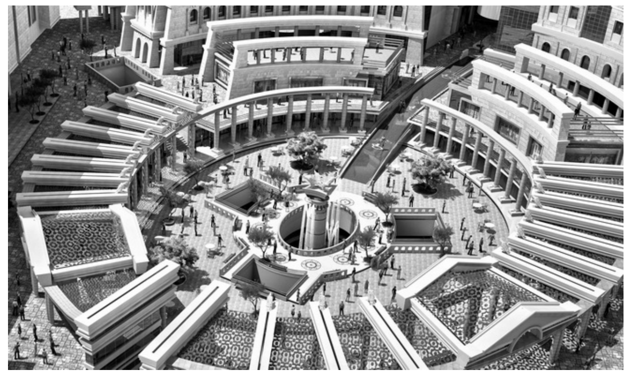

Fig. 11 A sample of designer final product 1

Fig. 12 A sample of designer final product 2

Fig. 13 A sample of designer final product 3

Fig. 14 A sample of designer final product 4

Although the pragmatic data that obtained by the designer is the most time consuming, but its usage delayed to the late design phases which sound to be reasonable due to the nature of the design session and its objectives, since the designer started his/her solution by creating masses and arrange the whole composition.

In the opposite, the more reliable data are those related to the visual and typological inquiries which are seems to be more valuable in the conceptual phase.

There is another important notice which is that the designer mostly depend on his/her implicit knowledge at the conceptual design phase, which means that the concept generation is the product of the designer background and personal information. But the designer cannot improve his/her product during the post design phases unless he/she take into consideration the data conducted from inquires.

Finally we cannot assumed that this study covered all about knowledge transformation issues into various design phases, but we hope that it -at least- highlights some of them.

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