Designing as a Team by Utilizing Analogue Media versus a Computational Tool for Parametric Modeling Lessons Learnt from a Study in an Educational Setting

Elif Sezen Yağmur-Kilimci ¹, Leman Figen Gül ¹

Istanbul Technical University, Istanbul, Turkey
{esyagmurskilimci,fgul}@itu.edu.tr

Abstract. In this paper, we report on the conceptual design processes of two teams of graduate students that emerged in an educational setting as the teams worked on two different but scope-wise similar problems by utilizing analogue tools and a computational tool for parametric modelling respectively. We describe the similarities and differences that we observed within each of the teams’ respective design processes and the nature of the solutions they generated for the respective problems as well as the similarities and differences that we discerned across the teams’ design processes. We discuss the implications of our findings for integration of digital technologies in architectural curriculum and development of digital technologies for supporting collaborative conceptual design processes in architecture.

Keywords: Design Behaviour, Teamwork, Collaborative Design, Parametric Design

1 Introduction

Reflecting the changes within the architectural design industry and the substantial demand for graduates to be digitally well-educated, the significance of developing digital design skills and knowledge in employing the digital tools in the conceptual design phase is gradually acknowledged. As technology continuously advancing, the question of how and what to teach to the new generation of students in this digital era becomes more challenging that would ‘require the consideration of new pedagogical approaches employing emerging design medium’ [1, p.203]. With these ideas in mind, we delivered a digital design studio for the graduate students in Istanbul Technical University, providing a comparative environment for students who were exposed to the analogue to cutting edge parametric tools for the conceptual phase of their design process. We reported the course structure, outcomes and our observations during the digital studio, discussing the findings and possible benefits of the digital design studio.

One of the key aspects of the course was to provide an environment for the students to experience digital design tools, such as parametric design tools in collaborative design settings. Architects use parametric models that ‘are in essence created by a set of constraints specified using parameters and their relations’ [2]. Ostwald [3, p.9] suggests that a parametric model must have four of the following guiding principles: the first one is that parametric objects should be the combination of...
‘dimensional, innate and rule-based parameters’. The second one is that the models should keep ‘connotative rules; this means that any change in parameter will have an impact on any others within the project’. The third one is that the model should not encumber ‘established rules or they will signal to the designer if they are forced to breach the rules or requirements of the system’. The final one is that models should be able to ‘output various forms of data’. With the developments of the digital design technologies such as ArchiCAD, Revit, and Rhinoceros 3D, the parametric modeling would be able to occur in the digital realm.

Previous literature has investigated parametric design from various perspectives with differing methodologies. Yu et al. [4] studied the design behavior that is exhibited while designing in a parametric design environment. The studies concerned with understanding the design processes conducted via parametric techniques have mostly been conducted in individual design context [5] and in educational contexts such as courses [6-9] or in workshops with students working on a design problem individually [10]. Similar to those studies, we also focused on one of the simulative packages that is Rhinoceros 3D in our design teaching, but differing with the addition of teamwork in design teaching.

Working in teams in the field of design is based largely around the determination to explore what the digital realm can achieve and provide to the collaborators in both practice and education. Collaborative projects are often rendered complex and challenging to carry out by establishing a common goal, and a common working culture and understanding, reconciling multiple concerns and ideas. Most research on co-located conceptual design processes in architecture as conducted via analogue tools has been studied with teams comprising expert architects [11]. Among the studies that looked into collaborative design processes of students, most have either focused on distance collaboration as realized with collaborative design environments such as virtual design environments [12] tools that support collaborative sketching or sketch based modeling or via tools of building information modeling [13,14] or focused on co-located collaboration that takes place as the teams co-generate digital sketches via sketch boards, tables or tables.

As digitally mediated collaborative and parametric tools appeared through popularization in design studios, the strategy of testing the new pedagogy would account for the opportunities it presents. In this paper, we discussed our findings from a course examining design behaviors of teams of students that would exhibit while working with two different mediums, analogue media and a computational tool for parametric modelling.

