

Architectural Design Studio as an 'Extended Problem Space'

F. Zeynep Ata and Fehmi Doğan

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Drawing on the foundational theory of Zone of Proximal Development, this paper approaches dominant architectural design studio pedagogies critically and explores how the concept of 'extended problem space' can help develop better pedagogies for design learning. A conceptual framework is introduced through a theoretical understanding of architectural design studios' multi-layered environmental sphere of cognitive systems based on previous research on studio education. The formation of the framework is inspired by an earlier study carried out in knowledge production and transmission processes in a research laboratory that considers the human and non-human components of the laboratory within an evolutionary mechanism. Cognitive components of architectural design studios, hence, are described through the social, cultural, material, and temporal dimensions within an understanding of embodied, distributed, enculturated, situated, and extended cognition. Next step of this conceptual study is to explore architectural design studios' cognitive systems empirically to investigate dynamics among cognitive components in different settings.

Keywords: situated cognition; extended cognition; learning environment; design studio; problem space

Introduction

Recent research on learning has increasingly focused on the role of the environment in its most comprehensive understanding of learning processes and is clustered mainly under the concept of situatedness (see Lave&Wenger, 1991; Greeno, 1998; Wenger, 1998; Newstetter, Nersessian & Kurz-Milcke, 2002; Henning, 2004; Engeström, 1991; 2014; Greeno & Engeström, 2014). The literature on situated learning reveals positive and negative impacts of social, cultural, material, and temporal dimensions (hereafter will be referred to as "multi-layered") in professional learning environments on cognitive processes (e.g. Herrington, 2005; Yeoman&Wilson, 2019; Franca&DeLuca, 2019). The motivation of these studies is to develop pedagogies that conceptualize the environment as a scaffold for learning. Vygotsky's seminal study on learning and development (Vygotsky, 1978) is the foundation of these studies (see Engeström, 1991; 2014; Sawyer, 2014; Reiser& Tabak, 2014). Vygotsky's theory reformulated learning as more than an individual mental activity. The theory approaches learning processes from an environmental perspective that focuses on the scaffolding impact of the physical, social and cultural environments in learners' cognitive processes of internalization of the knowledge.

In this study, the focus is on the environmental dynamics within the architectural design studio (hereafter will also be referred to as "design studio" or "studio") which is the core learning environment of architectural design education (hereafter will be also referred to as "design education"). Design studio is not just a physical environment; it embodies the studio culture, curriculum, social relations, and many other aspects of design learning albeit mostly implicitly. It has been one of the exemplary learning environments for professional education as Schön (1987) proposed in his theory of 'reflective practice'. It is both a formal and an informal learning environment that engagement with the place is considerably higher compared to classrooms. Such engagement has a higher impact (negative and positive) on learning. While Schön (1981; 1987) mostly focused on its positive impacts, many scholars criticize that there are problems in design studio learning because of high subjectivity, individuality, weak collaboration, hierarchy, excessive focus on crafting, or weakness in theoretical development (see Rapoport, 1984; Dutton, 1987; Webster, 2005; 2008; Tzonis, 2014; Frascara,



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2020; Meyer&Norman, 2020).

Research on studio conducted from a cognitive perspective mostly investigates different methods for design learning in the studio like the use of computation or crafting in designing (see Oxman, 2008; Koronis et al., 2021), or focuses on specific dimensions of the studio environment such as physical space, tutor-student communication, studio culture, or collaboration (see Thoring et al., 2018; Davidovitch&Casakin, 2015; Goldschmidt et al., 2010; Oh, et al., 2013; Ward,1990; Ketizmen Onal & Turgut, 2017; Vyas, 2012). Yet, as studies of situated learning suggests studio's multi-layered dimensions have a holistic impact on the learning processes. Hence, the aim of this conceptual study is to propose a theoretical framework to conceptualize design learning pedagogy taking into consideration the multiple layers of design studio.

