The Use of Parametric Mapping as an Analysis Method in Contextual Design Studio

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Abstract. This paper is discussed an experimental study carried out in the undergraduate Contextual Design Studio (CDS). The studio comprises four stages: Site Analysis Phase, Conceptual Design Studies, Design Development Phase, and Final Presentation. The site analysis stage lasts for about four weeks,10 hours a week in the studio. Particular importance is given to this part of the project so that students have a chance to gain different perspectives on multiple meanings of context and, more specifically, the historical, social and physical context of the the neighborhood. Besides conventional mapping and representation techniques and tools, some new design tools have been introduced in the studio, one of which was this experimental study in question. The study aims at the integration of the Parametric Mapping techniques, at a basic level, into the site analysis process in the contextual design studio to provide an entry point to thinking through the tool used for the students. In this term, the method of abstracting site features through Parametric Mapping was used in the site analysis process and the effect of this form-oriented data on the concepts of the projects was interpreted. NudiBranch, an add-on to the Grasshopper program, was used in the Parametric Mapping workshop. Students' works were discussed briefly with the help of some representative instances.

Keywords: Parametric mapping, Contextual design studio, Architectural design studio, Architectural education, Hybrid Education

1 Introduction

The Contextual Design Studio (CDS), which deals with the issue of “the design of a new building in existing urban fabric” or new building design in a historic environment, occupies a particular position among other design studios in the architecture curriculum. The studies related to it are generally based on a series of interconnected steps, i.e, site analysis, interpretation of the data

gathered, development of some design scenarios, proposals, and presentations. Research is an inseparable part of each phase.

Some conventional mapping techniques and tools are widely used such as mapping the transportation network or street layout, figure-ground mapping, structural/functional/land-use analyses, analyses of building heights and materials, street elevations, silhouette, modeling, and other interpretive drawings developed through personal observations, research or defined methodologies, which mainly stem from the place making theories. A series of representations obtained through new computational design tools have also been developed. Various hybrid or integrated methods enrich the design process dealing with the complex data of urban space. These methods both provide individual understanding/reading of an existing environment and, hence, offer new opportunities in solving design problems peculiarly (Şahin et. al. 2016).

Many experimental studies are being conducted in architectural education in terms of integration of computational tools into the design studio course (Headley, 2013; Lima et.al. 2020) and teaching parametric design tools and their functioning logic to design students (Aish and Hanna, 2017; Celani and Vaz, 2012; Globa et.al. 2015; Schnabel, 2013; Agirbas, 2022). Although teaching these tools as a series of lectures is common in many schools, integrating and working principles into the design process could be very challenging for students and lecturers in the early years of architectural education.

In this study, within the scope of hybrid education, an experimental study was conducted on the integration of parametric design digital tools into the analysis stage of the projects of the 2nd year students.

2 Methodology

In CDS, students are expected to develop coherent design senarios and solve certain complexities of multifunctional buildings to be inserted in the existing urban fabric. The studio conventionally comprises four stages: Site Analysis Phase, Conceptual Design Studies, Design Development Phase, and Final Presentation. The site analysis phase lasts for about one month four weeks,10 hours a week in the studio. In this period, students study the physical, historical and socio-cultural characteristics of the selected area and reflect what they have learned through site analysis. This phase of the course has many parameters and compexities that the students are expected to think about simultaneously (Figure 1).

Two areas were offered as project sites -Tophane and Üsküdar districts of Istanbul. Tophane district is located on the European side of Istanbul. It is a tourist attraction point as it contains many historic buildings such as Tophane-i Amire (Ceylan, 2003), Kllıç Ali Pasa Mosque (Bayrakal, 2018; Ostwald and Ediz, 2015), Tophane Fountain (Yüngül, 1958) (Figure 3). Üsküdar district is

located on the Asian side of Istanbul and has a significant urban fabric with many historical buildings as well (Gelengül Ekimci and Ahunbay, 2016; Kahraman, 2019; Gocek Karabey et.al, 2021; Aydin Ipekci and Ozer, 2015). The population of these two districts is mainly based on local inhabitants. Therefore, it is expected from students to design their building complex by taking into consideration not only local inhabitants but also passive users and visitiors such as tourists and students of the universities nearby.

