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Development of an approach for producing architectural form in architectural design education

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Abstract

At the early stages of architectural education, it is observed that students have difficulty to produce forms. Students, during the design process, comfortably use basic geometrical elements one by one, however are not able to diversify them by transformation because of the fact that students are not capable enough to transform basic geometrical forms in accordance with arithmetical operations and geometrical transformation. In this study examining the architectural form creation; a three-month case study is conducted with first year students in Department of Architecture through which the software is used. Initially architectural projects of students designed in accordance with traditional methods and it is observed that students are not able to throughly transform the forms. At the second stage, students are expected to develop their projects through sofware transformations. Additionally, a questionaire is also conducted with students in order to define the possitive and negative aspects of forms created with this method.

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Keywords: Architectural Design, Architectural Design Education, Morphologic Analysis, Formal Conversion.

1. Introduction

An architect designs a space as a whole related to its environment and internal relationships and reaches result form. Therefore, each data defining design process affects architectural formation. Forms, which constitute architectural environment, are generally explained in literature through theories on nature and social sciences. However, in the present study, the act of formation was analyzed within designing process in terms of the formation activity of the designer. "Form, which is obtained at the end of design process, is created with the experience of the designer and decisions taken in line with the information clusters which define design problem.". Stiny and Gips (1971), explained this formation process as follows: "While directing input information he/she transforms into forms in design process, an architect follows some composition rules which form with accumulation of experience which he/she puts in his/her mental library by filtering" . A designer has to think with form to make formation. In formation process, the designer firstly imagines information for design problem in an intuitional process and then to materialize his/her ideas for design, he/she visualizes the image he/she created using basic geometrical forms with

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two and three dimensional forms and finally produces the design product by transforming the style. However, since the students do not have sufficient experience and knowledge during the first years of design training, it was found that they experienced difficulty both in formation of architectural design and in realization of designs by transforming forms. For this reason, in the present study, we aimed to develop a computer-aided tool to help the students, who are at the basic training process in the field of architecture, to develop a design language they produced to address design problems and to help them to differentiate architectural composition while they make it objective. Accordingly, a case study was carried out with first grade architecture students for style production both through traditional methods and produced script. In conclusion, positive and negative aspects of producing style though successive use of traditional and digital methods were determined.

2. Rules of form transformation

The concept of form refers to formal order of an object which is created with the continuity of limits determining the general outlook of the object. On the other hand, in design, it was defined as the arrangement and transformation of the composition formed to materialize image of design idea with geometrical elements. Ching (1979) reported that principle elements which define form were geometrical forms and explained the rules which transform form with as central, linear, radial, gridal organizations and operational geometrical organization principles such as changing the dimensions of geometric whole, extracting parts from the whole, adding parts to the whole. Terzi (2009), on the other hand, reported that principle element which defined form was geometry and defined geometry as the abstract expression of the relationships in nature and life. He explained geometrical transformation of form with four different organizations. "Formal transformation of geometry is explained by Euclid geometry which explain Cartesian space, Non-Euclid global geometry, topological geometry which are explained with parametric functions and nurbs."

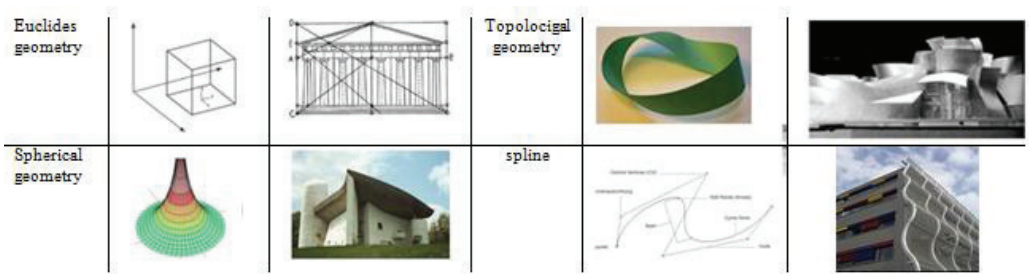

Figure 1. Geometric elements

Pottman, Asperl et al. (2007), defined geometry as the element which is present at every step of the process from the first decisions that form architectural design to the stage of construction and thus which forms the basis of architectural design process. According to these authors, although geometrical forms vary and although there is limited possibility of ensuring a formal diversity though traditional geometrical methods, differentiation of operations applied with today's computer technologies resulted in a formal revolution. The principle properties which ensure this diversity are the operations that provide formal conversion. Pottman (2007) categorized these operations which determine the rules of formal transformation in three groups. The first one involves adding new geometrical forms to basic geometrical forms, excluding geometrical forms from basic geometrical forms or arithmetic operations which are used to take cross-section of two objects. The second one is geometrical transformations including most basic geometrical operations applied to forms which are transformation, scaling, reflection and lengthening. The third one is formal deformation which ensures the modification of form as a result of value changes in point, superficial or volumetric data which define a prime geometric form. The form, which is obtained as a result of formal deformation, was ensured by modifications such as inflection, enfolding, torsion and shrinking of prime geometrical form.

