Future Resilient Landscape [Architects]

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Abstract: Parametric and computational design processes will evolve and inform the field of landscape architecture. This paper investigates a bottom-up teaching approach about parametric design to novice landscape architecture students as a viable method in their design pursuits. Using a case study, students explored a translation of an intuitive approach to design into a parametric script, taking them through concept ideation, fabrication, and ultimately informing implementation.

Keywords: Parametric design, computational design resiliency, public art installation, script

1 Introduction

Resilient landscape architects will be those who can anticipate, analyze, and address complex landscapes, including those challenges yet to emerge. All professional fields are developing cutting-edge technologies to facilitate the analysis of complex issues and the implementation of viable solutions. The emergence of new technologies in landscape architecture has been a significant factor in the development of this discipline and has facilitated relevant research and design processes. Landscape architecture, now maturing with its own digital design practice including computational design (popularly described as parametric design) is gaining momentum. The use of digital tools and techniques in the field of landscape architecture will continue to grow and evolve in the coming years (WALLIS & RAHMAN 2016).

Fascinating examples of new computational approaches and applications are emerging in landscape architectural projects. However, Bradley Cantrell and Adam Mekies believe that the mechanism through which these applications are implemented remains obscure. This is a missed opportunity since the logic, the thought process and the utilization of parametric design, could have been more evident to launch the complex execution (CANTRELL & MEKIES 2018).

Since 1967, the MIT Media Lab has successfully "civilized" or "tamed" design and computer code through years of effort. In 2003, the team designed the "Scratch" programing language so which began to employ a graphic interface rather than the laborious coding string (NAGLE 2014).

Mitch Resnick, a computer scientist at the MIT Media Lab, conducts the "Lifelong Kindergarten", where children learn to code and create from a very young age (RESNICK 2014). As Resnick indicates, "When you learn to read (code), you can then read (code) to learn."

Coding identified as the core to parametric design describes parametric design thinking as a method, and not a tool. Do design school curricula or instructors provide effective strategies to increase the broader adaption of recent technologies, specifically parametric design, to future students?

In recent years, the potential of computational media and its syntactical interface has been widely explored by young designers through the GUI (Graphical User Interface) syntax of

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scripting. "How can we leverage this newly acquired foothold and understand better what we are gaining from parametric modeling/visual programming/coding as a design process and conceptual generator?" (CANTRELL & MEKIES 2018).

In this study, the authors investigated a kinaesthetic learning approach to cultivate a bottom-up understanding of the computational design process and engage students with advanced digital tools. The goal was to encourage novice students to learn implicit knowledge of the computational design process first, and then learn explicit knowledge, in the following semesters. The emphasis was to employ parametric design tools in the design process rather than limiting, or devaluing, their use to mere digital representation efforts.

The research team supervised a group of six (6) second-year Bachelor of Landscape Architecture students, interested in a public art competition, to utilize computational design tools in concept and design development of a public art piece, and subsequently, its off-site digital fabrication and production, and on-site implementation. Prior to this project, five of the six students had not utilized commercial 3D computer graphics and computer-aided design application software, such as the Rhinoceros 3D, as used for this project. The use of computational design tools facilitated, and elevated, conventional design process activities into an ambitious design and implementation proposal.

2 Analogue (Kinesthesia) to Digital (Parametric)

The group of six (6) students enrolled in an independent course (design studio), co-taught by two faculty members, to prepare a design proposal for a public art design competition. Structured into three (3) phases, the studio included analogue rule sets, parametric/digital rule sets, and fabrication (Figure 1).

