Journal of **design studio**

v:2 n:2
2020 december

ISSN 2687- 2838

Journal of **Design Studio**

Journal of Design Studio is a peer reviewed journal published two issues per year, **July** and **December**. Journal of Design Studio is an open access electronic journal. There isn't any type of publication charge in the publication processes. Articles appeared in the journal cannot be used, whole article or in part, without proper referencing.

The journal aims to publish scientific articles based on design studio education of different disciplines and design research, especially in architecture, interior design, urban design, industrial design, communication design, graphic design, fashion design and all other design disciplines.

In addition to publication of scientific papers, the journal may include good studio practices and book reviews in the field.

All articles in the journal are subject to evaluation of two peer reviewers, all articles can be published after publishing decision of this peer review process.

AIM

The aim of the Journal of Design Studio is bringing different design studio researchers together on a multidisciplinary design studio research platform. This design studio research platform gives the researchers who made experimental studies in their design studio education to share their works with the other researchers in the same area or similar research fields. The scope of the Journal of Design Studios include all research and experimental works realized in all type of design studios.

SCOPE

Design studio pedagogy,
Design theories and methods for studio works,
Architectural design studio education,
Design principles for studio work,
Product design studios,
Interior design studios,
Urban design studios,
Landscape design studio,
Communication design studio,
Graphic design studio,
Media design studio,
Fashion design studio,
New trends in design studios,
Virtual design studios,
Design thinking,
Studio culture,
Studio teaching,
Innovative and creative works in design studios
Quality assessment in studio work,
Collaborative design studies in design studios,
Integrated design studio,
Design studio practice,
Design practice,
Design research,

EDITORIAL BOARD

ABSTRACTING / INDEXING

ASOS Index, BASE (Bielefeld Academic Search Engine), CROSSREF, GoogleScholar, Ideal online, Index Copernicus, ResearchBib Academic Research Index, ROAD (Directory of Open Access Scholarly Resources), World Catalogue of Scientific Journals,

Journal of **Design Studio**

JDS / ISSN 2687-2838

WEB

https://www.journalofds.com

https://dergipark.org.tr/tr/pub/journalofdesignstudio

E-MAIL

editor@journalofds.com

ARTICLE SUBMISSION

https://dergipark.org.tr/tr/pub/journalofdesignstudio

SOCIAL MEDIA

Twitter	Facebook	Instagram	Linkedin
@studio_journal	@journalofdesignstudio	journalofdesignstudio	Journal of Design Studio

DOI PREFIX

DOI Prefix: 10.46474/jds

Journal of **Design Studio**

V:2 N: 2 / December 2020

Contents:

Journal of
Design Studio
v:2 n:2 July 2020

Editorial

Orhan Hacihasanoglu
Özyeğin University, Faculty of Architecture and Design, Istanbul, Turkey

Refer: Hacihasanoglu, O., (2020), Editorial, Journal of Design Studio, V:2, N:2, pp 3-4

ORCID: 0000-0003-1835-6550
DOI: 10.46474/jds.841098 https://doi.org/10.46474/jds.841098

Editorial

Welcome to the second issue of the second volume of the Journal of Design Studio. There are ten research and five design studio case articles in this issue of the Journal of Design Studio.

The first article of this issue has the title "Adaptability of Primary and Middle School to Post-Pandemic Reuse - A Discussion in the Context of Flexibility" and which was written by Orkan Zeynel Güzelci, Sema Alaçam, Serkan Kocabay, Elif Işık Akkuyu. The article discusses "*how the existing primary and middle school buildings can be adapted to the new needs emerging in the Covid-19 process*". The three levels of adaptation were defined and in the scope of this study plans of five selected school were evaluated in the context of flexibility in the plan layout-function relationship.

Second article has been written by Ugur Tuztaşı and Pınar Koç, which was entitled as "Integration of Section and Model: Reflections from a Studio Practice". The main idea of the method in the article is to find transformations from basic design models and to benefit from basic design principles in the architectural design; the method is continued "*through the various design variables by giving the architecture students a fixed design resource that includes practicing the space through a sectional model*".

Nevşet Gül Çanakçıoğlu, is the author of the third article which is entitled as "Comprehending the Psychosocial Characteristics of Space through an Elective Course: The Experience of the Body and Cognitive Mapping in Design Education". The article based on mappings of students who visit an experiential activity by the guidance of a blind guide, in "Dialog in the Dark" which was a "*thematic dark environment where students experience many things and are invited to a cognitive mapping session through which they reflected their spatial experiences grasped via their senses*".

The article which is entitled as "An Introduction to Design Studio Experience: The Process, Challenges and Opportunities" had been written by Şehnaz Cenani and Yazgı Aksoy. Authors defined the main aim of the research as "*this design studio is to teach design with parametric design thinking while focusing on improving the cognitive skills of the students. An Introduction to Design studio experience that is formulated according to these features is described in this study*".

Pınar Çalışır Adem and Gülen Çağdaş are the authors of the article which was focused on computational thinking and cellular automata; their impacts on design studios. The title of this article is "Computational Design Thinking Through Cellular Automata: Reflections from Design Studios". "*Cellular Automata methods as one of the exploratory processes which have important role in the development of computational design thinking in design studios with different concepts and setups*".

"Bridges as City Landmarks: A Critical Review on Iconic Structure" by Ayça Arslan evaluates the bridges as city landmark elements. The aim of the article defined as "*to reveal landmark concept in the cities over bridge cases which are very aesthetical and flexible structures by their forms, construction styles, materials and functional diversities*".

The article which is entitled as "The Threshold of Abstraction in Beginning Design Pedagogy" by Stephen Temple covers a series of architectural design exercises gradually introduce abstract operations in design through a progressively transforming sequence over the first six weeks of beginning design studio at University of Texas at San Antonio. *"Delivered as analogous to architecture, each successive exercise initiates an abstract design operation as an individual design choice, enabling students to learn to see part in terms of whole, toward a working, conceptual understanding of abstraction in design"*.

The article "The Concept of Limits in Architecture as an Instructional Tool for Design Education" which is written by Aysenur Hilal Iavarone and Emel Birer, questioning the concept of "limit" transformed students' learning experiences in the design studio. Authors reached the conclusion that "*It has been observed that the act of designing with limits improves students' awareness, strengthens the relationships established with the context, and incorporates the social dimensions of architectural design into the design*".

Mehmet Emin Bayraktar and Gülen Cağdaş are the authors of the article "A Mobile Design Environment for Building Form Generation" which is based on developing a mobile design application. The application "*aims to support open-ended design thinking and to be fast and effective in terms of improving ideas. It is based on augmented reality and it works on mobile phones. In order to evaluate the application, a set of images consisting of tall buildings are shown to users"*.

"Artistic Skills and Scientific Abilities in Architectural Education" by Adil Zamil Manshad Al-Saidi, is based on "*the importance of integration between artistic skills and scientific abilities for the student to achieve high quality level of learning in the department of architecture in Iraq*".

Design Studio Cases section starts with article written by Esin Kömez Dağlıoğlu, Ekin Pınar, İpek Gürsel Dino, Pelin Yoncacı Arslan, Funda Baş Bütüner, which was entitled as "Teaching Architectural Design Studio Remotely: The Introduction to Architectural Design Course at METU". The article *"aims to briefly assess the potentials and limits of online learning environment for studio education by focusing on the case of 2019-20 spring semester studio of Introduction to Architectural Design course at Middle East Technical University's Department of Architecture"*.

Waldemar Jenek, Glenda Caldwell, Jared Donovan, Veronica Garcia Hansen, Matt Adcock, Mingze XI, are the authors of the article which is entitled as "Exploring Media Architecture Design in Virtual Design Environments: A Case Study of Undergrad Architecture Studio". "*This case study explores how architecture students can learn to design media architecture within virtual design environments tools. The target participants of this study are advanced (i.e. 3rd year) architecture students at the University of Applied Science, Bochum, Germany. To evaluate the student-experience, students were asked to develop a media architecture structure during the semester"*.

