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An interaction form generation tool: EduDesign

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Abstract

This paper investigates contributions of customized and simplified generative design tools on the development of novice architects' abilities of accelerating their interactions with digital tools and adapting new digital design processes with them. For this purpose, a plugin, called as EduDesign and including various form generations and instructional practices based basic design education, have been developed by scripts of 3D software. Its potentials tested and enriched by different student groups' experiences in KBU and ITU. According to the obtained results, positive and negative influences of the plugin are evaluated.

Keywords: Form-Finding, basic design, plugin, design education;

Introduction

In parallel to the speed of technological developments in recent years, the increases in effectiveness of digital tools on design fields have brought about some debates and problems. The most known and common ones of them are concerned with their contributions on creativity, integration to design processes and designers' interactions with them. When issues of the creativity are about replacing designers' roles with computers, the integration refers to define positions of these tools in design stages. The interaction defines designer's abilities of getting accustomed to them. On these issues, serious studies have been conducted and sample implementations have been presented for many years. However, it is not possible to say that these studies offer solutions to be generalized. Majority of these solutions are based on form-finding, an indispensable term in architecture, and its generation in pre-design works.

In digital design fields, contents of form generation works comprise shape grammars, simulations of natural forms and evaluation of "animation" concept with dynamic objects. Firstly, Shape Grammars having an initiator, a generator and a set of rules and symbols are used for learning existing designs and developing new design languages. Practices of Palladian Villas (Stiny & Mitchell, 1978), Traditional Turkish Houses (Çağdaş, 1996), Duarte (2001)'s reinterpretations of Siza's design grammars for Malagueria with a set of heuristics and new grammar samples on the plan typologies of Neo-Classical term developed by using the Koch Snowflake (Krawczyk, 2001) are typical examples of them. Secondly, simulations of natural forms are one of popular experiences in both digital and traditional architectural ways since the natural environment presents a source of inspiration, endless variety and alternative forms for designers' works. In digital media, their variations are realized by use of Genetic Algorithms, Cellular Automata and L-Systems and abstractions of natural objects by parametric modeling. These

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implementations can be illustrated with form of the Cockpit Building in an acoustic barrier in Rotterdam designed by analogies of muscle movements of a snake (Oosterhuis, 2005), Coates (1996)' architectural form trials with Cellular Automata, based on states of cells due to their neighborhood relations, Krawczyk (2002)'s researches on potentials of Seashells in terms of architectural and structural properties such as enclosure, orientation, compressive section shape and etc… Finally, digital tools enables design processes' transition from static to dynamic by animation techniques like keyframe animation, forward and inverse kinematics, dynamics (force fields) and particle emission. For instance, one of architects and theoreticians working intensively in this subject, Greg Lynn's design of a protective roof and a lighting scheme for the bus terminal in New York was made by visualizing force fields with simulation of present pedestrian, car and bus movements (Kolarevic, 2000). Another typical example is New York Presbyterian Church (Lynn, 1999), the project of transforming the existing building into a church and developing it with additional structures. In this project, Lynn and his team applied a design strategy based on animation techniques, commonly used in cinema industries.

Based on the existing conditions between architecture and digital media, in the light of the above-mentioned form generation approaches, the aim of this paper is to develop a plug-in, which is able to offer form suggestions starting from a defined initiator element, by scripts of existing 3D software for using CAD tools as a design-decision support in early stages of design education, especially basic design works. It is considered that this method, as well as rescuing from slow and laborious practices of traditional ways, can encourage designers to evaluate computers as a generation tool, which extends their perspectives, with its alternatives.

As known, at the beginning of design education, "Basic Design and its principles" are usually taught. So, theme of this study is based on these principles and is concerned to help student conceive them by computers. In this study, firstly, general information about basic design education is given. Then, components of the developed plugin, called as "EduDesign", are introduced and the studio implementations, done with this plugin, are demonstrated and discussed.

1. Basic Design Education

In nature, formation of living and non-living beings is based on two rules (Gurer, 1990). The first rule is that all structures are a whole and a part of an upper whole, also each whole occurs from the lower parts. Another rule is that forms are expressions of mutual relations of their sub-elements and their interactions with other wholes whose sub-components they are.

In basic design works, creating a whole (form) or composition is done by basic design principles. Namely, relationships of design elements (point, line, plane, color, etc…) among themselves and with whole are governed by these principles which are proximity, composition, rhythm, opposition, harmony, dominancy, balance and unity. These are usually instructed by theory of Dewey's "Learning by Making" one of the most widespread didactic ways in design education. The theory is concerned with problem based learning and it suggests problem-solving for learning new skills and knowledge in gaining professional experiences. Generally, by using traditional physical materials (sticky, paper, physical model, pencil etc...) in the studios, its various implementations have been realized for many years and positive results have been obtained.