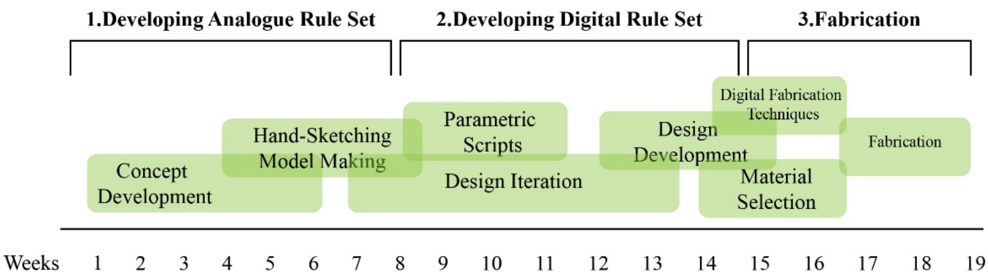

Fig. 1: Three phases of the design studio

The South Park project, by Fletcher Studio, inspired the method so that the computational tools test the resilience of analogue rules for spatial partitioning within a small park in San Francisco, CA. That project's research was prepared for the Acadia 2014 exhibition, an annual parametric design conference (CANTRELL & MEKIES 2018). When Fletcher Studio first began work on San Francisco's South Park, the initial design was developed "through iterative analogue diagramming" with a focus on "an intuitive understanding of the site and embedded in an analogue rule set" (FLETCHER 2021).

2.1 Case Study: South Park, Fletcher Studio, 2017

Fletcher Studio is a landscape architecture and urban design collaborative practice based in San Francisco, California. Fletcher Studio frequently uses parametric design software programs such ash such as Rhinoceros 3D, Grasshopper and Rhino script to test complex forms, functions, and site layout (Amoroso 2012). The Studio sought to reimagine San Francisco's oldest public space (Figure 2) with a contemporary interpretation of the "picturesque style" landscape (CANTRELL & MEKIES 2018). The award-winning design transformed the site from an English strolling garden into an integrated multi-purpose communal space (FLETCHER 2021).

Analogue to Digital: The design intention sought to retain a hierarchy of circulation patterns, access points, social nodes, and existing trees and structures (CANTRELL & MEKIES 2018). "In the initial design phase, these decisions were made through an intuitive understanding of the parameters of the site and embedded in an analogue rule set that guided design decisions" (FLETCHER 2017).

Fig. 2: Plan view of South Park by Fletcher Studio Image: (https://www.fletcher.studio/southpark)

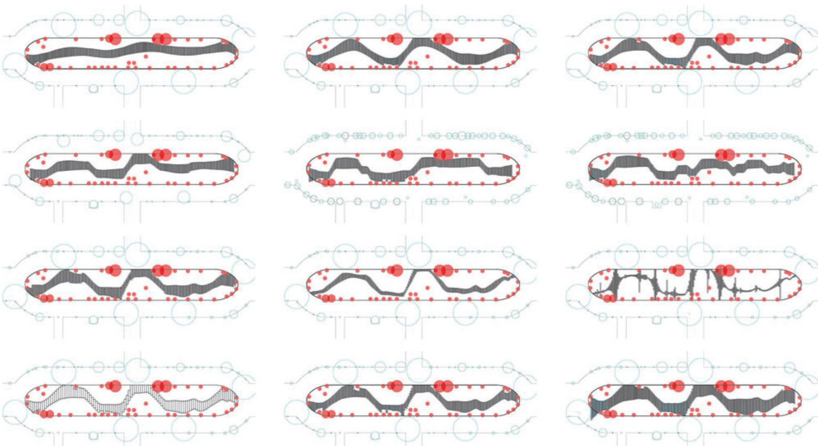

Fig. 3: Parametric scripting allows for the rapid generation of highly detailed design iterations. Fletcher Studio, image from David Fletcher, Parametric and Computational Design in Landscape Architecture, Bradley Cantrell & Adam Mekies (Routledge, 2018), p. 72.

Analogue rule sets require a considerable amount of testing time. “The same “idiosyncratic moments” that allow for the emergence of novel and intriguing design moves can also lead designers to overlook inconsistencies or flaws in their logic.” (FLETCHER 2017). By using a parametric modelling tool in the Rhino 3D software program, the system of organization developed in analogue (on paper), was translated into a Grasshopper digital script. The system evaluated “the design resiliency” of the diagrammed “tectonic and spatial systems” (FLETCHER 2021). This enabled the designers to re-evaluate any flaws in their logic while also rapidly iterating upon the design in detail, without violating the previously established constraints of their design concept (Figure 3).