Veli Şafak Uysal and Ipek Kay wrote the article "Lacunae in the Forest: A Phenomenological Approach in the Interior Design Studio", which has been covered the students tries in the studio *"to uncover and speculate the ways in which designs of the built environment challenged or perpetuated our various attributions to nature, all the while asking "What kind of a 'universe' at large does my proposed collection belong to?" at every stage of the process*".

"From Movie to Design: Interpretation of "Passengers" in the Form of Basic Design Principles" is the article by Damla Atik, which aims "*to make a contribution to the wide range of basic design course within a case study themed on cinema in this study*". This basic design studio teaching methodology was based on watching a movie, and according to feelings of students, inspired form the movie they were asked to design three dimensional models representing their inferences.

"A Design Studio Workshop Proposal for Comparable Evaluation of the First-Year Architecture and Interior Design Students" by Atlıhan Onat Karacalı is based on workshop proposal that aims to figure out whether the order of 3 different representation methods may be effected the understanding of first-year students.

Journal of
Design Studio
v:2 n:2 December 2020

Adaptability of Primary and Middle Schools to Post-Pandemic Reuse - A Discussion in the Context of Flexibility

Orkan Zeynel Guzelci
University of Porto, Faculty of Architecture, DFL, Porto, Portugal (Corresponding Author)
Sema Alacam
İstanbul Technical University, Faculty of Architecture, İstanbul, Turkey
Serkan Kocabay
DB Architects, İstanbul, Turkey
Elif Isik Akkuyu
Ryerson University, Department of Geography, Toronto, Canada

Received: August 3rd 2020, Revised: August 28th 2020, Accepted: September 3rd 2020
Refer: Guzelci, O. Z., Alacam, S., Kocabay, S., Akkuyu, E. I., (2020), Adaptability of Primary and Middle Schools to Post-Pandemic Reuse - A Discussion in the Context of Flexibility, Journal of Design Studio, V.2, N.2, pp 5-22,

O. Z. Guzelci ORCID: 0000-0002-5771-4069, S. Alacam ORCID: 0000-0002-5979-3282, S. Kocabay ORCID: 0000-0002-0803-3224, E. I. Akkuyu ORCID: 0000-0002-0969-1843

DOI: 10.46474/jds.776665 https://doi.org/10.46474/jds.776665

Abstract: This study discusses how the existing primary and middle school buildings can be adapted to the new needs emerging in the Covid-19 process. The three levels of adaptation are defined as follows: Building envelope-outdoor space relationship, plan layout-function relationship, and furniture relocation. In the scope of this study, five selected school plans were evaluated in the context of flexibility in the plan layout-function relationship. In this study, the concept of "adaptation" is considered as a design approach at the early design phase and/or intervention to respond to a new need in the life cycle of the building.

Keywords: Education buildings, Primary Schools, Adaptability, Covid-19, Post-Pandemic

1. Introduction

The World Health Organization (WHO) (2010) defines "pandemic" as "worldwide spread of a new disease". The origins of "pandemic" can be traced back to Ancient Greek, where the root words "pan" meaning "everyone" and "demos" meaning "people" are combined to describe the phenomena (Online Etymology Dictionary, 2020). In 2020, the term pandemic has become a part of everyday vocabulary, all over the world. Following the WHO's official pandemic declaration due to a highly contagious virus, Covid-19, on 11th March 2020 (World Health Organization, 2020), the global social, cultural, and economical relations have been radically affected by the outbreak. In addition, the duration of the pandemic-based regulation remains uncertain, as well as the methodologies of overcoming strategies. As of July 30, 2020, 17.031.281 cases and 667.060 deaths have been officially reported in 213 countries under Covid-19, and this table is getting more and more severe (Worldometer, 2020). The measures taken against Covid-19 are updated dynamically with the experiences gained worldwide. Accordingly, there emerged frequent and rapid responses by governments regulating the transportation of people and goods on a large scale (i.e. buildings, cities, or nations). Among several measures against the spread of Covid-19, “social distancing” became more apparent regarding the spaces and their affordances.

Due to the uncertain nature of Covid-19 spread, it is difficult to anticipate any emerging needs and their potential effects on architectural practice. On the other hand, how existing spaces can respond to changing functions / routines / regulations becomes a topic of discussion. Since the current pandemic has specific characteristics different from the historically observed outbreaks, there are no direct precursors to the applications and architectural strategies to be developed. Meanwhile, in Turkey, regulations, and planning in regards to spaces where individuals could spend time and socialize in groups are periodically updated.

Education is one of the areas most directly affected by this uncertainty. New measures are defined according to the speed of the progression of Covid-19. However, studies concerned with the adaptation of educational buildings to the “new normal” and studies concerned with future projections of social spaces are especially limited. In addition to many other contradictions and tensions, the challenges in the adaptation of educational buildings to changing needs after the pandemic are deepening, especially in dense cities, like İstanbul. Keeping these ambiguities in mind, this study examines how existing primary and middle school buildings can be adapted to the post-pandemic process. To discuss the adaptation of existing buildings to the new needs emerging in the post-pandemic process, the following three levels are proposed:

- Building envelope-outdoor space relationship: New additions to existing buildings, changes to the building envelope;
- Plan layout-function relationship: Creating new spaces through transforming the separator elements in the interior and changes to the existing functions;
- Furniture relocation: Changes made through the displacement of moveable fittings without interfering with the structural elements.

The reasons for proposing three levels of adaptation can be listed as follows: being able to evaluate the discussions on flexibility and adaptation at different levels and scales in the literature (Abbasi, 2016; Tapkı & Canbay Türkyılmaz, 2012; Woodman, 2016) and to define the scope more clearly in a way that it reveals the original contribution of the study different from existing studies. The authors argue that revisiting the concept of flexibility by architects might provide insights to frame the problem of adaptation to the Post-Pandemic period. Within the scope of this study, the adaptation opportunities of primary and middle schools to the emerging needs in the Covid-19 era are discussed in the context of flexibility in the plan layout-function relationship.

2.Existing School Building, New Needs and Problems

The official data of the Ministry of Education of Turkey in 2019 (T.C. Milli Eğitim Bakanlığı, 2019) illustrates that at the primary school level, there are 22.931 public and 1808 private schools, with a count of 5.005.214 public and 262.164 private school students. Primary school students are educated by 268.065 public and 32.667 private school teachers. At the middle school level, there are 16.874 public and 2060 private schools with a count of 5.099.275 public and 338.046 private school students. Middle school students are educated by 312.761 public and 41.437 private school teachers. Therefore, due to the pandemic outbreak, the new needs and faced problems in existing school buildings concerns 10.704.699 students, 654.930 teachers, and their families in total throughout the country.

Over time, while the number of students has increased rapidly at primary and middle school levels, this increase has not been proportionated to the number of teachers and school buildings available. When it comes to the adaptation of school buildings to changing external conditions, it is observed that design solutions with the goal of only increasing the capacity of buildings are at the forefront and the issues related to the quality of buildings remain in the background. Due to economic and temporal limitations and the expectation of standardization (Köse & Barkul, 2012) "typical projects" are preferred by the Ministry of Education of Turkey (MEB). MEB's justification for the selection of "typical projects" are construction (easy to operate) and post-occupancy (easy to maintain) based. Typical projects are defined as designs that are independent from environmental factors and the surrounding built environment (Tapkı & Canbay Türkyılmaz, 2018). Although the preference of "typical projects" appears to be more economic and efficient in the short term, the adaptation of educational buildings planned as typical projects to the new requirements of Covid-19 becomes arguable, considering the long-term costs.

With the measures taken against Covid-19, the Ministry of Education of Turkey has suspended in-person education throughout the year, as of March 16, 2020 (T.C. Milli Eğitim Bakanlığı, March 13, 2020). As of March 23, 2020 (T.C. Milli Eğitim Bakanlığı, March 17, 2020), distance-education has commenced in all levels of education, partially and/or for an indefinite time. On the other hand, there is much uncertainty regarding when educational buildings will be reopened for in-person education.