In this context, instead of traditional techniques in design education, evaluating opportunities of digital media for teaching these principles is able to contribute on solving the problem of getting used to digital tools with support of theory of Learning by Making. Hence it is necessary to customize and organize structures of digital tools designed for general purpose works with respect to the problem-specific. In this way, it is considered that specialized and customized models are able to service as a design-decision medium beyond a representation medium, too.

2. An interaction form generation tool: EduDesign

"EduDesign" plugin has been developed as a design-decision support tool for 3D digital form derivations having instructional qualifications and encouraging new digital design approaches. It is an interface plugin designed by scripts of the existing 3D software. Interactive interface which is based on basic design implementations includes

menus and submenus, which can be used both individually and collectively. These menus are put in order as Stick Composer, Shell-Surface Deformations, Making Composition Tools and Ray Composition, and Utilities (Fig1).

2.1. Stick Composer

The menu allows students to practice with conceptual models of structural systems, one of the classic basic design implementations of most architectural schools. With this menu, it is aimed at enabling novice designers to interpret applicability of their works in view of an architectural reality and generate variations of modular samples. Its implementation stages are to create and select an initiator stick object, to define directions (X, Y and Z) according to the position of the object, to generate new objects in a form of a cube skeleton and to go on the generation process with selection of any generated object.

2.2. Shell and Surface Deformations

The menu has been designed for creation of shell surfaces with their lattice systems decorated by interesting patterns and tiling samples; interpretation of them in the extent of referring to the starting of basic architectural form works; and, thus, experiences on learning basic design concepts like composition, combination, unity, rhythm. By all this purposes, some existing commands of the 3D software have been gathered and customized on this menu. Its implementations can be summarized as defining and selecting any object; generating patterns on the surface of the object by rules; applying modifying functions; creating a frame system from modified model and controlling its dimensions; scaling the surface and connecting with the frame.

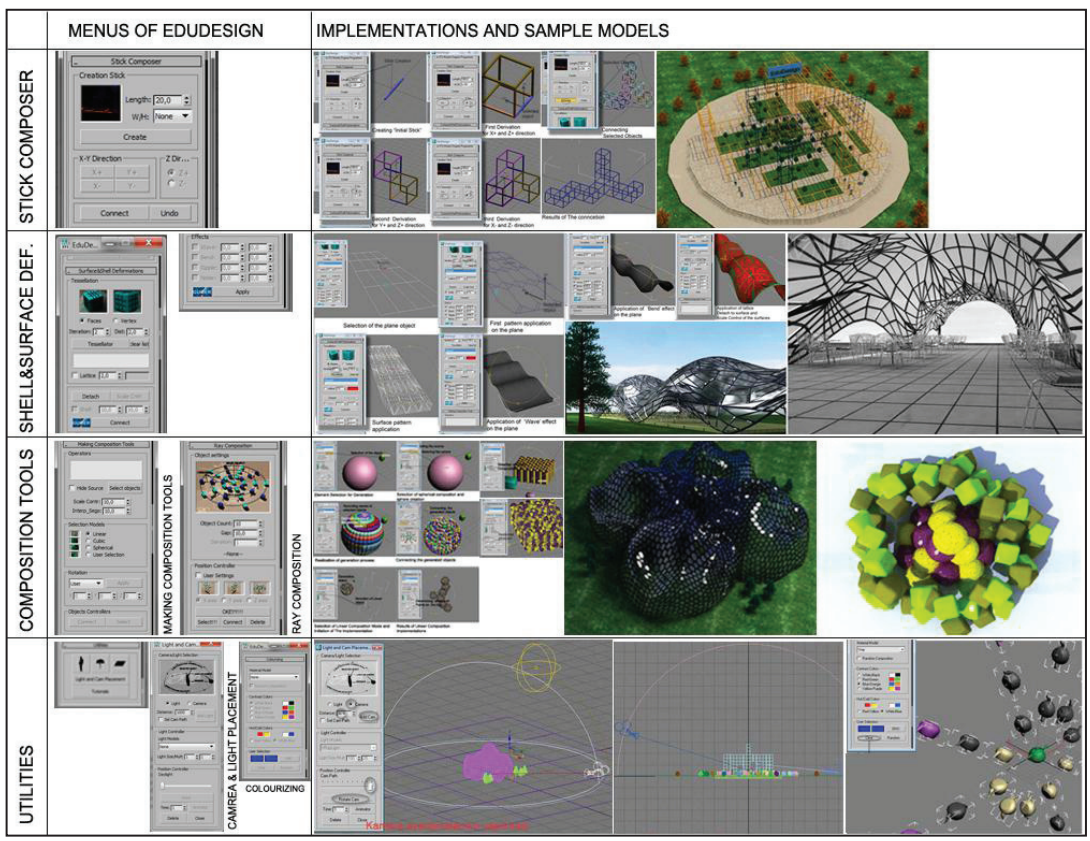

Figure 1: Menus of “EduDesign” plugin and its implementations

2.3. Making Composition Tools and Ray Composition

These menus of the plugin have been prepared for teaching the concept of *"Composition",* one of the indispensable parts of basic design practices, improving designers 'composition cognition and supporting the other two menus with different combinations. In the menus, various composition models such as linear, spherical, cubic, user-selection and ray are presented. When "Ray Composition" is arranged as a different menu due to its different parameters, the others are collected in the title of "Making Composition Tools".