In this study, the studio environment is defined as an 'extended problem space' following Nersessian's (2005) conception of research laboratory's knowledge production and transmission. Newell and Simon (1971) introduced the concept of 'problem space' to study problem-solving. The concept was further expanded in Nersessian (2005) in her studies of laboratory settings. In this paper, we elaborate on Nersessian's definition together with Vygotsky's theory of learning to conceptualize a framework that might respond to some of the issues highlighted by recent research in design learning. Accordingly, the 'extended problem space' concept in this paper is defined as an abstract multi-layered environment of all human, non-human, and conceptual components that take part in design learning, as well as the interaction among them. Thus, 'extended problem space' includes at least learners, tutors, visiting professionals, representational tools, representational materials, terminology, physical space of the studio hall, architectural space in the real world, the curriculum, the library, and the studio traditions like design jury and one-to-one tutor critiques.

This paper begins with the "Theoretical Perspective" section that gives a summary of the environmental perspectives in learning starting from Vygotsky's approach to an overview of current research. This is followed by "Design Studio Learning Framework" section introducing a design learning pedagogy concept that proposes parameters for design learning process supported by multi-layered contexts. Use of the framework is illustrated in a visual diagram as a model for future studies to explore the dynamics of cognitive components empirically in different settings. Finally, in the "Discussion" section, existing studio pedagogies are critically examined through a holistic environmental perspective and prospective future studies based on the proposed framework are discussed.

Theoretical Perspective

The literature on situated learning mostly criticizes the poor qualities of formal learning places and curriculums (see Freire, 1968; Lave & Wenger, 1991; Greeno, 1998). The underlying cause of this poverty seems to be the positivist tendencies that approach learning as a merely mental activity (see Schön, 1987). Situated learning researchers, on the contrary, consider learning as an embodied and socially constructed process. Their proposal is based on the efficient involvement of the multi-layered environment into learning processes. They mostly draw on the foundational theory of Vygotsky (1978), and especially the concept of Zone of Proximal Development. Despite being focused on development in childhood, the theory is interpreted as a helpful guide in understanding the human faculty of learning in general. It emphasizes the critical role of human interactivity with the environment in learning processes. In this theory, language use and tool use are suggested as the main instruments of human development as they regulate and enhance the interaction with the environment (Vygotsky, 1978). In the situated learning literature, the environment is proposed as a scaffold in the learning processes (Brown et al., 1989).

The main focus of situated learning literature is the social-cultural relations among the learners' and teachers' community, as seen in studies of Freire (1968), Lave and Wenger (1991), and Brown and colleagues (1989). All have explored how environment, especially the social context, can influence learning processes positively. Freire's (1968) 'culture circles' was a proposal of equal and free dialogue groups that a social environment facilitates. Later, Lave & Wenger's (1991) theory of 'legitimate peripheral participation' has been a framework for master apprenticeship setting that novice ones gradually become involved in the practice and in time become professionals. Similarly, Brown and colleagues (1989) proposed the concept of 'cognitive apprenticeship' in which they build on the traditional master apprenticeship setting as the starting point for a multi-layered pedagogy. They highlighted the significance of 'authentic activities' in learning processes, which they explained as learning activities that are situated within "coherent, meaningful and purposeful activities" like the activities of practice in the real world (Brown et al, 1989, p.34).

Schön's theory of 'reflective practice' has been influential in higher education. Schön criticizes the weaknesses of impoverished positivist education in professional education (Schön, 1987). As he emphasizes, the result of such an educational setting is "the crisis of confidence in professional knowledge" (p.3). He proposes

architectural design studio as a model for professional education. His ideas on studio education influenced many educators to adopt studio setting in educational processes (see Wacks, 2001; Shaffer, 2003; 2004; Reimer&Douglas, 2003; Griffiths, 2020).

Another stream of research was by Engeström and his colleagues; they build on Vygotsky's philosophy to frame the Activity Theory. They define the activity system as including at least "the object, subject, mediating artifacts (signs and tools), rules, community, and division of labor" (1999, p.9). Their studies are more related to collective activity rather than individual activity and based on the cultural-historical school of Russian psychology (Engeström et al., 1999). Engeström and colleagues' studies (1991; 1995; 1999; 2000) focus on the collectivity of the activity considering the value of criticism, change, and novelty in organizations. They criticize Lave and Wenger's 'legitimate peripheral participation' as it misses an important aspect in communities of practice: "questioning of authority, criticism, innovation, initiation of change" (p.12). The master-dominancy and closedness of the practice were indeed the main weakness of master apprenticeship settings. Yet, as Lave and Wenger (1991) argued, the communities of practices are powerful enculturation mediums for novice ones, whereas formal learning communities usually lack in providing that engagement and just promote individual activity.