In this context, some problems and needs that may be encountered are listed below:

- Can existing educational buildings enable social distancing measures?
- What kind of new problems may be encountered if educational buildings are used with a 50 percent occupancy?
- Can existing school buildings be used with natural ventilation systems without the need for mechanical ventilation infrastructures?
- Is it possible to develop new principles and guidelines on the re-functioning and newfound use of common spaces such as washrooms, change rooms, sports halls, and dining halls?
- How will the transformation of routines and social behaviour (with respect to social distancing and changes to the previously open-purchased, unwrapped cafeteria goods) reflect on the design and use of common spaces such as cafeteria and stationery shops?

In the context of adaptation of educational buildings to new needs arising due to the pandemic, the parameters that are more difficult to change can be listed: number of teachers, number of students, count of available school buildings, and the envelope of the buildings. The envelopes of the buildings are highly difficult to change as they are dependent on spatial factors such as land-size, borders of the courtyards, and high densities associated with the located neighbourhoods. Therefore, the growth possibilities of the buildings in dense urban environments are limited.

In projections where there are no expected major changes to the number of teachers and students, the institutions that provide full-time education seek methods to return to the dual education system, which consists of morning-afternoon sessions to decrease the capacity of education spaces to 50 percent. However, a factor that constrains dual education planning are limitations in the number of teachers within the educational system. Despite institutions aiming to continue with the dual education approach (TRT Haber, 2018), due to social distance requirements in buildings, there is a need for transforming existing spaces used for different functions (i.e. dining hall, sports hall, libraries, etc.) in educational buildings to classrooms.

Considering the affordances of the interior space in the educational buildings, the number of students that can use a classroom simultaneously can be assumed as one of the major problems. However, apart from the closed spaces like classrooms, circulation in the buildings and new "intermediate spaces" that can meet the disinfection needs of people and objects between outdoor and indoor spaces become problematic. Additionally, not only the movement of people but also how the air will flow throughout the building or how the circulation will be controlled still remain unsolved.

3. Adaptation Approaches in Educational Buildings and Flexibility as An Affordance

Although there are numerous studies on the adaptation of educational buildings to the new education systems, trends and requirements (Abbasi, 2016; Dovey & Fisher, 2014; Karabey, 2004; Kızıltan, 1967; Tapkı & Canbay Türkyılmaz; Woodman, 2016), studies are very limited on the topic of adaptation of educational buildings to pandemic scenarios, such as Covid-19. The concept of adaptation has been mostly discussed in relation to flexibility (Dovey & Fisher, 2014; Karabey, 2004; Yürekli, 1983), changeability (Kızıltan, 1967) and ability to grow (Kızıltan, 1967; Yürekli, 1983). In the scope of this study, the concept of "adaptation" is considered as a need-based design approach during the early phases of design and/or an alternative solution to meet new requirements faced during the post-occupancy phases of the buildings (functional, performative, structural). Different combinations and sequences of adaptation approaches provide a well-balanced state of flexibility in buildings. On the other hand, it is difficult to provide a definition for flexibility where the requirements change continuously. In this sense, flexibility indicates a potential and an affordance that has not yet actualized itself. In its broad form, adaptation is the convergence of a given environment / situation / organism in its level of resilience to meet its needs based on the setting, where flexibility refers to an unactualized potential for an unknown future.

There is not a consensus on the meanings of the concepts of flexibility, changeability, and growth and the contexts in which they are used. Kızıltan defines flexibility in the context of primary school buildings as a combination of the following features: ability to expand, change, and be modified (Kızıltan, 1967; Yürekli, 1983). Kızıltan (1967) also defines "ability to expand" as merging a classroom(s) to obtain bigger classrooms or meeting halls as well as adding new classrooms to the educational building or reducing the number of classrooms; "ability to change" is defined as not only to expand the area of the space with educational purposes but also the ability to re-organize these spaces to provide opportunities for new and changed activities. Lastly, "ability to be modified" refers to the ability to modify all separating partition walls, not including structural systems and building envelopes (Yürekli, 1983).

Woodman (2016) discusses the concept of flexibility in the context of educational buildings; the following are discussed on the axis of time, space, use, and movements. Time flexibility according to Woodman (2016) refers to the "ability of a structure to change over an extended period of time to satisfy significant changes in need", while space flexibility is related to the "transformational type of change" in the spatial arrangements. Woodman (2016) considers "use flexibility" as the affordances of the same place being open to different uses, while "movement" flexibility" indicates the movement of teachers and students.

In cases where identified needs of buildings change with time, and/or goals of the multiple adaptation approaches employed contradict amongst themselves, the following question remains: what kind of approaches can be adopted in the adaptation of such cases? For instance, an educational building that can be classified as flexible at a certain instance in time may be evaluated as not flexible at a different time instance, due to changes in needs with time, space and activities. Therefore, the benefit from the adaptation levels mentioned in the introduction section is necessary to discuss the different adaptation approaches and strategies presented in the existing literature (Table 1). In Table 1, underlined parts refer to the subjects discussed in the scope of this study.

Table 1. Potential adaptation levels aiming to address flexibility in educational buildings.

Level of Adaptation	**Tapkı & Canbay Türkyılmaz (2012)**	**Abbasi (2016)**	**Woodman (2016)**
Building envelope-outdoor space relationship	-Spatial, visual, auditory and air temperature related comfort conditions	-Developing strategies to reduce the scale of the educational buildings	-Time flexibility
Plan layout-function relationship	-Ratio between physical space and number of students	-Creating social spaces -Promoting transparency and visual relations -Increasing flexibility	-Space flexibility -Movement flexibility
Furniture relocation	-Appropriateness of selected furnishings in terms of ergonomics	-Decision-making on furniture design and relocation	-Use flexibility -Movement flexibility

In this study, adaptability of primary and middle school buildings to post-pandemic settings are discussed based on Kızıltan (1967)'s "ability to expand, change and be modified" framework through 5 existing sample projects. The design approaches discussed in this study are related to the "space flexibility" in Woodman (2016)'s classification. Moreover, this study focuses on the "decisions made in planning and layout" which Yürekli (1983) defines as an approach for flexibility and neglects the "decisions made in construction techniques and systems". In light of Covid-19, to meet social distance requirements, the potential of expandability of classrooms is examined while keeping the number of teachers, number of students, minimum number of classrooms, and building envelopes as constants. Figure 1 illustrates different plan layouts of educational buildings derived from various sources (de Graça, 2007; Dudek, 2007; Pereira et al., 2018).

