Chapter 3

Slow Computing: Teaching Generative Design with Shape Grammars

Terry Knight
Massachusetts Institute of Technology, USA

ABSTRACT
This chapter describes the teaching of shape grammars within an architectural design program. Developed over thirty years ago, shape grammars remain today a distinctive computational paradigm – a slow paradigm – for generative design. Shape grammars are visual and perceptual and, at root, non-digital. They are expressive and interpretive, as well as creative and generative. They foster unhurried, reflective design computing. To promote these unique computational features, shape grammars are taught using a manual approach in a collaborative, learning-by-making environment. An overview of the teaching of shape grammars at the Massachusetts Institute of Technology is given here. The potentials and challenges for slow computing versus fast computing by machine, in teaching and in design practice, are considered.

INTRODUCTION
This chapter describes the teaching of shape grammars within an architectural design program. Developed over thirty years ago, shape grammars remain today a distinctive computational paradigm – a slow paradigm – for generative design.

Shape grammars are visual and perceptual and, at root, non-digital. They foster unhurried and reflective computation through shape ambiguity and emergence. They foster explanation and understanding of design computations in addition to the generation of designs. Shape grammars are not solely a means to an end (the production of designs) but an end in themselves. To promote these unique computational features, shape
grammars are taught using a manual approach in a collaborative, learning-by-making environment. Deliberative, by-hand shape calculations allow students to develop a rich understanding of shape grammars, and computation in general. They build a command over the development and consequences of computations and are better able to generate successful results. Computers do not have a central role in this learning environment. Students are the computers – slow computers.

The teaching approach described here has some parallels with ideas from theories of education and learning, in particular, situated learning (Lave and Wenger, 1991) and constructionism (Harel & Papert, 1991). It shares with situated learning the idea that social interaction and collaboration among learners in an activity-based environment is key to learning. It shares with constructivism that idea that learning is most successful when learners make tangible, public artifacts for reflection and for conversation with others. In general, the pedagogy for teaching shape grammars described here assumes that a good appreciation and understanding of shape grammars cannot be transmitted abstractly from teacher to student, rather it must be created through active doing and making.

The teaching approach described here also has some very loose affinities with ideas from “slow” movements (Honoré, 2004) – for example, slow design (Strauss & Faud-Luke, 2008), slow technology (Hallnäs & Redström, 2001) and slow education such as slow reading and writing (Bauerlein, 2008). The agendas of these various movements range from the personal to the political, and are difficult to encapsulate. However, the approach here shares with slow theories their general advocacy for the benefits of slow, reflective, physical or sensory engagement in activities. While slow theories usually do not argue for or against digital technology or computers, the idea is that when technology is used it must be put to the service of reflection and awareness. Where digital technology is seen to impede understanding, as some argue is the case for reading and writing, then it should be avoided or supplemented with other media. A premise of the approach here is that computers do not help initial learning about shape grammars, and therefore are not part of introductory teaching.

The remainder of this chapter is organized in three sections. Shape grammars and their distinctive characteristics and mechanics are introduced in the Background section. They are discussed relative to other generative design approaches and situated in the early history of computation. A brief review of shape grammar research and teaching over the years is also given.

The next section, Teaching Slow Computing, describes a two-semester sequence of shape grammar courses in the Department of Architecture at the Massachusetts Institute of Technology (MIT). The objectives, structure, teaching approach, and outcomes of the courses are discussed. The foremost objective of these courses, especially the first semester course, is for students to begin to see the design potentials of shape grammars and to begin applying shape grammars in their own work with just a minimal introduction to the mechanics of shape grammars. Slow, in-class exercises with pencil and paper and with physical 3D shapes are central to this goal. Teaching follows a spiral approach giving students multiple opportunities to absorb and practice shape grammar fundamentals at varying levels of complexity, and in the context of different design activities and problems – from analysis to synthesis, in 2D and in 3D, and in team and individual work. Student projects are an important aspect of learning, and importantly, they often inspire new avenues of research in the field. In this regard, recent student work combining forms with material properties and physical behaviors in grammars is highlighted.

Challenges for advancing slow computing within and beyond introductory shape grammar courses are discussed in the last section, Conclusion and Future Directions. Roles of fast computing using computers and digital technologies in academic and professional settings are discussed.
Related Content

Mapping the Relationship Between the CDIO Syllabus and the CEAB Graduate Attributes: An Update
[www.irma-international.org/article/mapping-relationship-between-cdio-syllabus/67130/](www.irma-international.org/article/mapping-relationship-between-cdio-syllabus/67130/)

Web-Enabled Remote Control Laboratory Using an Embedded Ethernet Microcontroller
[www.irma-international.org/chapter/web-enabled-remote-control-laboratory/61465/](www.irma-international.org/chapter/web-enabled-remote-control-laboratory/61465/)

Module-Based Teaching of Mechanical Design
[www.irma-international.org/chapter/module-based-teaching-of-mechanical-design/100679/](www.irma-international.org/chapter/module-based-teaching-of-mechanical-design/100679/)

Problems First, Second, and Third
[www.irma-international.org/article/problems-first-second-and-third/134454/](www.irma-international.org/article/problems-first-second-and-third/134454/)

Introducing Problem Based Learning (PBL) in Textile Engineering Education and Assessing its Influence on Six Sigma Project Implementation