2.2 Teaching Design Studio

The authors included kinaesthetic learning approaches in the phase of developing analogue rules associated with this studio. Kinaesthetic learning is a learning style in which individuals effectively “learn through doing”. Landscape architecture curricula historically include kinaesthetic learning approaches. Students increase understanding and testing of the products and outcomes of design exploration by touching and manipulating them; hence, practical information is usually preferred over theoretical concepts. A kinesthetic learning experience can aid the teaching of parametric design; one can read about it, listen to instructions, or watch videos of how to design parametrically – but deep learning occurs when one is physically involved with it. For their course, the instructors employed learning approaches including hand-sketching and model making to engage in an intuitive approach to design. These were “hands on” ways of exploring, developing and testing design concepts, aligning with the theme for a public art competition.

Competition Overview: The Winter Stations design competition is an open, single-stage, international design competition held annually in Toronto, Ontario. Guided by a provided theme, participants submit design proposals of temporary winter art installations incorporating the existing lifeguard towers situated along Toronto’s Woodbine Beach, on Lake Ontario. The OneCanada project, informed under the competition’s provided theme of “Resiliency”, and designed and installed by six studio-course students, represents one of several submissions from artists and designers, worldwide, and was the only representation from landscape architecture, let alone an undergraduate student cohort.

2.3 Analogue to Digital

The following phases characterize the study undertaken:

PHASE 1: Developing Analogue Rule Set [Concept]

Students were asked to develop a concept based on the competition theme of Resiliency. Their concept sought to interpret, appreciate, and promote the inspirational example of resilience of the Indigenous peoples of Canada, who continue to withstand adversity and persevere through generations of oppressive colonial policies. The concept also sought to bridge a gap between Indigenous and non-Indigenous peoples through an opportunity of “gathering” among the layering of the seven grandfather teachings (wisdom, love, respect, bravery, honesty, humility, and truth). The students envisioned the teachings to represent seven white, and stacked circular forms, with a situational siting around a Woodbine Beach lifeguard station, representing the collective responsibility in the “guarding of life.” As an obvious beacon along the waterfront, art patrons, guests, and peoples from all backgrounds, could gather at the installation. The seven teachings, originating with the Anishinaabeg, and have been passed down from generation to generation ensuring the survival for all Indigenous peoples.

PHASE 1: Developing Analogue Rule Set [Hand Sketching and Model Making]

Based on the initial concept, students generated ideas and imagined the form of the installation. Due to the lack of experience with 3D modeling software programs, students explored multiple design iterations through hand sketching and physical model making (Figure 4). As a result, the team developed analogue rule sets or design principles that guided design decisions:

1. Using circle as the prime form of installation. Circle is a sacred symbol of the interdependence of all forms of life in Indigenous culture (Stevenson 1999)
2. Represent the seven grandfather teachings in minimum seven independent layers: wisdom, love, respect, bravery, honesty, humility, and truth.
3. Demonstrate unity in a sequence to symbolize bridging the gap between indigenous and non-indigenous people
4. Using a pattern to attach the separate layer which represents strengthening of relationships, and the protection of culture through the gathering and unity between people

Fig. 4: Students presenting their sketch models at the competition site based on the analogue rule sets to develop an intuitive understanding of the form

These analogue rule sets, developed on paper and through model making, were translated into a parametric script using the Grasshopper plugin for the Rhino 3D software program.

PHASE 2: Developing Digital Ruleset [Parametric Script]

Without guiding the students through the complexity of learning algorithms or the coding behind the scripts, three algorithms or scripts developed in **Grasshopper** and were provided in a ready-to-use format to the students. The four (4) rule sets translated to 'input parameters' followed by multiple components in the Grasshopper plugin to rationalise the design process and to operationalise the principles. Using a 'parametric lens', the students could experiment, test, and generate design iterations and several design alternatives which allowed rule-based three-dimensional platform to inform the decision making (Figure 5).