2 Methodology

The ‘Digital Architectural Design Studio’ (DADS) is a compulsory 3 credit course for the graduate students of the architectural design computing program in Istanbul Technical University. Every semester, the course is delivered by a different lecturer with a certain theme relating to the intersection between digital technologies and architectural design.

In Spring 2016, the course was announced to be carried by the second author with the theme of ‘design collaboration in the computer mediated design environments; its
objectives were (1) to introduce students to concepts of team work mainly over synchronous communication, (2) to introduce students to varied design environments from analogue to object based and parametric, (3) to develop skill of managing and monitoring a team work in a computer-mediated environment, (4) to gain an understanding of the changes in the architectural design practice through the employment of different design medium.

In the course, the students would be required to generate conceptual designs for three different design problems by working in teams and utilizing three different media respectively. First, they would be designing additional workshop and exhibition spaces for the faculty of architecture at the area located behind the faculty building via utilizing analogue media (this is called- AT in this paper). In the second design problem, they would be generating an initial design of a high-rise tower at a virtual island within a 3D virtual world, Second Life, which supports object based modelling and scripting. In the third, they would be designing a pavilion at the University’s main campus with a parametric design approach by adapting a tool that supports parametric modelling, Rhinoceros with Grasshoppe plug-in (this is called PMT in this paper).

This course attracted nineteen graduate students from the architectural design computing program with eighteen holding a bachelor degree in architecture and one holding a bachelor degree in interior architecture. At the first day of the course, the students were randomly formed into 5 groups. They were introduced to the content and structure of the course and were required to establish a team-blog until the second class in order to keep logs about the experiences they had, the schemes they worked in, and the activities they carried out on a weekly basis. During the term, the students worked on design with AT for two weeks (at weeks 2 and 3), worked on their design within virtual world for 4 weeks (at weeks 6 to 9) and worked on design with PMT for four weeks (at weeks 10 to 13). They were introduced to the design environments at the first week of their designs within virtual world and with PMT and presented their designs to the jury following the completion of each of these projects, including weeks 5, 9 and 14 respectively. After the exercises were carried out, students were asked to write a reflective report about their design processes with an emphasis on how they collaborated throughout the process. The students were also required to fill in a questionnaire about their design with AT, and their past experiences of designing with analogue tools.

During the term, students worked in two different classroom settings: in a classic studio setting in first design exercise and in a computer lab during the second and third design exercises. The study was conducted via the first authors’ participating in all the classes during the term as an observer by informing the students about the motivation of her participation and collecting various forms of data from the four teams that gave consent for participating in this study in addition to those collected via direct observation. These involve video recording the processes of the teams, images of the drawings or sketches that the members generated, any written material that teams have generated, such as notes they had taken during the class and off the class hours if any and personal accounts collected via unstructured interviews and informal conversations with team members on the issues that came to attention during the study.

Since the end of the term of the class, we have been reviewing and transcribing the video-records of the groups’ design processes, presentations and the members’ reflective reports in order to investigate the issues that we set forth in the context of
larger research agenda. In this paper, we mainly discuss the partial findings that we reached at in this larger study regarding the processes of two teams as they design with AT and PMT, where we are in the process of reviewing and transcribing 80 hours of video footage collected during the course of the whole semester.

2.1 Overview Of The Design Outcomes

Group A- Design with AT. Group A’s proposal for the first project, welt-beat (Fig. 1), involves a series of prismatic demountable units connected to a wheelchair friendly walkway, a walkway that starts from the back door of the main building, continues straight to the service road at the back yard in alignment with the main axis of the main building. The walkway is composed of set of stairs with different widths and a ramp composed of parts (sloped and un-sloped) running in oblique direction in between the stairs. The pavement of the stairs composing the walkway are also used at the courtyard of the main building in the same proportion with that used in stairs, as if the stairs are continuing inside the building.