As Nersessian (2008) explains the situatedness and distributedness of cognition emerge and evolve in a system, not merely in the mind or in the world since every mental activity in fact interacts with "other material and informational systems (including other humans)" (p.117). There is a continuous and dynamic connection between human brains, bodies, and multi-layered environments in any cognitive process that forms interlocking 'systems' (see Sprevak, 2020). Clark's (2008) concept of 'cognitive niche construction' is a valuable viewpoint in exploring human development in practice in everyday settings within the influence of the culture it embodies. Cognitive niche construction is defined as the "process" by which humans "transform problem spaces" through constructing their own environments that facilitate their activities (p.62). This process is a long-term one that is developed within the evolution of the specific social, cultural, and material contexts (Clark, 2008). The environment accordingly becomes the 'cultural cognitive niche' with its cognitive offloading mechanism in which a novice learns to carry out the activities (Clark, 2008). Clark's example is a bartender who learns how to prepare the drinks according to the order of orders with the help of the diverse shapes of the glasses. In this example the material environment support novices to learn practices through the already structured setting that evolved in long terms of practice.

The environmental perspective of learning that involves the interaction with the material environment increased after the 1990s (see Clark, 1996; 2001; Hutchins, 1995; Hutchins&Klausen, 1996). Thought experiments of Clark's hypothesis of extended mind have usually been technological artifacts that people use or can possibly use in the future as an extension of body and mind (see Clark, 1996; 2001; 2008; 2012). Hutchins's study (1995) on pilot training on plane cockpits was about the use of material environment functions developed through technology as a cognitive offloading mechanism. In Hutchins's study (1995), tasks in the cockpit are distributed among the equipment and people. For novice ones, the cockpit is a classroom where learning happens within shared activities; these activities are important components of "learning a complex job like flying an airplane" (Hutchins, 1995, p.13).

When viewed from an individual's perspective, there seem to be two dimensions that should be considered in processes of engagement with the environment: expansion and implicitness. The first dimension is the expansion of cognition as Clark defines. Clark (2008) explains the embodiment in the world as a process of gradually creating a broader and fluent existence within the 'extrabodily world'. This embodiment leads an individual to define the body as 'transparent equipment' (see Clark, 2008 in reference to Heidegger, 1927/1961). Accordingly, the more an individual becomes fluent within the environment, the more h(er/is) mind 'expands' to the environment (Clark, 2008). This paper interprets this 'expansion' to the multi-layered environment as learning.

The mechanism of engagement with the environment in cognitive processes are also explained with 'internal' and 'external' representations. Nersessian (2008) proposed that "coupled cognitive system" consisting of a "relationship between the internal and external worlds" constitutes the basis of representational components of cognition in general (p.115-116). An architect's sketching process is not a process of reflecting the ideas in mind, but it is a process of supporting design thinking process, just like using a pen and paper for mathematical calculations.

The second dimension of engagement with the environment is the implicitness of the engagement. Research on human perception and learning shows that interaction with the environment is primarily through implicit and automatic processes (see: Lewicki, 1986; Reber, 1989). These studies support that implicit and explicit learning processes are intertwined, so the implicitness of the processes is not distinguishable from the explicit ones (Reber, 1989). Indeed, enculturation of the environment is a way of transforming human cognition both