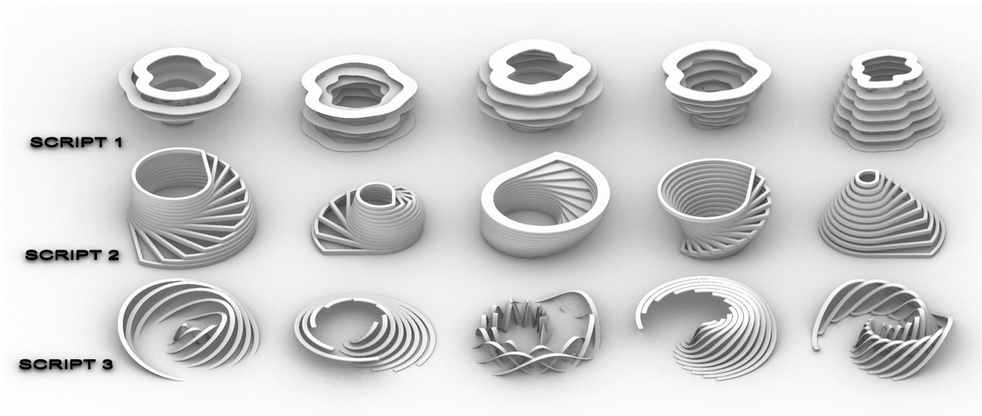

Fig. 5: The design iterations generated by students using 3 scripts. It allowed students speed up the design process and inform decision. It also helped to provide informed evidence-based approaches, so design is less arbitrary, and enabled the implementation of a system thinking approach in class.

The final iteration (Figure 9) and parametric script, for the competition submission, were determined from the various alternatives generated (Figure 6, Figure 7, and Figure 8).

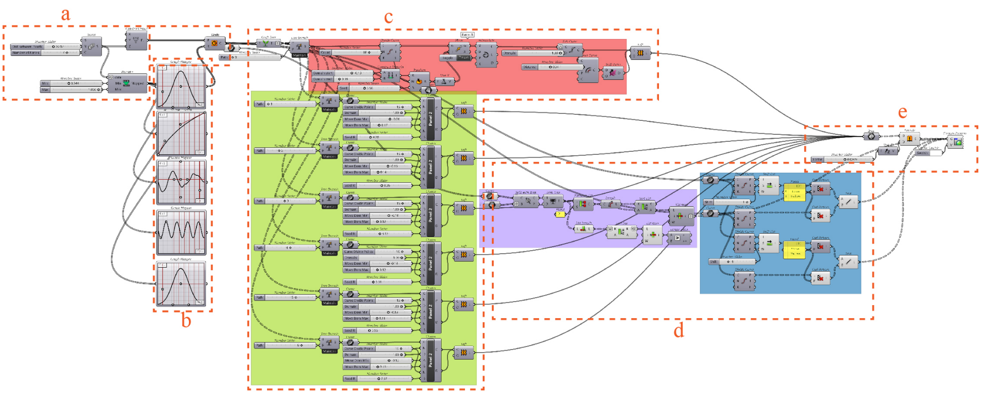

Fig. 6: Final selected script. (a) Rule set 1- Generating base circles. (b) Rule set 3 – Using graph mapper to generate the form iterations based on Bezier, Gaussian, Sine, and Perlin functions. (c) Rule set 2 – Representing 7 rings as symbols of grandfather teachings. (d) Rule set 4 – Creating the rope pattern. (e) 3d model real-time simulation.

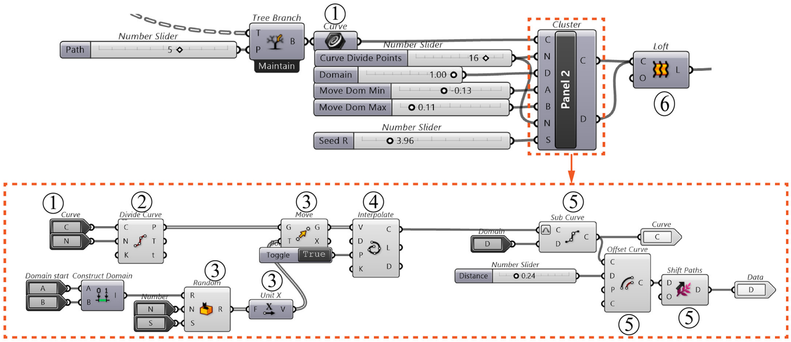

Fig. 7: One module of Rule set 2 (c). The panel components consist of eight sub-components with multiple variables or parameters to generate design iterations.