![Fig. 1. Representations of Group A’s design proposal for the first project](image)

Group A- Design with PMT. Group A’s proposal for the third project, the ‘ex-quilt’ (Fig. 2) is located at greenery in front of classroom building in the campus area, a space which is commonly used by the students for leisure purpose during the class breaks at the dry and warm weathers. The proposal involves a shelter designed to cover semi open and enclosed spaces defined for the required facilities. The shelter involves a free form surface that curves multiple times in both directions, is supported by tree-like columns, a surface which is located at the minimally used area on the greenery, and whose form is defined based on the paths pedestrians were likely to take while roaming at the greenery, the relative densities of movement on these paths, the spacing between grid underlying the organization of the classroom building’s façade.
Group B- Design with AT. Group B’s design proposal for the first project, ‘the axis’ (Fig. 3) mainly involves a building with two intersecting prismatic masses with one slightly higher than the other. The project is called axis, mainly because the two intersecting masses mainly emerged upon groups’ conceptualizing the referent axes. One of these masses lies on the entrance-exit axis of the main building and houses the main entrance area and the workshop area. The other mass lies on an imaginary axis that is parallel to the contours of the terrain and houses the exhibition area, the service areas like kitchenette, offices, and the service entrance. It should be noted that the physical model of the project also involves an undulated shelter over the entrance, which the group included into their proposal symbolically at the time, with the vision that they could work on its design when working with PMT.

Group B- design with PMT. Group B proposed their design ‘the amphitheatre’ (Fig. 4) as to be located at the as they call ‘lake area’, at a spot which can be accessed from the road, and where the terrain slopes down towards the lake. The design mainly involved a shelter covering service areas, an area for seating and a stage for performance. The shelter is composed of a free-form shell surface that descends down in the direction of the slope towards the lake ‘as if welcoming people and leading down to the stage area’ as the team says. The shell sits on the ground at 5 points, 4 at the corners and 1 in the middle. The seating area rests directly on the terrain, with the terrain
being carved and prepared to generate the seating area and the stage is a floating stage above the lake and is connected to the land via walkways.

![Fig. 3. Group A’s proposal for the third project](image)

**Fig. 3.** Group A’s proposal for the third project

Group B- Design with AT.

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![Fig. 4. Group B’s design proposal for the first project](image)

**Fig. 4.** Group B’s design proposal for the third project

Next, we first outline the similarities and differences that we observed across the different team’s design processes while working with the same media and give a brief overview of the groups’ design processes with regard to the aspects that we discerned to be similar and different across the groups. We first focus on the processes conducted with AT and then those conducted by utilizing DPT.

### 3 Observations

Although differing in pattern of their occurrences and intensities, the groups undertook a similar set of design activities in a cyclic fashion while designing with the same media and carry out some further activities in their processes with PMT. In both processes, the teams carried out a series of activities for defining and framing the problem, generating ideas for possible solutions, modelling and evaluating these ideas. The additional activities observed in processes with PMT, mainly involved those that relate to parametric thinking/modelling, such as establishing the relationships between parameters or constraints and those that relate to realization/making of the design ideas such as evaluating/manipulating alternative solutions by considering whether they can be realized with the form generation capabilities of the tool or with their tool knowledge; or whether they can be fabricated with the fabrication technologies available to the groups’ use at the time.

The members of each group interchangeably worked in at least two different modes of collaboration throughout their design processes. These were much like what Kvan [15] defines as close-coupled and loose-coupled modes, where “the participants work intensely with one another, observing and understanding each other’s moves, the reasoning behind them and the intentions” and where “the participants work separately on the agreed-upon parts and then they put them together” respectively. Here we use the term ‘at least’ because there were various instances where some members of a group worked in a close coupled mode while other(s) work independently in a loose coupled mode.
We further observed that the members of the same group worked in the same collaboration mode when dealing with similar issues and/or carrying out the similar activities across their processes with different tools, in other words we observed members to somehow establish their own collaborative design styles. For instance, in both of their processes members of group A generated their design ideas by working in a close-coupled mode, and often worked on visualizing/detailing alternative ideas in a loosely coupled model; members of group B carried out both of these activities in a closely coupled mode across different processes. In addition, we found members of both groups, to work almost at all times together in close-coupled mode, at the times they work on defining the constraints and goals, exploring possible ideas for solution and deciding on the idea to pursue with, while working with both media.