explicitly and implicitly, as seen in both Clark's 'cognitive niche construction' and Hutchin's plane cockpit. Interested in both perspectives (from humans' and from environment's), this paper uses Newstetter, Nersessian, and colleagues' study (2002) as a model for interpreting the role of the environment in design learning processes. Their study compares distinct characteristics in a research laboratory and an undergraduate course classroom. Research laboratory is evaluated as an environment of in-vivo activities. It involves interacting human and non-human components (Newstetter et al., 2002). The study shows that such an environment of in-vivo activities is more effective in learning rather than learning in a classroom environment (Newstetter et al., 2002). Accordingly, they argue that for better learning processes, the knowledge production processes in laboratory should interact with the classroom knowledge production processes (Newstetter et al., 2002). Nersessian's (2005) succeeding publication proposed that laboratory environment is a dynamic and 'extended problem space' "with permeable boundaries" as an "evolving distributed cognitive system" (see "cognitive system" in Hutchins, 1995) within its social, cultural, and material environment (p.15). Her definition highlights the distributed nature of problem-solving (see Newstetter, Nersessian, and Kurz-Milcke, 2002; Nersessian, 2005; Nersessian, 2006; Kurz-Milcke, E. & Nersessian, N. J. & Newstetter, W., 2003). Newell and Simon's (1971) concept of 'problem space', in fact, was criticized by scholars and several proposals were given to expand it (see Greeno, 1998; Kirsch, 2007). The proposals by situated cognition researchers were potentially richer characterization of 'problem space' that considers the role of the environment. Nersessian's (2005) definition is based on those. It includes all "resources for problem-solving" which are "people, technology, techniques, knowledge resources (e.g., articles, books, artifacts, the internet), problems, and relationships" (Nersessian, 2005, p.20). From the situative perspective, every problem depends on the conditions of the environment it is in, and each is solved through reasoning using material and cultural resources in the environment (Kirsch, 2007). Hence the so-called problem depends on the "discourse" of the activity; therefore, it is "socially structured" (Kirsch, 2007, p.266).

When interpreted from the perspective of the theory of Zone of Proximal Development, the multi-layered learning environment is in fact the 'extended problem space' for design learning processes in the studio. The environment is both the reflection of how the education is intended to take place and the reflection of how learning processes are performed. Learning environments are socially, materially, and culturally structured and thus have the potential to scaffold learning like it is in the research laboratory study of Nersessian, or not support an efficient learning process like it is in classroom learning settings. Schön's (1987) proposal of architectural design studio as an exemplary learning environment for professional education was also partly for its potential in scaffolding novice ones, due to its rich communicative setting. Indeed, studio environment is potentially an efficient place for design learning if the limiting characteristics of the studio culture are understood and mitigated.

The following section is a proposal of a monitoring tool that considers diverse components involved in the cognitive systems within the 'extended problem space' of studio. The proposed theoretical framework is a model which involves dynamics of the cognitive components in different studio settings. The function of the framework is modeling the scaffolding role of the multi-layered environment of studio. The main target of this model is to compare different settings in future studies to reach which patterns of multi-layered environment serve better for architectural design studio education.

Design Studio Learning Framework

If learning is an internal cognitive construction with internal and external processes, designing is, in the reverse direction, an external construction with internal and external processes. This requires effective use of 'coupled representations' that Nersessian (2008) mentions, such as design thinking processes with the use of modeling and sketching. In other words, the design learning process is already a process that progresses in interaction with the environment. And the environment can be both facilitator and inhibitor in these processes. The conceptual model proposed here considers the impacts of the studio environment on design learning and suggests parameters to monitor and evaluate its role in scaffolding within an understanding of embodied, distributed, enculturated, situated, and extended cognition.

Design is a human act of situated 'material creation'. Designers do not just deal with the 'human-made world', but with the totality of everyday life. (S)he also deals with human experiences, psychological processes, social interactions, or interactions with nature. Gero and Kulinski (2000) define 'situated design' as "a conversational activity between the designer and the physical expression (representation) of his/her design ideas" (p.213).

This perspective is limited because it does not include the main environmental sphere introduced with the situatedness and the designer's dynamic complex interaction with its environment. Chiu (2003), elaborated on Gero and Kulinski's model by adding two levels. In the "micro-level", the model includes (a) exploring and