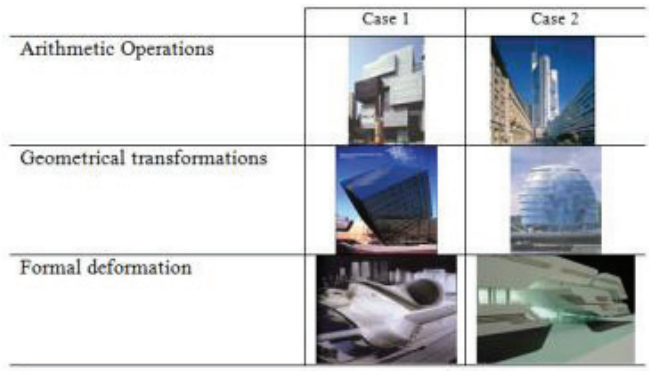

Figure 2. Examples of formal transformation

3. Case study and findings

Students enrolled in the department of architecture have to perceive the environment they live in, to create their own design language for its problems, and to create their architectural compositions by transforming the existing design problems in this environment with creativity and skills. Students use forms while materializing their ideas for solving design problems. To form formal composition, they have to determine basic elements constituting it, properties of elements and organization principles. However, since the students do not have adequate knowledge and experience in the first years of architecture training, they often experience problems in creating formal compositions. In the present study, we aimed to develop a digital computer-aided tool written with max script to guide the students to create formal composition in architectural design training, to provide visual diversity and to use it in diversification of basic geometrical forms which is a common problem. Accordingly, a case study was conducted. The case study analyzed the transformation of students for creating forms who received principle architecture training through traditional methods and produced script.

Case study was carried out with a total of fifty two first grade architecture students who completed basic design training. The students were performing architectural project in a design studio for the first time. The students were asked to produce a youth center project which contained accommodation units, activity and sports functions within a fourteen - week period. The study was carried out in three stages. Firstly, the students were observed in terms of formation though traditional methods. In this process, the students formed design problem according to geometrical elements and principles they defined. Design process was analyzed in three stages to analyze each transformation in detail. The stages of design process were as follows: draft project which included concept development as a result of functional requirements, environmental data and cultural analyses and first formal works; development stage which ensured formal transformation of draft product though operations such as arithmetic operations, geometrical transformation and formal deformation and finally the final project which included presentations visualizing the design product. The stage of research which involved literature review was not taken into account. In each of these stages the way each student transformed two and three dimensional formal composition was documented through prepared observation forms, observations during studio environment and photographs of final products.

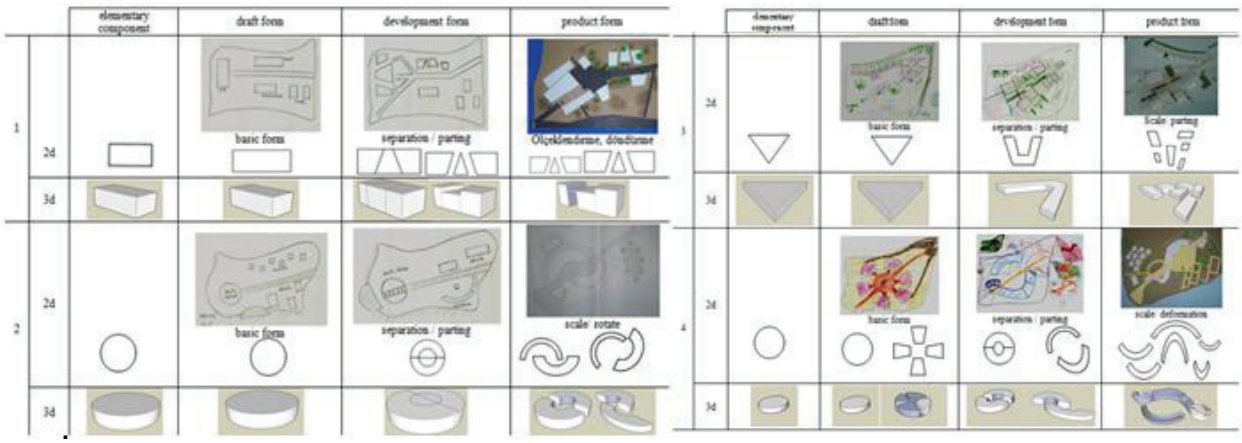

Figure 3. The observation form of traditional design period

Observation forms determined the principles of transforming two and three dimensional geometrical forms used by the students. It was found that majority of students comfortably used basic geometrical forms individually, however they failed to transform and diversify them. It is understood from the rectangle and circle scheme draft products presented in the table that at the end of twelve - week period, adequate formal transformation and diversity could not be achieved. In addition, as indicated in organic scheme draft products which were obtained by transformation of triangle and rectangle, few students managed to perform desired transformation through traditional method according to formal operations. The fact that the majority of the students could not achieve visual diversity and formal maturity in their designs made the solution of the problem difficult and suggested the necessity of using computers as a supporting system in architectural design training.