Like their carrying out similar activities by working in the same collaboration mode, each of the teams exhibited similar approaches in their design processes, as though they have developed their own ways of designing. In both tasks, group A, first worked on defining the problem by collecting a large amount information and identifying as many of the constraints and requirements as they can and explored various alternative ideas for solving the problem that is being specified in parallel. They then narrowed down their solution space by evaluating their various ideas against the emerging set of goals/criteria/requirement, and worked on one or a couple of more ideas in detail, to elect and develop it into a full solution. On the contrary, in both tasks, group B focused on identifying a possible solution or partial solution, or a means to derive at the solution as early as they can with a concern for its applicability for the problem at hand, or the problem that they redefined in the light of the potential of the identified solution. Once they justified the solution at hand, they immediately proceeded with developing it further or modifying it in accordance with the current definition of the problem at hand.

In their both design processes, the participants heavily relied on sketches, along with verbal utterances that describe the entities they were sketching at the moment, for expressing and communicating their design intent. In cases where they cannot sketch, for instance due to lack of a drawing sheet or an easily accessible surface for sketching on, they turned to co-speech gestures for depicting the visuospatial aspects of the design ideas that they are referring to in speech at the moment. They also tended to produce gestures at the times they are talking about a further visuospatial aspect of an element (as in Fig. 7 and 8) that they have depicted in their sketches or are currently inspecting the computer screen, such as the relationship of a building bock with the sloppy terrain, or the 3D form of a roof depicted in plan or section view.

Both groups heavily relied on sketches for expressing and exploring their ideas both when designing with AT and PMT; they did not generate any physical model for exploring design in their processes with AT; they only generated one for presentation purpose. Indeed, they made use of the PMT in different ways while designing with PMT. As will be described later, one of the teams did not use the parametric component in their design processes at all. They rather used the geometric modelling component for the purposes of generation and optimization of form. On the contrary, the other group used the parametric modelling component along with a suite of different applications such as those supporting swarm intelligence.

As can be observed in Fig. 1 to 4, nature of the designs that groups generated while working with different mediums were quite different from each other. In their design
with AT both groups generated forms with prismatic geometries whereas while designing with PMT both groups generated forms with free-form surfaces.

3.1 Groups’ Design Approach While Working with Analogue Tools

**Group A.** Upon coming from the site visit, members of group A first studied the characteristics of the site individually with reference to their observations on site and by looking into their copies of the site plan and tracing sketching certain/derived features of the site on the sketch paper laid over the site plan (Fig. 5- left). This session was followed by a collaborative session (Fig. 5- right) where members worked in a close-coupled manner; expressed visuospatial aspects of their ideas mostly via sketching and/or gesturing; explored their ideas via spontaneously and collaboratively sketching often on a shared surface, (on the surface of a tracing paper laid over the site plan), and by interpreting, adding to, modifying and reinterpreting the developing sketches.

![Fig. 5. On the left: members of group A are studying project site in a loose-coupled mode; On the Right- members are exploring ideas for a solution in a close-coupled mode via sketching on a shared surface](image)

In this session, the group examined the potentials of the site; identified constraints and requirements imposed by the site/building the program; set up their goals and concepts for the project; began to explore possible ideas for solution mainly by focusing on issues of circulation, access and possible schemes of layout for masses/functions on the site. In developing the proposal, group was mainly concerned about developing a path for, ‘affording access’ as they say, between the back yard and the main building, a path walking through which one can, ‘become a part of’ as they say, visit/view exhibitions or come across/join workshops. The path should be aligned with the main axis of the main building and should be accessible for the wheelchairs so it had to involve a ramp. The enclosed exhibition and workshop spaces should connect to the path by creating courtyard like spaces. These functions should be housed in demountable units that have minimal contact with the ground and would have a minimal impact on the terrain in the case they are to be removed.

After coming up with a set of initial ideas for the design solution, the group members continued to work in a loose and close coupled fashion in a cyclic manner; close coupled at all the times they work on generating alternative ideas and making decisions, and loose coupled often at the times they work on developing/visualizing versions of the same idea or exploring an aspect of an idea e.g. calculating the relative
levels at which the building masses should sit on the ground in relation to the slope of or different aspects of a core design idea, and studying cases and/or collecting information about an issue the group is dealing with at the moment.