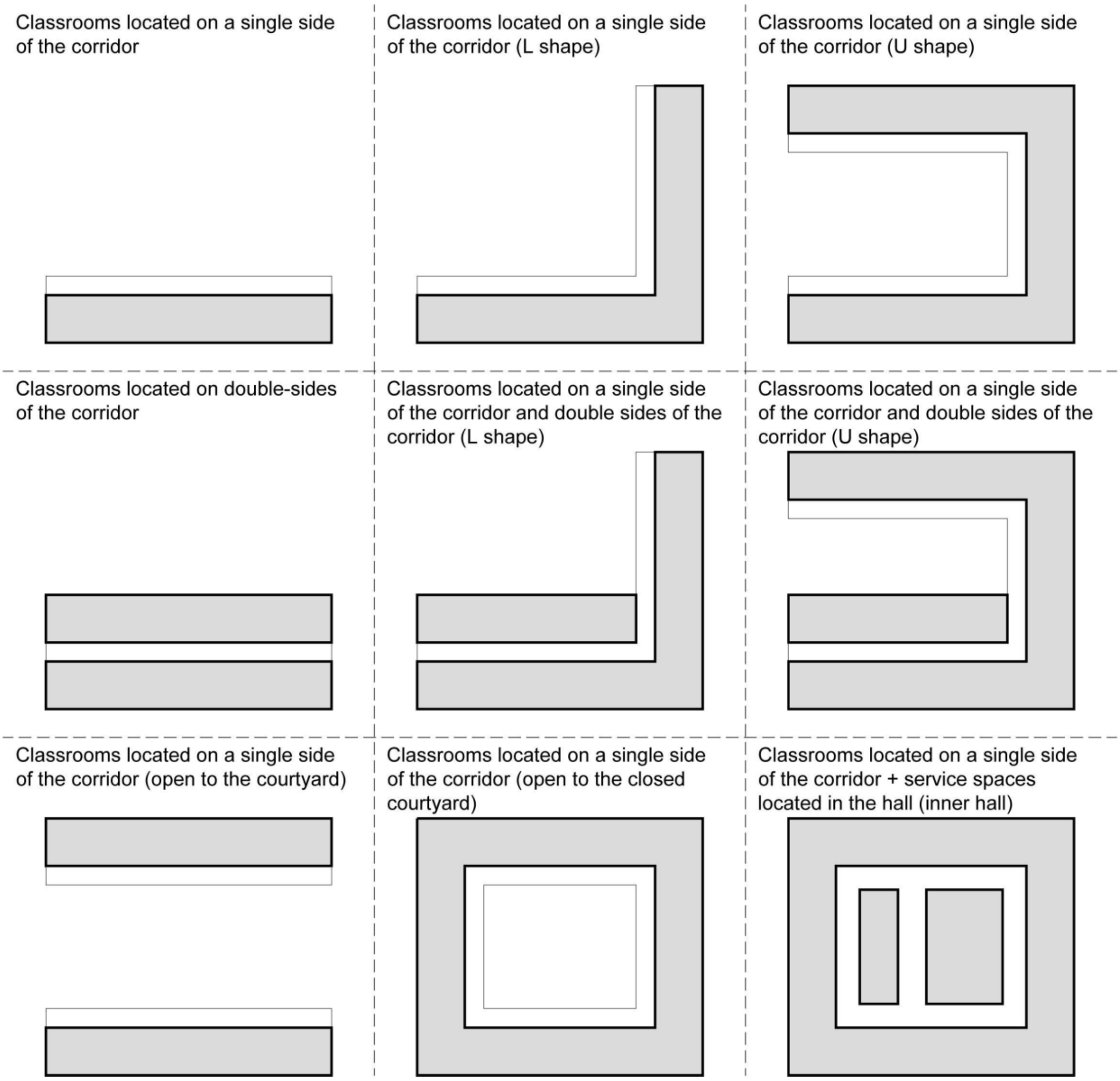


Figure 1. Various plan layouts of educational buildings (de Graça, 2007; Dudek, 2007; Pereira et al., 2018).

Although the classroom-circulation area relationships illustrated in Figure 1 provides advantages in many aspects during the construction process, these relationship types cannot respond to scenarios where the building envelope remains as constant; classrooms cannot be expanded into the remaining interior spaces due to spatial limitations within the buildings. To expand existing classrooms using the existing space in the interior of buildings, void spaces have to be defined. The plan schemes proposed by Dudek (2007) and shown in Figure 2 produce partial solutions to the need for expandability through interior spaces.

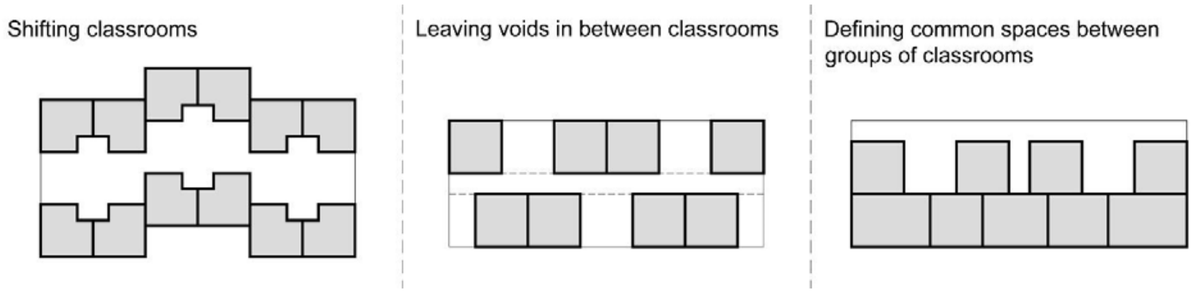


Figure 2. Design decisions for providing voids that can be applied to plan schemes illustrated in Figure 1 (Dudek, 2007).

4. Flexibility of School Buildings in the Plan Layout Level

In this section, the flexibility of primary and middle school buildings is examined through their plan schemas to check the appropriateness of educational buildings for the purpose of continuing educational activities in the post-pandemic period. The first four projects examined in this study are schools, all of which are designed and built at different time periods and each with differing plan schemas. However, the fifth examined school project has not been constructed yet and characteristic features of this project are similar to the second project.

The first sample, Ataköy Primary School was designed by Muhteşem Giray in 1967, in relation to the population increase in the Ataköy neighbourhood. Ataköy Primary School is constructed on 8000 m^2 lot, as a single floor. The building consists of 3 parts that are connected to each other with closed circulation areas (corridors). While two of these parts include classrooms, the third part includes a sports hall and offices. Each classroom has the same rectangular shape with dimensions of 7 to 8 meters and each classroom has its own private storage area. Based on his calculations, Muhteşem Giray (1967) claimed that Ataköy Primary School was not more costly than the constructed, preferred “typical projects”. The plan typology of Ataköy Primary School can be identified as classrooms and service areas opening to a common central inner hall (Figure 3).