In the second stage of the study, we analyzed the development of immature designs in terms of form though defined formal transformation operations in computer media in two - week period and creation of different formal alternatives. Titles of script, arithmetic operations, geometric transformation and formal deformation produced at this stage address to formal transformations. Mathematical or logical implications were not performed by computer; the transformation was fully under the control of designer (user). Basically, it involves making modifications on selected units according to determined titles. One of the most important properties of Maxscript is that it allows for parametric modifications on objects. Thanks to this, the possibility of performing formal transformation was analyzed for each student. Each student modified the premise form he/she created in traditional media according to functional relationships and reached more than one final form; he/she selected one of those and interpreted and developed it in his/her point of view.

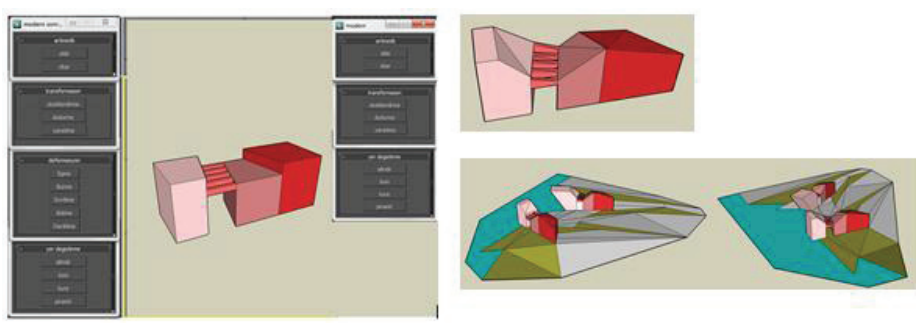

Figure 4.The transformed form with Maxscript

At the final stage of the study, a questionnaire was administered to the students who used both traditional and recommended computer aided formation techniques to evaluate their competencies in formation. In the questionnaire, the students were asked to evaluate these two techniques in terms of their competency in producing formal solutions; their effectiveness in providing formal transformation; capability to change and improve design process; capability to re-organize the design; questioning of creativity value; usability in all stages; quick and easy usability and capacity to include disadvantages in usage. The questionnaires were statistically analyzed.

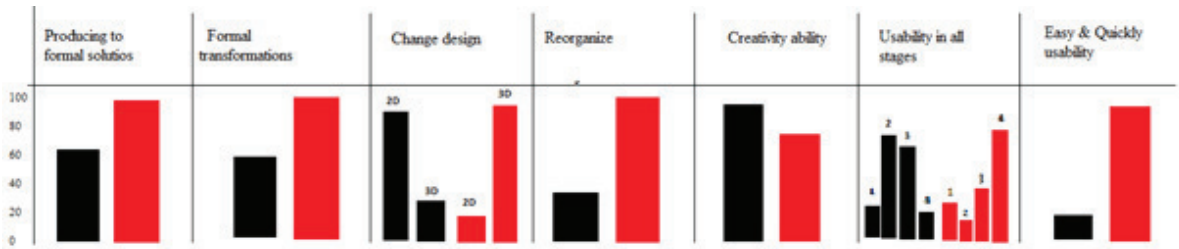

Figure 5. The results of questionnaire

It was found that the students found computer aided technique more positive in terms of its competency in producing alternative forms, effectiveness in ensuring formal transformation, possibility of changing and developing design process, possibility of re-organization of design and quick and easy application. The students reported that they found this technique more positive since transformation rules they did not realize in their previous research were given with definitions; they were able to form transformation simultaneously on the monitor in 3-dimensional version; they were able to perform formal transformation operations in a synchronized manner with different operations, they were able to archive each transformation and use it as a step for the next and that they were able to undo the formal steps they did not like. As for questioning creativity values and usability of them in each stage, the students found traditional methods more positive. The students found this technique positive as the traditional method was realized in a longer time, conceptual ideas were based on drawing and research, reciprocal interactive communication established in studio environment with the lecturer further improved creativity while readily available transformations might have a negative impact on creativity.

4. Conclusion

In the present study we tested the existence of a computer aided formal tool which can help students of architecture in design process. The tool can help the students to make different transformations to the formal alternatives when they fail to reach required maturity for solving design problems. Formal alternatives could be produced by synchronized use of both methods. The alternatives which were used in computer media were found to be appropriate for use in training as the rules set by the designer can be changed; they offer the possibility of creating a difference and novelty in the process and final product, the design continues in a controlled manner, it can be changed and improved, rather than restricting the mental operations of the student, it crates stimulating and new connotations in the mind of the designer for new design and formation process can be monitored. In addition to these, while production of formal alternatives with traditional methods depends on prime geometric forms, in computer media, this process is diversified by modification of superficial and volumetric parameters of prime geometric forms; it produces countless alternatives to the designer and helps in derivation. In conclusion, it was found that with their storage capacities and features or making logical implications, computers turned in a system aiming to support design process more than being presentation tools.

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