**Group B.** Design process of group B started with some of the members’ studying the site plan and reading the brief for a brief episode by occasionally asking questions to each other. It then continued with the members’ discussing the characteristics of the site in close coupled mode and occasionally drawing some of the aspects/features/reference lines that see in/identify at the site on the sketch papers that they each placed over their site plans (Fig. 6- left). The design took its course around the 10th minute of the discussion, when the members considered to use the entrance-exit axis of the main building as an axis in their design and the line one of the members drew in intersection with this axis, and in parallel to the contour lines of the terrain as a second axis in their design and then decided to house two primary functions by generating masses that lie along these two axes.

**Fig. 6.** On the left: members of group B are studying project site and reading the brief in a loose-coupled mode; On the Right- members are exploring ideas for a solution in a close-coupled mode via sketching on a shared surface.

From this moment to the time that the team (have thought to) have taken all the decisions for specifying their conceptual design, the team intensively worked on developing the idea of designing the building by using axis, in a close-coupled manner (Fig. 6- right), and with members often expressing their ideas via sketches, by referring to the sketches or gesturing about them, and generally one member generating the sketches for capturing/expressing the ideas under discussion. In this session, the team mainly explored the physical characteristics of their masses, the layout of the functions in relation with each other and with the constraints/ opportunities/ goals that they identify based on the characteristics of the terrain, physical conditions of the site and the existing uses/buildings at the site. Following this session, the members of the team concluded their design process by working on the details of their design and generating its drawings in a loose-coupled mode.

**3.2 Groups’ Design Approach While Working with Parametric Modelling Tools**

**Group A.** At the beginning of the process, members of group, alternatively carried out two primary activities sometimes by working individually, sometimes in subgroups and sometimes all together. First of these activities was the examination of precedents in
pavilion design, particularly those designed via a parametric design. The other was searching for the possible sites and the kinds of analyses that can be conducted for identifying potential sites on the Campus for the project. While carrying out these activities, the members spent considerable amount of time in discussing the constraints for their design, ranging from fabrication techniques available to their use to the modelling capabilities of the tool; thinking about possible schemes or sources for deriving parameters ranging from via conducting chemical experiments with materials to examining patterns on leaves; and methodologies they can adapt for defining the site and generating their form.

Fig. 7. Image above left- members of group A are discussing about a precedent design; Above right- one of the members is sketching an idea, Below left- one of the members is expressing and modeling the form she imagines in her gesture space, Below right- one of the members is expressing her idea.

Following this initial process, the group identified trajectories of movement by simulating swarm behaviour, and use these trajectories for developing the 3D geometry of the pavilion. The groups’ process unfolded with this decision. From this moment forward, working in a close coupled mode, they expressed and explored their ideas via sketches, thought iteratively about: how they would identify exact spot for the pavilion based on the outputs of the simulation e.g. least dense area, mostly passed by area; how they would use the trajectories of swarms in deriving form e.g. whether they would use them for fragmenting the surface, or as trajectories of strings that would then become intertwined to define surfaces; what other site-driven data they could use for generating their forms such as the patterns to be driven from the leaves of the trees on the site, the grids on the building surface; the methods of modelling they could use to and whether they could generate the forms that they envision within the environment
of the current PMT and by which digital fabrication technology or how those forms could be fabricated.

During this process, the members relied heavily on sketching to express and explore their ideas, particularly to envision the layout of the form on the site, and the nature of the building form to be derived based on the selected variables. They often used gestures to communicate their ideas about form and procedures to derive form particularly at the times they are trying to express free forms; and even simulated the transformations the tool would apply on the trajectories by drawing them and then simulating to be stretching them to the third dimension in certain forms via their gestures. Having identified their methods, and envisioned and visualized the possible geometry of their form by working in a close coupled mode, the members started to work on activities for realization and making of the form in a loose-coupled mode by allocating the work based on their interests and expertise, such as a participant working on acquiring data from simulations of swarm intelligence, other processing that data for it to be used in the PMT, another working on generation of the model within the tool’s environment.