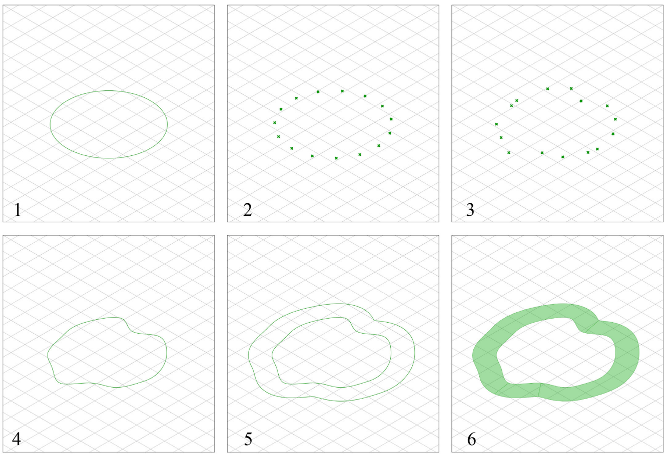

Fig. 8: Each Grandfather Teaching principle is interpreted as a simple circular shape (1). Students are able to choose the ring (shape) number as a variable in the "Tree Branch" component, extract the ring control points (2), move them in random order on xy plane (3), create a new curvilinear geometry (4) which represents the challenges to accomplish unity. Finally, a surface is generated based on the offset component (5 & 6).

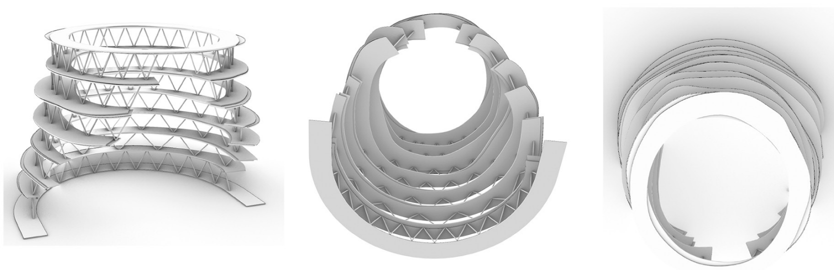

Fig. 9: Final design iteration

PHASE 3: Digital Fabrication [Construction]

With the rising presence of digital modeling in the field of landscape architecture, and accessibility to requisite equipment, digital fabrication has become a major facilitator in the development of research and design, in both professional practice and academia. As described by Andrew Madl "Professional design firms and universities providing use of digital fabrication in-house is becoming increasingly common. How to exploit such equipment is now taught in academic settings as skillset that is in line with traditional model making." (MADL 2022).

Teaching digital fabrication techniques requires significant amounts of time and resources. The intention of this phase was to develop a general introduction and awareness by providing a glimpse into the advantages of parametric design tools.

Fig. 10: The CNC machine cuts the wood panels based on provided construction documents

Fig. 11: OneCanada Installation at Woodbine Beaches in Toronto, Ontario. Photos by Jonathan Sabeniano

Following the previous phases, students were required to prepare construction documentation or "shop drawings" suitable for a professional fabricator. Utilizing computational design tools developed in the previous phases, and through ongoing consultation with CNC fabrication professionals, students learned to prepare the fabrication files and facilitate the CNC cutting process (Figure 10). The goal was to encourage students to experiment with digital modeling and file preparation, suitable to fabrication.

Finally, the project's implementation occurred through a team effort, ranging from detailed off-site work including material determination, metal welding, support strut wrapping, CNC-cut wood panel painting, transport, etc., to on-site assembly and construction (Figure 11).