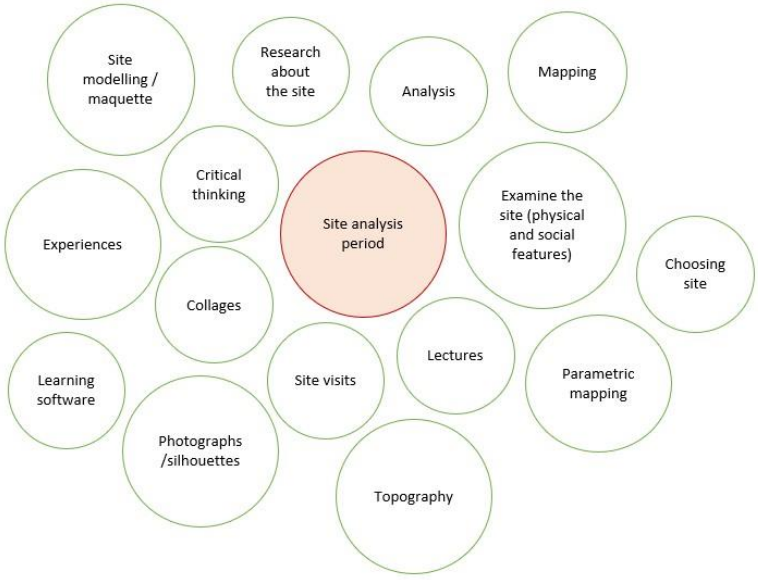

Figure 1. This site analysis period and its parameters. Source: Authors, 2022.

Within the scope of this study, a workshop was held in the studio. There were 2 studio groups with a total number of 22 students (11 students for each group). Eight students among them participated in this experimental Parametric Mapping.

The workshop planned was held during the site analysis process (Table 1) Students were asked to use the Parametric Mapping in their site analysis. Since the workshop was conducted in the 3rd week, the students had preliminary information about, the project site, before the workshop. Students were expected to interpret this prior knowledge with Parametric Mapping.

The architectural design studio was conducted face-to-face and online (hybrid education). The choice to attend the course face-to-face or online has been left to the students. Most of them preferred to participate in classes face-to-face. The lectures of the workshop have been recorded for students to watch the lectures anytime needed. The following lesson after the workshop, a face-to-face session was held to answer students' various questions regarding the implementations.

Table 1. The information about the workshop

Student level	2nd year Bachelor of Architecture students
Course type	Context-based design studio Compulsory course
The site	Istanbul (Tophane or Üsküdar districts)
The total period of the course	14 weeks (10 hours a week)
Students registered to the course (2 sections)	22 students (11 students for each group)
Workshop period	3rd week of the course
Content of the workshop	Use of parametric mapping as an analysis method
Students participated	8 students

2nd-year students generally have some familiarity with some design tools like AutoCAD, SketchUp, and Photoshop. Some students can also use Rhino. Most students do not have Grasshopper experience. Therefore, within the scope of the workshop, the explanation of the basic commands (such as installation, moving, and saving) related to the use of Rhino and Grasshopper is also included. In the study, ready-made scripts of the Nudibranch add-on working with the Grasshopper program were used. First of all, the students were shown how to import the AutoCAD drawing file of the chosen area into the Rhino program. Afterward, how to use the ready-made scripts that come with the installation of the Nudibranch (2022) add-on was shown (Figure 2). Information on how to play with the number sliders in these ready-made scripts, how to change the number slider value ranges, how to change the size of the initial grid, and how to increase the number of points were given. The lecture was recorded and uploaded to YouTube so students could look at it anytime. In this way, students were able to look back at this YouTube link whenever they needed.

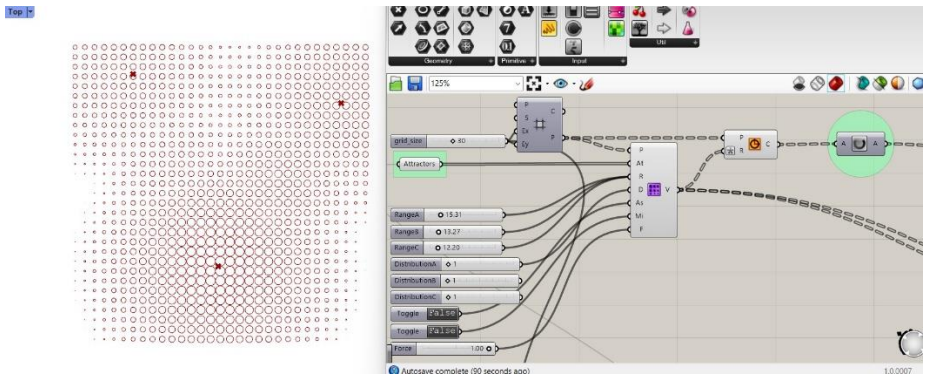

Figure 2. Sample Nudibranch ready-made script. Source: Authors, 2022.