The issues that concerned the members most were mainly related to finding generating, or fine-tuning the form of a design, based on parameters that might or might not be related to the design problem at hand, rather than the functional and behavioural aspects.

**Group B.** The group started the process by identifying a site for the project which is not specified in the brief, with the consideration that getting to know/analysing the project area first can make their design task easier as it did in the analogue design session. Studying the site plan of the campus, the group considered lake area as a potential site for the project; the lake area houses dorms that are far from facilities at the campus area and has a sloppy site where the land descends towards the lake. If they selected their project site from the lake area, they could focus on providing students, living at the dormitories there, a place to eat during the weekends and the people at the campus a place to eat and/or spend some leisurely time by looking over the lake.

As the group was examining topographic characteristics of the lake area, and trying to figure out further reasons or motivations for selecting the site, one of the members suddenly recalled his friend at the university’s drama club mentioning about the club’s being in need of a performance area and suggested that with such a slope they could design an amphitheatre. The other said they could put the stage on the lake, and seating towards it; he knows a case where the stage was on the water. This moment was much like the moment at which the group’s design process with AT had taken its course by members seeing the two imaginary axes as the axes of the masses in their design. Following this moment, they conducted a search for relevant cases, previous designs relating to performance areas and their shelters and stages on lakes as cases to learn from or transfer certain features.
From this moment to the moment that they believed they had an idea that they could go further with, the group carried out various activities and focused on various issues at a time in a cyclic manner such as identifying requirements’/constraints based on the precedents and site characteristics, setting up goals, determining the exact project area with the consideration of the requirements and their goals, generating ideas about the form of the shelter, arrangement of the seating area, the form of the stage and their relations and etc. This process was quite similar to that they carried out while working with AT with the only difference being in team’s considering the modelling and fabrication issues while thinking about the form of the shelter such as in what ways the idea they generated can be modelled with the tool, whether they can model it with one of these methods and what implications these methods might bring about in fabrication of the model. As in designing with AT, during this process, group members expressed and explored their ideas by sketching and occasionally gestured to represent their ideas about the geometry of the form, indeed more than that they did in designing with AT. They began to use PMT in service of their design (not for learning) during the process only after they had a conception about the form of the shelter and the layout of the shelter, the seats and the stage on the site (as in Fig. 8). They mainly used the geometric modelling module of the PMT together with an add on for optimizing the geometry of their form.

Throughout their overall design process, team members worked on the design by alternating between closely coupled and loosely coupled modes. They worked in close coupled mode particularly in discussing about and identifying potential areas for the project, defining the constraints, requirements and goals towards framing the problem and generating ideas for solution, and loosely coupled mode particularly while conducting case studies to deepen their understanding about seating arrangements in performance spaces, parametrically designed shelters, and searching for methods to
model the generated form in the PMT, and modelling and fabricating their design proposals.

As can be inferred from the members’ conversations, the group’s conception of parametric design was that it involves generating/fine tuning design based on parameters- where parameters have to be driven from the site, function, etc. Although thinking so, the group did not incorporate any parameters in their generation of design.

4 Discussions and Concluding Remarks

In our study, we observed the teams to carry out similar set of design activities while working with both media with the only exception of their processes with PMT to involve activities relating to the realization and making of the form. We also observed the teams to exhibit different approaches while designing with both media but each team to exhibit similar strategies while designing with different media. Among these outcomes, groups in a sense developing their own ways of designing, approach to design, was an intriguing outcome for us given those that the members of these groups had never worked together and some even did not know each other prior to the class, and they were working with different media. We need to carry out further studies to investigate occurrence of such a phenomenon as group way of designing and its exhibiting itself in different design situations.