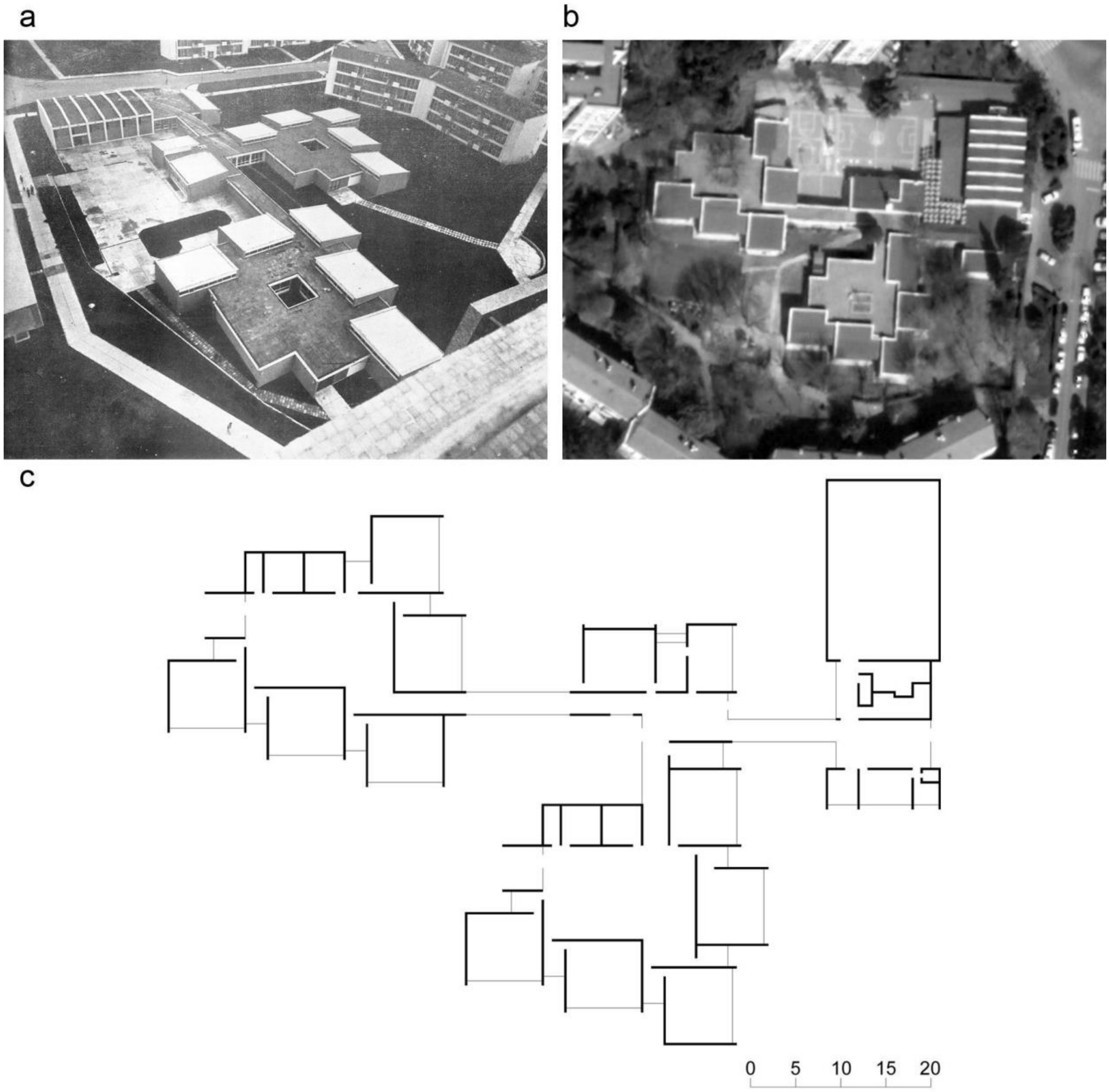


Figure 3. (a) "Primary School in Ataköy located in 2nd Neighbourhood" designed by Giray (1967); (b) Aerial view of Ataköy Primary School, 2020; (c) Schematic plan drawing of the "Primary School in Ataköy located in 2nd Neighbourhood" (Giray, 1967).

The middle school building including 21 classrooms was designed by Orhan Akyürek as a "typical project" for the Ministry of Public Works of the Republic of Turkey. This typical project was applied to sloped and flat lands to include 8, 12, and 16 classrooms, when necessary. It is known that the project by Orhan Akyürek is applied in neighbourhoods of İstanbul such as Şehremini, Baltalimanı, Çamlıca, Bakırköy, Esenler, and Kocasinan. The plan schema of this design can be defined as classrooms located on the double-sides of the corridor (Akyürek, 1973). The building, which was found to be built as a middle school in 1970 in the Kocasinan district of İstanbul, is currently used as the Kocasinan Multi-Program Anatolian High School (Kocasinan MPAHS) (İstanbul Bahçelievler Kocasinan Çok Programlı Anadolu Lisesi, 2020) (Figure 4).

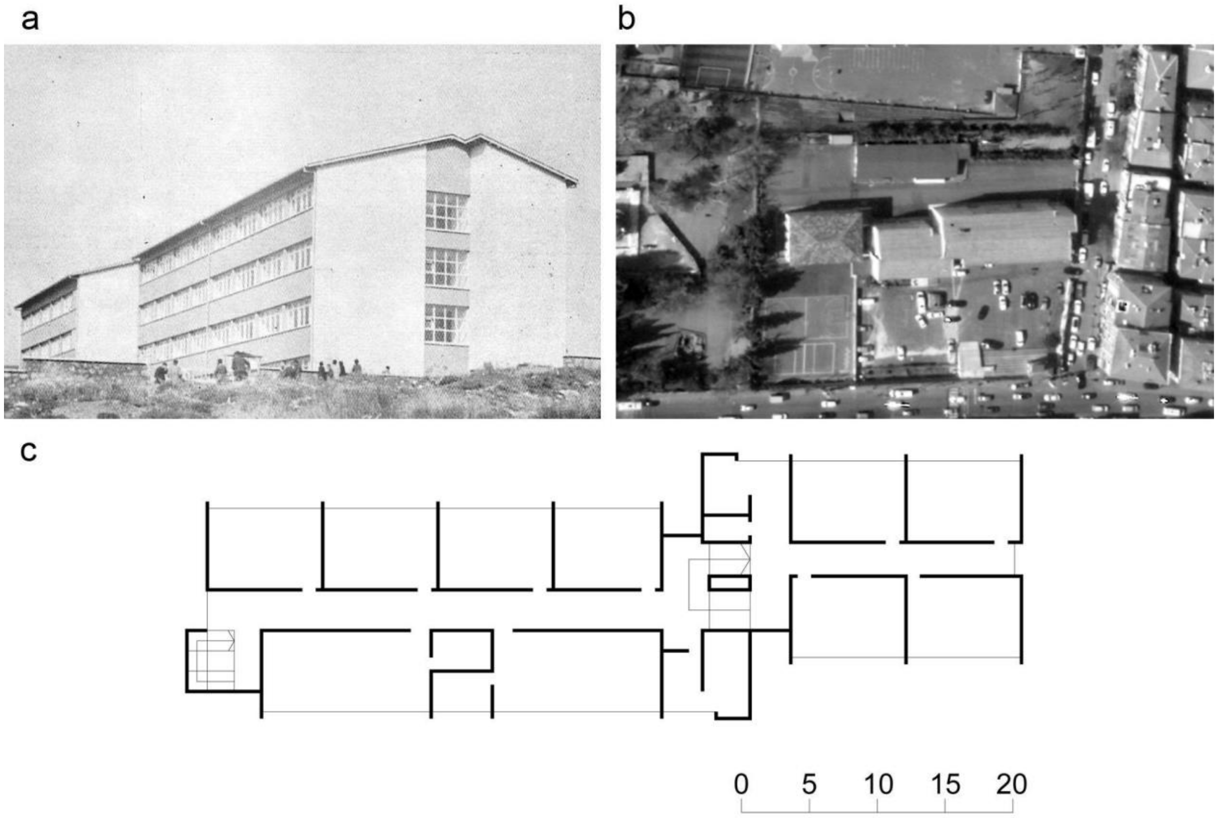


Figure 4. (a) "A Middle School Building" designed by Akyürek (1973); (b) Aerial view of Kocasinan MPAHS, 2020; (c) Schematic plan drawing of the "A Middle School Building" (Akyürek, 1973).

The main educational building of Fide Schools: İdealtepe Campus was designed by ddrlp Architecture and Design Services has 12 classrooms. Located in a highly urban setting, the campus consists of 1219 m^2 of closed areas and 1291 m^2 of open areas (Fide Okulları, 2020). While transforming a former textile factory into a school building, designers aimed to preserve open and green areas. To do so, designers added an external circulation element (staircase) to the building and developed a unique plan typology that includes two distinct inner halls (Arkiv, 2020) (Figure 5).