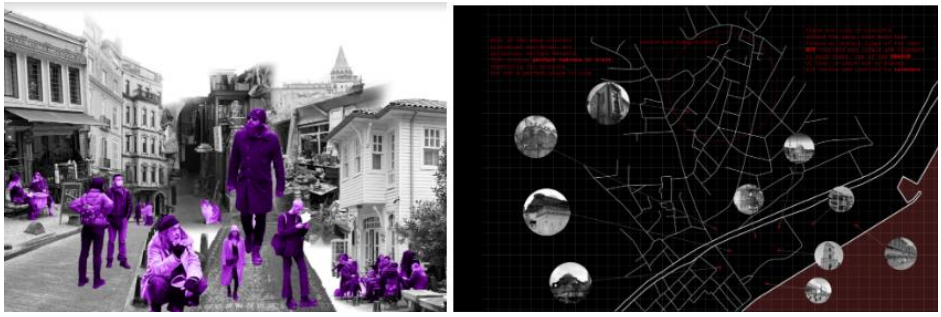

Figure 3. Representation of the atmosphere in Tophane and its nearby districts. Source: Authors, 2022.

3 Experimenting with the parametric mapping tools: representative instances

Eight students from the studio groups adopted parametric mapping techniques to analyze the project areas. In this context, parametric mapping was used to reflect various characteristics of the existing urban space studied such as the distribution of functions and historical buildings, the dispersion of sound, noise, and smell, the display of the transportation points and pedestrian densities of streets and the determination of visually and physically accessible areas. The students determined which of the ready-made scripts they would use according to the subject they wanted to analyze. The majority (7/8) of students used the ready-made scripts with 2D features, maintaining the habit of 2D mapping used in traditional mapping methods, and ignored the possibility of including the data of the site in the third dimension, provided by parametric mapping.

The students rearranged the parameters of the ready-made scripts according to the data in their site analysis. For example, while analyzing the smell on the site, by rearranging the existing points in the script according to the points that are the source of the smell, and representing the intensity of the smell with the changes in the force parameters, a mapping showing the dispersion of the smell was obtained. Some of the students enabled the production of new analyses by exporting their parametric mapping studies from Rhino and combining them with representations such as photo collages, maps of green areas and topography curves created in different media. The two sample studies of the students were discussed in the following sections.

3.1 Project 1

The student working in the Tophane benefited from parametric mapping in the functional analysis in the region. The student, who designed handicraft shops and a tourist center, analyzed the distribution of carpet making and

weaving workshops, ceramic workshops, coppersmiths, art galleries, hotels,and cafes in the neighbourhood. First, individual mappings were made for the distribution of each function. The locations of the functions were marked by changing the numbers and places of the points in the ready-made script. Then, the increase and decrease in the number of functions at the marked points were expressed by changing the density and force parameters. In this way, the areas on the map where the functions increase could be represented as denser and larger patches, and the areas where the functions decrease could be represented as lighter and smaller patches. After analyzing each function separately and assigning a different color to each of them, all analyzes were superposed on a single map. The site analysis and the superposed map are shown in Figure 4 and Figure 5. The resulting mapping provided a visual data of where the investigated functions are concentrated and where they are diluted. The analysis made through parametric mapping was used as a determining factor in the student's project area selection. Instead of areas where similar functions were concentrated, the student chose the area where it is less frequent and not far from the tourist attraction center.

Figure 4. Site analysis. Source: Authors, 2022.

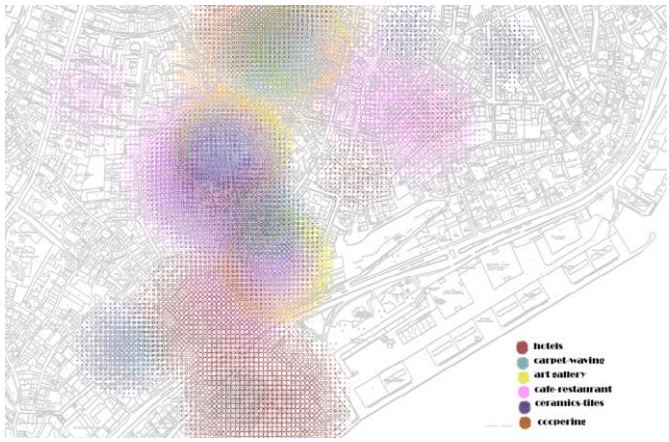

Figure 5. Site analysis with parametric mapping, Project 1. Source: Authors, 2022.