2.4. Colorizing and Utilities

In the basic design education, as well as the concept of the form generation, the practices are commonly backed up with additional architectural concepts such as material, scalability and lighting giving architectural meaning to the form. Unlike the previous menus, to respond these requirements, these menus have been arranged. When the menu of Colorizing includes operations of assigning materials composed by fundamental color relations, the menu of Utilities comprises of Camera-Light Placement (a daylight simulation and a camera mechanism with its vertical and horizontal orbits) and Architectural Objects (human, tree, ground plane, etc…) analyzing the generated models more logically

3. Studio Experiences:

Potentials and applicability of "EduDesign" plugin were tested by different groups of architecture students in ITU and KBU. The practices were realized with three and four sessions after giving information about the content of the plugin. During the practices, students were asked to develop models to be transformed into architectural forms. The process of the practices is as follows:

- Designing simple structural models by using stick elements.
- Creating and modifying shell and surface models including various pattern types.
- Integrating the structural models with the shell models and making relationships between them.
- Increasing varieties of shell and structure models by evaluating composition tools.
- Assigning the materials to created models
- Examining architectural scalability of models by with a human and tree figures or a ground plane.
- Getting new perspectives from the created models and analyzing them by using the customized camera

In the practices where the results were obtained beyond the expectations, the students revealed successful samples taking their initiatives with different trials of the plugin menus besides obeying the defined program. Some of these works are demonstrated in Fig2.

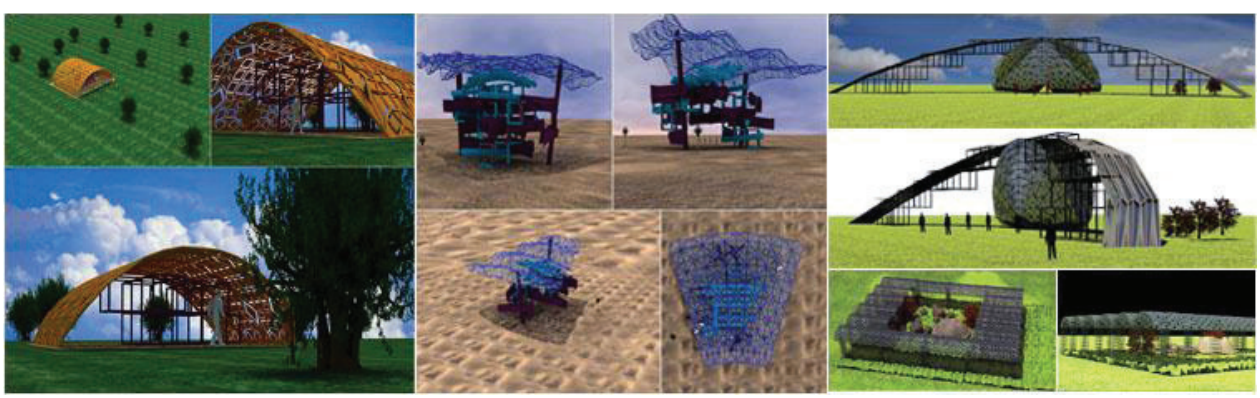

Figure 2: Samples of the practices in ITU (at right) and KBU (at left)

In the works, it was emphasized on importance and necessity of the plugin variations in the type of EduDesign as well as its simplicity, practicability, didactic qualification and support of creativity with positive feedbacks. Unlike traditional methods, it was seen that the practices increased students' affordance and developed students' design cognitions and abilities of versatile thinking were developed affirmatively with their options of rich alternatives and advantages of time saving. The adaptation problems of conceiving and using the plugin were overcome quikly. Furthermore, it was seen that students' demands occurred for enriching contents of the plugin practices about form generation and creating more mature models and increasing the numbers of the implementations or software like EduDesign occured. Finally, some of the emerged deficiencies was eliminated with the adjustments on the interface (simplification of the interface, changes of some commands or adding new commands etc…)

4. Results

According to the results of this implementation research, offering a solution proposal about the problems like interaction with digital media, their adaptation into design processes and contributions to the process, it is possible to say that the beginning aims and expectations of this paper have been reached. These results have pointed out importance of meeting innovative potentials of digital design tools in early years and qualifications of managing them by customizing instead of relying on their present structures in terms of the present architectural trends. Therefore, interaction with them at the beginning of design education can be useful, because "Learning by Making", one of the most common ways of design education, leaves permanent impacts on novice architects' development. Accordingly, dealing with specialized practices of digital design tools, exploring their potentials with the method of problem-solving at these stages will enable them to step in the way of future architectural approaches.

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