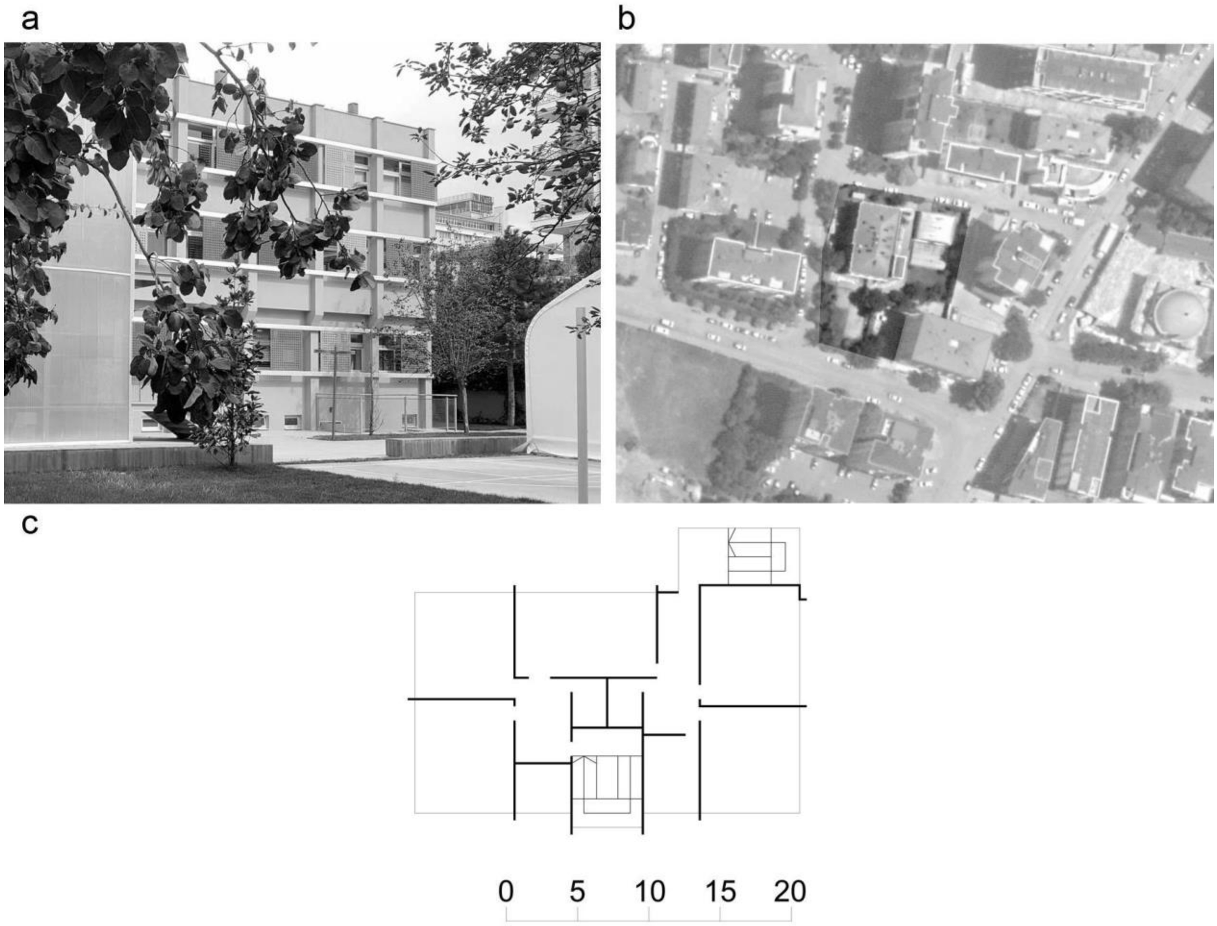


Figure 5. (a) Fide Schools: İdealtepe Campus designed by ddrlp Architecture and Design Services (Arkiv, 2020); (b) Aerial view of Fide Schools: İdealtepe Campus, 2020; (c) Schematic plan drawing of the Main Educational Building of Fide Schools: İdealtepe Campus (Arkiv, 2020).

Beykoz Koç Middle School designed by Cannon Design and DB Architects with the goal of transforming the educational environment. After its construction, the school was donated to the Ministry of Education of Turkey to be used as a public school. Columns in round form provide flexibility in space partitions and in the organization of 21 classrooms at the school. Non-bearing walls and folding glass dividers are used to divide spaces. Classrooms and offices, which are grouped on the 4 branches of the building are open to common areas obtained by the placement of the units and then to the general circulation areas (Arkitera, 2018) (Figure. 6).

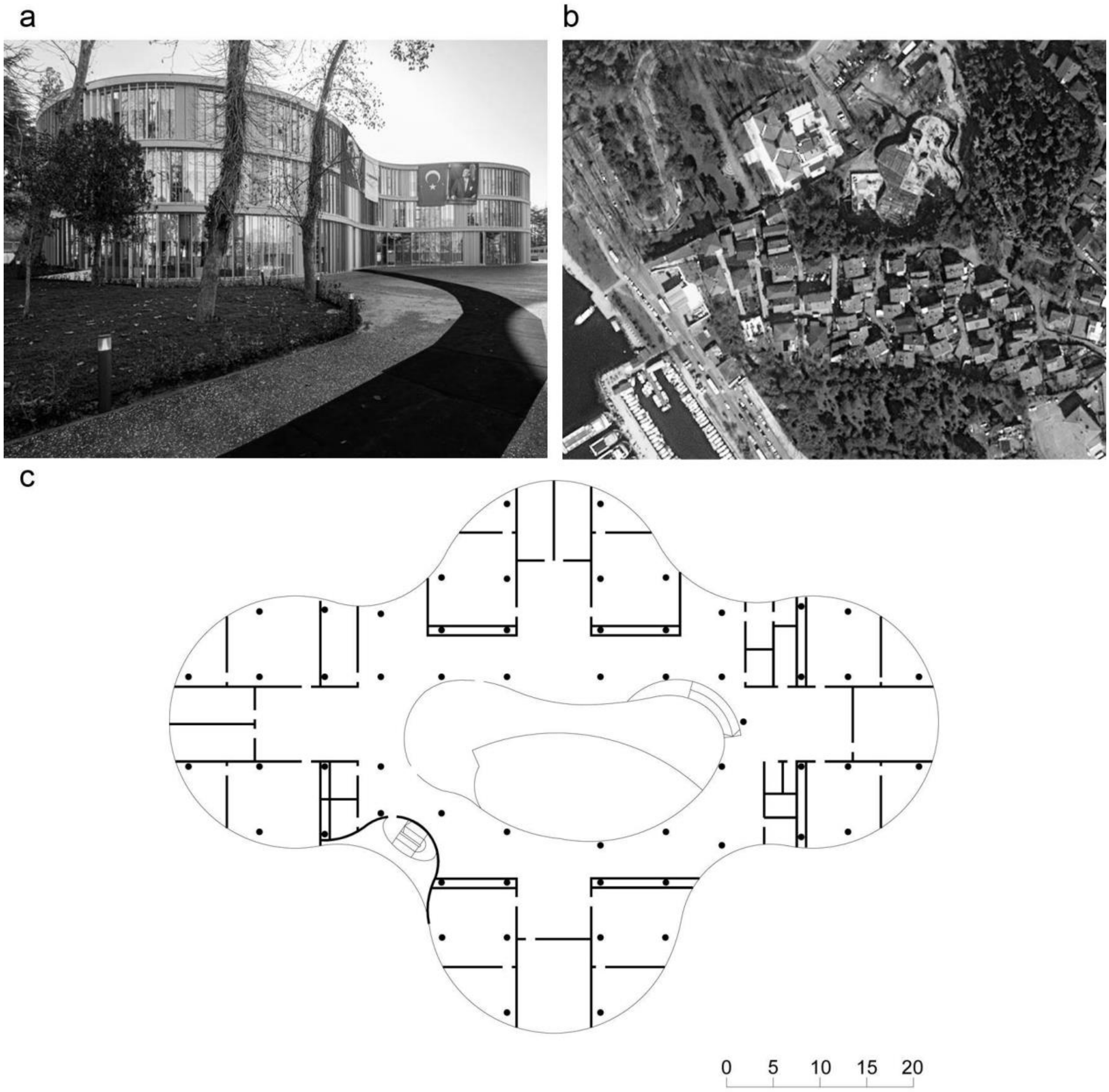


Figure 6. (a) Beykoz Koç Middle School, 2020 (Arkitera, 2018); (b) Aerial view of Beykoz Koç Middle School, 2020; (c) Schematic plan drawing of Beykoz Koç Middle School (Kalender Mimarlık, 2020).

The fifth sample project including 32 classrooms was designed by anonymous architects as a “typical primary school” for the Ministry of National Education of Turkey, Department of Construction, and Real Estate. (Figure 7). The school building consists of a basement floor, ground floor, first floor, second floor, and third floor. The area of the ground floor is 1440 m^2. The classrooms, offices, and service areas are located on the upper floors, while the multi-purpose hall and sports area are placed in the basement. Similar to the Akyürek (1973)’s typical project, in the typical project designed in 2020, the classrooms are located on double-sides of the corridor. The context-specific information such as orientation, climate, environmental conditions, and site plan is not available (Figure 7).