In our study, we observed that members of each group interchangeably worked in lose coupled and close coupled modes throughout their design processes, and exhibited similar collaboration behaviours while carrying out similar activities across their different processes, a phenomenon that we refer to as collaborative work style in this paper. We further observed that the groups’ members worked in close-coupled mode at all the times they were working on defining the constraints and goals, generating and evaluating ideas for potential solutions while working with both media. Kwan proposes that collaborative design is cyclic and often co-operative in nature and collaboration occurs at the times of negotiation and evaluation [15] our findings here tells us that collaboration in design can take both forms alternatively and there could be a relationship between the nature of the activities and the collaboration to occur; groups might work in close coupled mode while carrying out activities other than those relating to negotiation and evaluation. They further suggest that different teams might exhibit different patterns of collaboration, and due to each establishing its own collaborative work style and they might have different needs and expectations from collaborative work environments.

In this study, we observed group members to use sketches both for communicating their design intents and thinking about their design ideas as a group, and turn to gestures for communicating visuospatial aspects of their ideas in cases where they can access to a drawing surface. When we asked the groups about their sketching, they said sketches are indispensable for them, if they were to work again as a group, they would utilize sketches as their main medium for sharing and exploring their ideas together, regardless of how experienced they would become in using digital tools. Whether this is just a feeling or a necessity for group design processes for expressing their design ideas, needs to be explored by further studies. Here, gestures deserve attention as a medium
of communicating the design intent and as a means to quickly complement information that is not expressed in referent sketches.

As reported by previous studies [4], members of the two teams employed different methods and approaches for defining and deriving the parameters and thereby generating their designs. In the groups design processes with PMT, the most intriguing observation for us was that the students have different conceptions about how to design parametrically and what parametric design is mainly about. One of the groups seemed to consider that in parametric design constraints and variables can be driven from various sources, which might or might not be critical, related to the needs of the design. This group after exploring variety of sources ranging from form finding experiments with chemical experiments to patterns on leaves at the trees on the site, derived their geometries by generating values based on analyses of swarm behaviour conducted at the site and the grids of the columns of the building on the site. The other group, after stating the need for defining parameters based on site variables, did not carried out a parametric design process and only used the geometric modelling component of the tool for generating a digital representation of their design intent and an add on for form optimization.

Given that some of the students in course had previous experiences with parametric design processes, such as having completed a project in education/practice, we do not know what led to such a conception. This raised the question of how we should teach parametric design and realisation/fabrication processes. We believe that students first should be introduced to concept of parametric design as a methodology in analogue medium so that they apply this knowledge while designing with any digital tool. As such any conceptions of parametric design that might originate from the capabilities and the limitations of the tool can be avoided.

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References

Flat Form: A Software Design for Capturing the Contribution of Personality and Ordinary Activities in the Design Process

Marilena Sorrou 1, Mark Meagher 1

1 University of Sheffield

sorroumarilena@gmail.com, m.meagher@sheffield.ac.uk

Abstract.

Flat form is an ongoing research that introduces a workflow that aims to enhance the contribution of the user during the design process. At first, implicit as well as explicit data, about both space as a living place and the user as a personality, will be captured. Then, the data will be analyzed in order to build an ontology that will eventually be visualized in human readable format. After that, an external application will evaluate the resulting data structure, pointing out any potential conflict between the spatial arrangement and the user’s desires. The outcome will be visualized in a form of a topological diagram that will constitute a new augmented “active” memory for the architect.

Keywords:

Participatory Design, Ontology, Topological Representation, Human-Computer Interaction

1 Introduction

What is a design process? A brief answer could be that a design process is a reaction to a design problem. Usually, such a reaction is considered as a cognitive process that receives, manages and infers information in order to recall or create units of knowledge in the context of a problem-solving method (Definition: Symbolic Order, 2016, Hamel, 1995, Norman, 2013). The information or the unit of knowledge is either stored to or extracted from memory. According to Hamel, memory is divided into three sections, “Long Term Memory”, “Short Term Memory” and “Working Memory” (Hamel, 1995). Each part refers to nonactive, active, and instantly activated information respectively each time a problem solving process occurs.

Normally, humans break down the whole, maybe yet unknown, problem into clear parts using their “active” memory. At the same time they retrieve further information from both “working” and “long term” memory in order to eventually find a solution. Especially for design problems some extra data is required deriving from additional external sources such as visualizations (Hamel, 1995, Alexander, 1965), interviews or live data monitoring.


