Chapter 5
A Pedagogical Model to Integrate Computational Thinking Logic to First Year Design Studio

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ABSTRACT

Today, computational thinking and computational design approaches transform almost all stages of architectural practice and education. In this context, since students are most likely to encounter computers, in this study, the approach of teaching students computational design logic is adopted instead of teaching how to use computers only as a drafting or representation tool. This study focuses on developing a pedagogical model that aims to teach computational thinking logic and analog computing through a design process. The proposed model consists of four modules as follows: abstraction of music and text (Module 1), decomposition of buildings (Module 2), analysis of body-space (Module 3), design of a space by the help of spatial patterns (Module 4). The proposed model is applied to first-year students in Interior Design Studio in the 2019-2020 fall semester. As a result of Module 4, students designed both anticipated and unanticipated spaces in an algorithmic way.

INTRODUCTION

The concept of "computational thinking" interested the research of almost all disciplines of sciences and humanities such as architecture, biology, economics, engineering, education, and statics (Bundy, 2007; Wing, 2008; Wing, 2011). Wing (2006; 2008; 2011) defines computational thinking as an analytical way and a mental activity of humans to formulate and solve a problem. Computational thinking also

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presents a universal and fundamental skill set that can be learned and used by everyone without any expertise (Wing, 2006; Cuny et al., 2010). The core concepts of computational thinking can be listed as follows: algorithmic thinking, abstraction, decomposition, evaluation, and generalization (Selby and Woollard, 2013; Curzon et al., 2014). When dealing with a complex problem, the phases and stages of the computational thinking processes are intertwined, also operated in parallel and recursively.

In computational thinking, humans as an information processing agent do not act like computers, on the contrary, agents contribute to the process with their creativity. In these cases, where each individual has a different mental skill set, intuition, and reasoning incorporated with the process, the variety of solutions to the problem is expected. In other words, unlike computers, humans can create different outputs with the same inputs (Wing, 2006).

During the last decades, with the emergence of computational systems and rapid development of technology "computational design" as one of the computational-based approaches adopted by the architectural design field became prominent (Dino, 2012). With the developments, computational design approaches have been transforming the designs from conceptualization to modeling/representation and production phases both in architectural education and practice. Particularly, in the architectural design education, the potential encounter and communication of students with technological tools, devices, and software have emerged the need for adoption of computational thinking logic by the students.

In response to this necessity, teaching computational thinking logic to the students is faced as a challenge because of the previously accepted traditional design education methods. As Lawson (2005) emphasized, in the traditional design studio students keep their focus and spend most of their time on the end product, instead of being involved in the stages of the design process.

The paradigm shift brought along by the information age changed the characteristic of the design process where the design process is no longer a mechanical sequence (end-product oriented) but a series of steps including thinking and actions that model the design's logic (process-oriented) (Uysal and Topaloğlu, 2016). Similarly, Oxman (2006) states that current theories related to digital design changes not only the representation of design (form) but also the way of thinking. With this new theory, the concept of form (end product) transformed into the concept of formation.

In the traditional design studio, representing the end product with scaled drawings is a common approach. However, drawings only show the end product itself and do not reflect the system or logic developed during the design process. In this context, teaching students how to explain and represent their design processes is faced as another challenge.

Based on these shortcomings, the authors proposed a pedagogical model that aims to teach computational thinking logic through a design process including 4 integrated tasks. Another aim of this study is to teach basic computational design concepts implicitly and how to perform analog computing through the process. The proposed method is applied to first-year students in Interior Design Studio 1 course in the 2019-2020 fall semester.

The principal questions intended to be pursued within this study are as follows:

- How can the process-based design approach be taught to students by avoiding a product-oriented approach?
- Can first-year students learn computational design concepts and integrate them into their design processes without using a computer?
- Can first-year students explain their computation-based design processes with conventional representation techniques?