3.2 Project 2

Addressing the accessibility issues, the student underscored some visual and physical connection problems between the inland and the waterfront. The primary intent was to create access through the spaces and connections to be designed. The student first determined the potential points where it could provide visual continuity and physical accessibility in the existing urban pattern. The points were also positioned to form a route that ensures continuity. Then, he transferred the determined points to a gridal map of the ready-made script. The density and force parameters of the ready-made script were changed according to the positions of the points, thus transformations occurred in the gridal pattern (Figure 6). The regions where the impact areas of the points intersect showed the areas with the maximum potential in terms of accessibility and are used as data to create the building design form. The student evaluated the gridal pattern created by parametric mapping as an input for his design project and tried to transform the mapping into a form. In addition, the gridal pattern overlapped with the topography curves to include the slope, which is an important site-specific element, in the design process. The resulting mapping prevented the form from being evaluated in only two dimensions, and made the stratifications that could be made in the third dimension visible (Figure 7). In this way, some site-specific features were visualized by parametric mapping and contributed to the formation of the design concept and form. The student also reflected the mapping form on the building facade and landscape design (Figure 8).

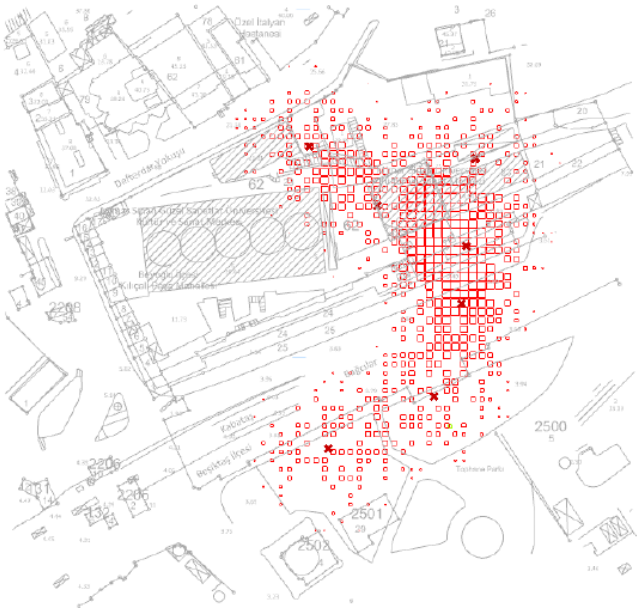

Figure 6. Site Analysis with Parametric mapping, Project 2. Source: Authors, 2022.

Figure 7. The section of the building design proposed. Source: Authors, 2022.

Figure 8. Reflections of parametric mapping study to landscape and facade design. Source: Authors, 2022.

4 Discussion

Integration of new digital tools into projects has become a necessity. Especially in the early years of architectural education, this integration can be challenging for both the student and the educator. It is necessary to conduct various trials and discuss the results to achieve such integration. In this context, an experimental study was carried out to adapt the studio curriculum to the new requirements.

According to the results of the study, it was seen that some students interpreted the parametric site analysis to develop their designs. It was also observed that some students performed site analysis with parametric mapping tools in the analysis stage only as representation.

One of the main goals of the Contextual Design Studio, the approach of analyzing the site-specific features and providing input to the design process, was a point emphasized by the instructors in the process. It was observed that the students' parametric mappings of certain spatial elements such as function, smell and sound dispersion, and pedestrian density were generally decisive in the project area selection. One of the students included the pattern he obtained through parametric mapping during the analysis process as a direct input to his design concept and form-finding processes. In other words, he abstracted the site-specific features with the help of parametric mapping and included them in the design process using the same thinking attitude, which was relatively new for the student. This parametric mapping attempt, which is very promising in the analysis stage of the project, provided an entry point for the student to adopt the parametric way of thinking, which might be applied through the entire design process, from site selection all the way to design details.

It was seen that video recording of parametric mapping lecture helped students to implement the process quickly and conveniently since they can stop and watch the video recording anytime.

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