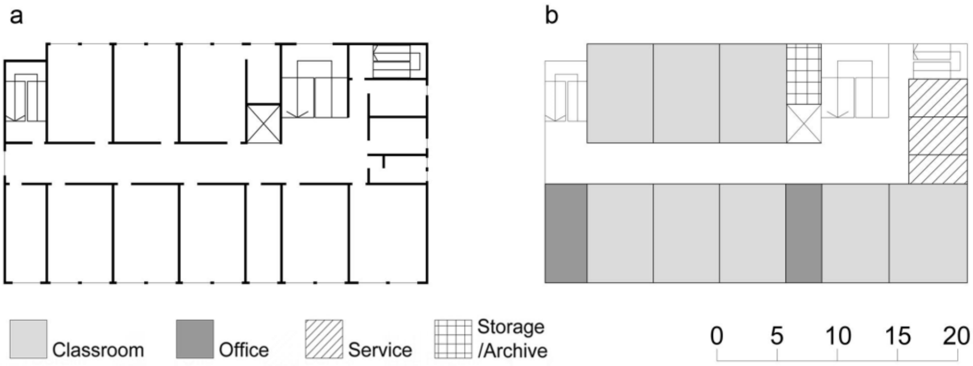


Figure 7. (a) Schematic plan drawing of the "Typical Primary School" (T.C. Milli Eğitim Bakanlığı İnşaat Emlak Daire Başkanlığı, 2020); (b) Function diagram of "Typical Primary School".

4.1 Evaluation

For over 50 years, Ataköy Primary School has been continuing its educational activities without any major architectural intervention on its building envelope. The plan scheme and its features provide benefit by permitting flexibility within the 2 inner halls and the individual storage areas of each classroom; as such, Ataköy Primary School has the potential to expand the classrooms through the available interior space (voids) to increase the area per student, as needed. A diagram illustrates the possibilities of expanding classrooms and offices without damaging circulation. In this context, Ataköy Primary School is able to operate educational activities under social distancing measures without changing the number of students, number of teachers, and/or number of classrooms; this is a positive outcome of the plan layout (Figure 8a, b).

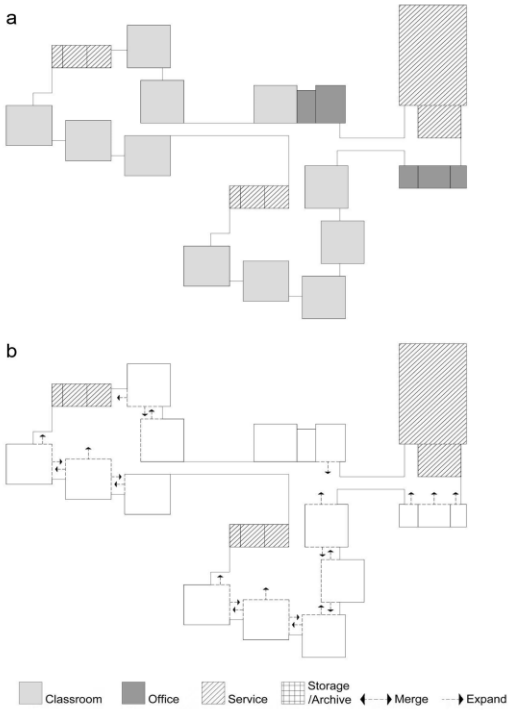


Figure 8. (a) Function diagram of Ataköy Primary School; (b) Flexibility diagram of Ataköy Primary School.

In Beykoz Koç Middle School, the voids designed with the purpose of common use, the storage areas in the classrooms and circulation areas are significantly wider than the provided guidelines and frameworks, which ensures the possibility of expansion through the interior of the building. The diagram below, (Figure 9a), shows the potential of merging storage areas to classroom space when necessary. Figure 9b also shows the partition walls and glass dividers of classrooms can be shifted through the circulation area to accommodate social distancing measures without eliminating any classrooms.

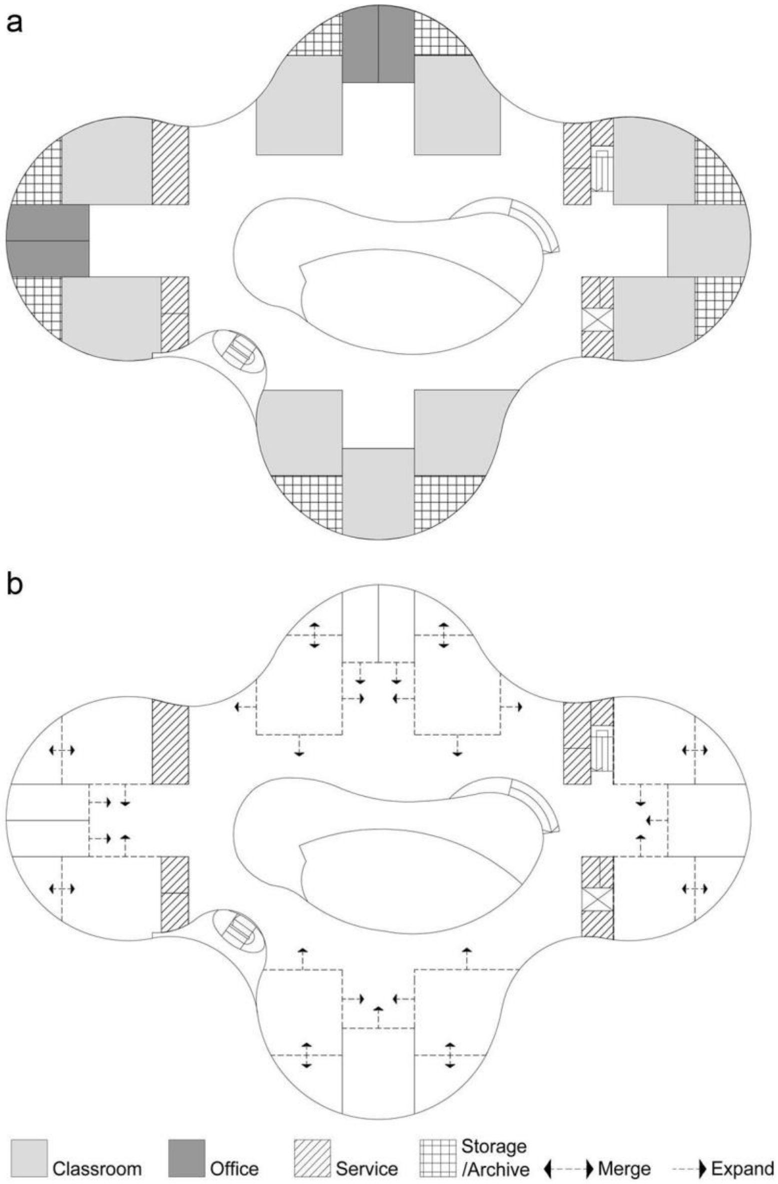


Figure 9. (a) Function Diagram of Beykoz Koç Middle School; (b) Flexibility diagram of Beykoz Koç Middle School.

Table 2. Comparison of selected school buildings/projects in terms of flexibility.

School Buildings	Plan Typology	Potential to Expand through Interior	Potential to Expand through Exterior
Ataköy Primary School	Unique	+	+
Kocasinan MPAHS	Typical	-	+ (limited)
Fide Schools: İdealtepe Campus	Unique	-	+
Beykoz Koç Middle School	Unique	+	+ (limited)
Typical Primary School	Typical	-	(no specific site)

Among the examined school plans, Ataköy Primary School, with its "open-plan layout" demonstrates a higher ability to adapt. The plan typologies and circulation areas in schools where the minimum dimensions are employed such as the typical middle school project (Kocasinan MPAHS) and Fide Schools: İdealtepe Campus Educational Buildings, and "Typical Primary School" project represent the absence of any potential for expanding classrooms through the interior (Table 2).