thinking on precedents, (b) thinking on the design problem and its environmental circumstances, (c) space of working and working tools. The "macro-level" involves (d) communicating to the group of people at the workplace and (e) interaction with the culture. Gero and Kannengiesser's (2003) study proposed a wider conception that focuses on the environment. They introduced three environmental types comprising (a) the 'external world', (b) the 'interpreted world', and (c) the "expected world". This advanced model tends to divide the 'world' into two in terms of "external" and "interpreted". Hence, the body and the adopted tools can either be included in the interpreted world or the external world. However, as Clark (2008) underlines, cognition within the "extrabodily world" is enabled through considering the body as "transparent equipment". We can interpret these 'extrabodily' tools as part of our cognitive 'fluency' as long as we adopt them as if they are 'extensions of our body'. Polanyi (1967) supports this idea arguing that "whenever we use certain things for attending from them to other things, in the way in which we always use our own body, these things change their appearance" (p. 16). He continues, "they appear to us now in terms of the entities to which we are attending from them, just as we feel our own body in terms of the things outside to which we are attending from our body" (p. 16). Accordingly, the 'tool' we are "attending from" becomes the "transparent equipment", whether it is the corporeal body or a tool. Furthermore, all social, cultural, and material interactions became "transparent equipment" when we are "attending from" them. So, expanding the cognitive system into the social, cultural, and material environment results in gaining the mentioned fluency in designing processes. This model considers the use of the environment in design learning as potential 'transparent equipment' of learners, which, then, could be conceptualized as an 'extended problem space'. Hence, change in the studio environment is crucial. The change in the cognitive systems of studio is considered based on two main pillars comprising (1) cognitive expansion of the learners through implicit and explicit learning processes and (2) evolution of the environment (including artifacts) due to interaction among human and non-human agencies.

Cognitive Expansion

Design studio is the medium of designing in interaction with the cognitive systems in the environment. The focused cognitive processes are mainly 'outside' the cognitive components which mean the focus is on the interactions/relationships of these components. All interactions/relationships conducted by learners and tutors are potential 'transparent equipment's for them. In order to become 'transparent equipment', learners' internalization of design learning is achieved through developing certain skills to an advanced level and appropriation of the design 'body of knowledge' within a critical stance.

The skills and the design knowledge are implicitly or explicitly acquired by a learner through the scaffolding of the environment. This scaffold is modeled as a network of cognitive components that embodies the abstract concept of 'extended problem space'. The cognitive components are envisaged as comprising at least learners, tutors, visiting professionals, representational tools, representational materials, terminology, physical space of the studio hall, architectural space in the real world, internet, and the library (see Figure 1). The outsider cognitive components of the studio environment are what the studio environment cannot transform single-handedly. These outsiders are at least architectural space in the real world, internet, terminology, and library. The insider cognitive components of the studio environment are what the studio environment can transform. These insiders are at least tutors, learners, representational tools, materials, and design representations (external representations). As a result, studio pedagogies are seen as regulators of the interactions among insiders in the studio.

As seen in Figure 1, there are two types of relationships among these cognitive components. One is through material interaction, and the other is through social interaction. Material interaction is physical/perceptual; hence it is embodied; social interaction is communicative. Dynamics within the cognitive systems of studio are reflections of the cognitive expansion. Positive effects of these dynamics on design production are the indicators of efficient learning processes in the studio environment. For example, communication between two students in the studio about their design schemes can help both develop their knowledge; or a student can experience characteristics of a material in a building material library that can help h(er/im) to increase awareness for most suitable ways to use this material in design or learning to use a parametric 3d modeling software with the help of a friend can help a student develop skills of computational design.

In fact, the quality of the relationship is the driving force of learning more than the existence of the interaction among agents in the design studio. Hence, this conceptual model seeks qualitative aspects of the structured relationships in different studio settings. In-depth interviews with learners and tutors are necessary tools to develop an understanding of quality in these relationships. The environment of the virtual studio, on the other hand, is considered to be a perfect medium to quantitatively analyze these relationships.