3 Discussion

In the discourse of architectural fields, the term parametric design is associated with a particular attitude, aesthetic, and theory. Typically, one envisions the outcome as extraordinary and provocative designs that inspire a set of morphological principles (MADL 2022). The first perception of parametric design is limited to contorted formal expressions and the over-sophistication of geometry, which need to be deciphered. While this study emphasizes teaching the process of generating complex formal expressions for a public art installation, the research team addressed the potential of the method for future discoveries more specific to the field of landscape architecture.

In this course, some students gained the full understanding of the potential parametric design thinking offers at the end while a few had difficulties in developing a logic string of design steps that relate to the parametric approach, they preferred or felt back to intuitive or conventional designing. However, the later group was interested to work within the parametric framework if there is a team member managing the scripting part. This might inform an indication of the future of design so that the analogue embraces digital rather than introducing an absolute departure from analogue to digital. While parametric design offered a palette of possibilities, students got exposed to the realities of budget constraints and current limitations of digital fabrication, which eventually reduced the range of possibilities.

Regardless of understanding the details behind the script, the "end product" and the process was well received by the students involved and has encouraged other students, privy to the course, to pursue "script" moving forward.

4 Conclusion and Outlook

Imagined to provide interested students with an implicit understanding of the parametric process and to motivate them to create scripts unique to a project in future, this course enabled students to look outside the box, and even produce their own tool sets. Caroline Westort of Iowa State University explains that future landscape architects will not be only tool users but rather toolmakers. She indicates: "I actually think we do lose something by not training or teaching students the basic building blocks of what's behind the black box, what's behind the software . . . we are an information technology discipline, whether we like it or not." (Bentley

2016). This indicates the need of training future resilient landscape architects, adept at creating script.

Parametric design can be difficult for students who may not have a strong background in computer science or programming. It can also be time-consuming and challenging to learn and use these tools effectively, especially for those who are already comfortable with traditional design approaches and intuition. Many designers will not engage at the high level of syntactical knowledge necessary for scripting given time constraints as one of significant barriers. However, Grasshopper, Rhino, other GUI-based scripting allows designers to more readily connect the outcome of code with the formal representation without having to know how to write code (CANTRELL & MEKIES 2018).

Contemporary landscape architecture theory and practice necessitate the processing and design of data connected with complex systems in order to accurately reflect composite and emergent scenarios (MADL 2022). The field of landscape architecture, along with other design disciplines, are undoubtedly evolving through computational discovery.

Landscape architects and landscape architecture itself can respond to ever-evolving nature of practice and their resulting consequences. The outcomes of this design studio proved that parametric design permits a level of ambiguity, inquiry, discovery, confidence, and execution expected in creative and learning environments.

By training future resilient landscape architects with computational tools, universities and educational institutions can make a significant contribution in keeping pace with evolving principles. It is expected that these skilled professional practitioners and researchers will be introduced to the community, adequately versed, and improve the model of practice-based research, which ultimately improves conventional and speculative design workflows.

References

AMOROSO, N. (2012), Digital Landscape Architecture Now. Thames & Hudson Inc., New York.

BENTLEY, C. (2016), Follow the Script: Computation Reshapes Landscapes – And Thinking. Landscape Architecture Magazine, pp. 70.

CANTRELL, B. & MEKIES, A. (2018), Codify: Parametric and Computational Design in Landscape Architecture. Routledge Taylor & Francis Group, Abingdon, OX/New York, NY.

FLETCHER STUDIO (2017), Project: South Park. https://www.fletcher.studio/blog/2017/5/26/the-parametric-park.

FLETCHER STUDIO (2021), Project: South Park. https://www.fletcher.studio/southpark.

MADL, A. (2022), Parametric Design for Landscape Architects. Routledge, New York, NY.

NAGLE, J. (2014), Getting to Know Scratch. The Rosen Publishing Group, Inc.

RESNICK, M. (2012), TED Talk. www.ted.com/talks/mitch_resnick_let_s_teach_kids_to_code.

WALLIS, J. & RAHMANN, H. (2016), Landscape Architecture and Digital Technologies: Reconceptualising design and making. 1st Ed. Routledge, New York, NY.