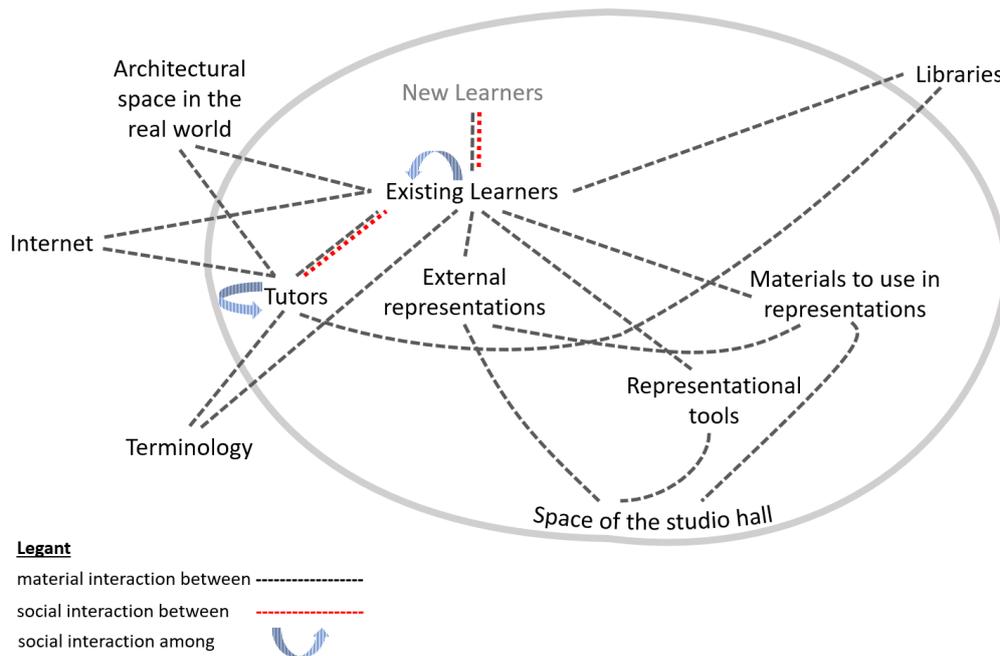


Figure 1. Cognitive components of the studio and the network of relationships

Evolutionary Aspects

The interrelations of the cognitive components are considered as the most important factors in the evolution of the cognitive components and the environment. The other dimension that influences this evolution is the temporal context. That is, the studio traditions such as design jury, weekly one-to-one critiques with tutors, duration of courses, or design projects are accepted as evolutionary actors in the studio. They shape the characteristics of the relationships between cognitive components, and they are drivers of when and how the evolution of the systems happens.

Depending on the curriculum, a studio can be either an ongoing medium for designing processes that new learners can get involved from time to time or an episodic medium for learners of specific time periods (like semester-based studios). In any case, studio's cognitive systems are always in an evolutionary process either in an implicit or in an explicit way. In this model, the evolution of the systems is considered on three levels, comprising (1) the microevolution of the design representations, (2) the evolution of learners throughout design learning processes, and (3) macroevolution of the studio settings.

The microevolution of the design representations is a visually observable process. The development of design can be observed through representative objects that we consider as part of coupled representations in design thinking processes. These objects mostly trigger the following steps taken in the design thinking process. They are both like frozen pictures of the process and they can become standalone artifacts. They represent the fastest level of evolution in the studio.

The evolution of learners throughout design learning processes is the most important aspect of evolution in the studio. It reflects how effective the studio environment is in the learning processes and it is the mainline this model will focus on. The analysis of the microevolution of the design representations will enrich the understanding of this process.

The macroevolution of the studio settings is what the model will monitor in different studio settings in comparison. The analysis of the evolution of learners throughout design learning processes will enrich the understanding of this process. The analysis of this macroevolution of the studio settings will help us to understand possible directions that the material, social, cultural, and temporal environment influence studio learning processes.

Discussion

Studio setting is a more lively environment compared to classroom setting; but we believe that common studio pedagogies are usually difficult to adapt, especially for new learners. The difficulty of crafting, use of terminology, individuality, hierarchy, design juries, or high subjectivity of design are among challenges for the novices in studio.

Seeing the design studio as an 'extended problem space', on the other hand, offers an alternative. It changes both the description of the design problem and differentiates the structure of problem-solving processes. Accordingly, the problem is no longer just the student's individual problem, but the whole group of students' communal problem. The design problem becomes a problem solved together with peers and instructors in the studio, interacting with the physical, social, and cultural environment. We believe that current studio pedagogies cannot consider different layers of the studio from a holistic perspective within a critical stance. When examined from such a holistic perspective, the proposed model can evaluate, for example, the effects of 'hidden curriculum' (see Dutton, 1987) on learning processes by associating it with the physical environment of the studio, communication styles among students, or the use of representation tools.

Questioning Studio Pedagogies

After Schön (1987), the studio pedagogy is further scrutinized (see Lawson & Dorst, 2013), but in many architecture schools around the world, the accustomed studio framework has stayed essentially unchanged for decades. Problems related to the studio pedagogies have been discussed through the concept of 'hidden curriculum' (see Dutton, 1987), power relations (see Webster, 2005; Webster, 2008), master-apprenticeship hierarchy (see Rapoport, 1984), or weakness in design theory (see Meyer&Norman, 2020). Yet, we believe that the problems are intertwined among the cognitive components. For example, the desk crit and design jury with the grading system support the dominance of the studio tutor as the 'master', whose wisdom cannot be questioned (see Rapoport, 1984). Yet, it is known that the studio tutor and students' one-to-one relationships do not demonstrate an ideal symmetrical structure, as evidenced in Schön's (1987) Petra-Quist and Judith-Northover dialogues. Judith-Northover dialogues show that the student is disturbed by the dominance of the tutor; she does not want to accept him as a 'master'; and there is no communication between them that will benefit from the experience of the tutor (Schön, 1987). On the other hand, Quist and Johanna's communication shows that these dialogues can be constructive.

As Dutton (1987) emphasizes, collaboration in the studio is usually weak which is in contrast to the laboratory setting studied by Newstetter and Nersessian. The design is accomplished individually and is mostly isolated from peers. Of course, this is rooted not just in the grading system, but also in the individualist lifestyle in everyday socio-cultural life emphasized by the design world. Still, learning processes are negatively affected by this individualism (Dutton, 1987), and such individual learning processes increase resistance to the benefits of situated learning, just like it is in real-world practice.

Petra, Johanna, or Judith's design learning processes could have been considered by Schön (1987) through their 'embodiment and situativity'. Hence their relationships with each other and with others (formal and informal), their reactions to studio rituals (through their artifacts, thoughts, or speeches), the representational tools they use in the design process could have been deconstructed within these human and non-human components' interrelations. This could have helped reach different layers and reveal the existence of different dynamics. With this belief, the future step of the study is to evaluate various studio setting (including real-world studios and virtual studios) within the proposed conceptual model to reach a holistic understanding of studio environment through its cognitive systems. Before starting to explore studio environment, focus group studies are planned to be conducted with studio tutors from different backgrounds and different pedagogical approaches. As a start, a series of pilot design workshops will be conducted to develop data collection instruments in real-world and virtual world settings. Accordingly, a mixed-method study that will include both virtual studio settings' quantitative analysis and qualitative analysis of various studio settings will be designed.

Conclusion

What we know about studio's interwoven social, cultural, material, and temporal aspects and their effects on design learning processes is limited. It is known that the studio environment is usually rich and dynamic but also individualistic and competitive. The use of cognitive artifacts in the studio is usually limited to pre-defined designing activities with specified tools and is dependent on students' individual talent. Since the focus of the design learning research has often been on designing activities, there is not enough insight about the impacts of studio's physical, social, and cultural aspects on designing and learning. Yet, it is seen that students' engagement with the studio's multi-layered environment as an extension of the 'problem-solving processes' is usually limited. Although there are possibilities that a studio can be more integrated into students' design learning processes, the common pedagogical approaches make studio more like a space of transition. When design education researchers begin to understand the architectural design studio as an 'extended problem space', it can be possible to understand the strengths and weaknesses of existing pedagogies. Design education researchers then need to rethink the design tasks being given, the design tools being proposed, the

studio processes being planned, and grading methods employed.

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F. Zeynep Ata

Izmir Institute of Technology, Turkey

fatmaata@iyte.edu.tr

F. Zeynep Ata is a doctoral researcher at Izmir Institute of Technology. Her study focuses on the environmental perspectives in design cognition and design learning. She has a bachelor's degree in Architecture and a master's degree in Architectural Design Computing, both from Istanbul Technical University. She is also a part-time lecturer in architecture.

Fehmi Doğan

Izmir Institute of Technology, Turkey

fehmidogan@iyte.edu.tr

A professor of architecture, Dr. Fehmi Doğan is currently the dean of the Faculty of Architecture at Izmir Institute of Technology. He has a PhD degree from Georgia Institute of Technology and conducts research on design cognition and design learning. He has published in journals such as *Journal of Architectural Education*, *Journal of Learning Sciences*, *Journal of Environmental Psychology*, *Design Studies*, *Design Journal*, *The Journal of Architecture*, *ARQ-Architectural Research Quarterly*.