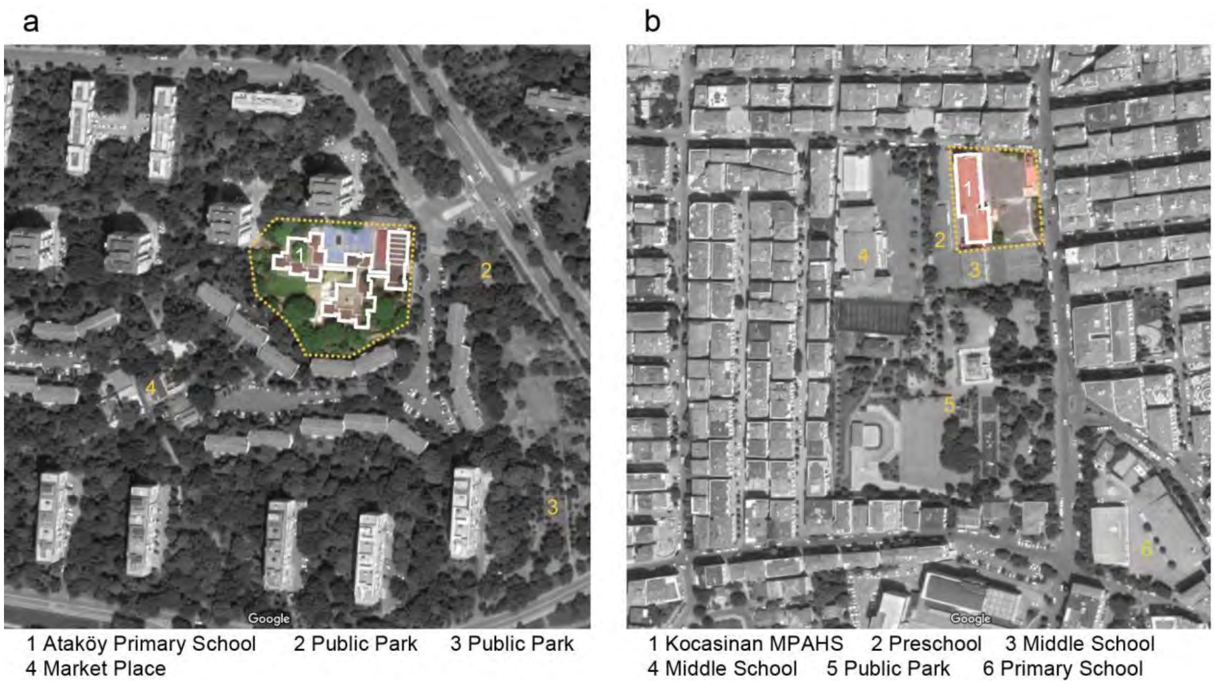


Figure 10. (a) Aerial view of Ataköy Primary School and its surroundings, 2020; (b) Aerial view of Kocasinan MPAHS and its surroundings, 2020.

Regarding the ability to expand through the exterior area, Ataköy Primary School involves more ambiguous boundaries. Ataköy Primary School is surrounded by low-density high-rise residential buildings and green area that allows pedestrian access to the school building (Figure 10a). On the other hand, Kocasinan MPAHS consists of clearly defined boundary elements.

While four individual school buildings (Figure 10b) are located close to each other, there is no direct access to neither public park nor other school building's courtyards. In such a dense urban environment (Figure 10b), the total open space that belongs to the school is smaller than the total area of the building. Therefore, the potential to expand to the exterior remains limited. Similar to Kocasinan MPAHS, Fide Schools: İdealtepe Campus Educational Building is located in a relatively dense environment. However, Fide Schools: İdealtepe Campus Educational Building has the potential to expand to the exterior, especially to the courtyard, considering the size of the reserved open space is equal to the size of the building itself (Figure 11a). Beykoz Koç Middle School has a unique plan typology, however, the defined outdoor space that can be used as a courtyard is limited, as it is surrounded by a public park, playground, and cemeteries (Figure 11b). Since the context-free "Typical Primary School" has not been constructed and has no site plan available, it is not possible to evaluate the potentials of expanding through exterior space and relationship with its surrounding.

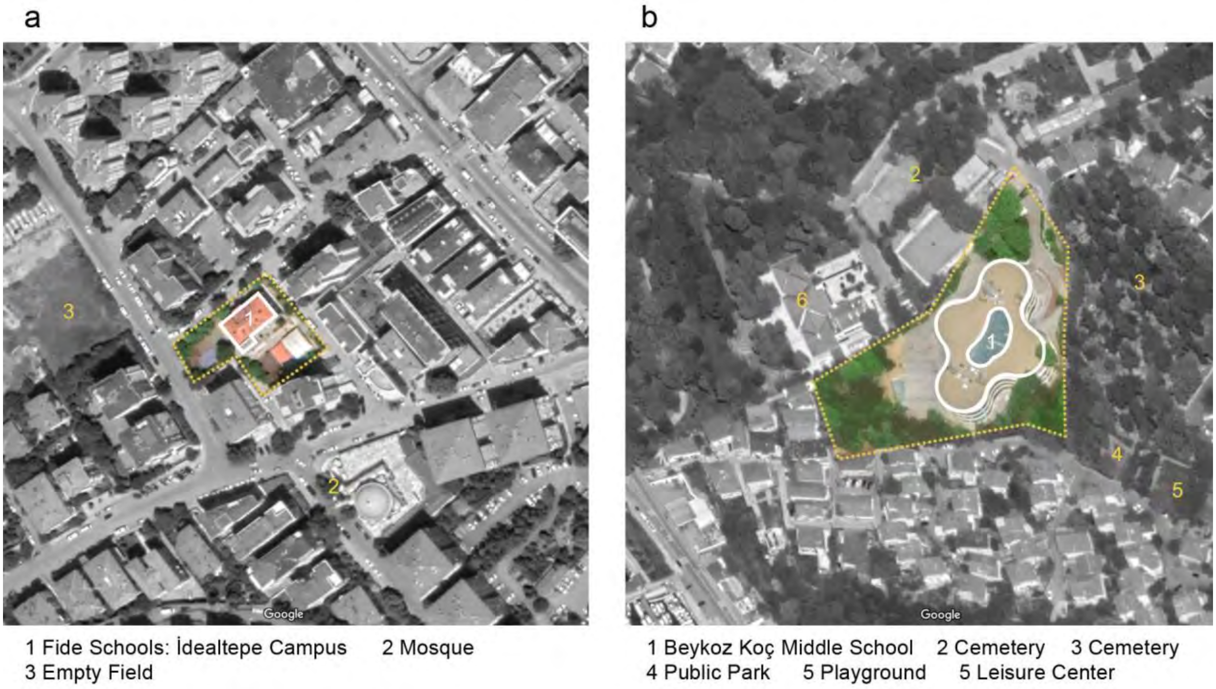


Figure 11. (a) Aerial view of Fide Schools: İdealtepe Campus and its surroundings, 2020; (b) Aerial view of Beykoz Koç Middle School and its surroundings, 2020.

5. Concluding Remarks

This study introduces three levels of adaptation for existing educational buildings to adapt to new needs derived from the post-pandemic process as: (i) Building envelope-outdoor space relationship, (ii) Plan layout-function relationship, and (iii) Furniture relocation. Among the introduced three levels, plan layout-function relationship level is examined in detail in the context of flexibility through the five selected school plans from the periods between the 1960s to 2020s. Four of the selected samples with varying plan types are located in İstanbul, while the fifth plan belongs to a typical project without a location. Due to high urban density, interventions to building envelopes in İstanbul are limited. Therefore, the building envelope level is excluded within this study. This study attempts to develop a systematic approach to frame potential problems regarding the adaptation of existing educational buildings to the post-pandemic process, rather than providing solutions to the identified questions.

A major problem in the design of existing educational buildings in Turkey stems from adhering very closely to the minimum dimension standards described in the building guidelines/codes, rather than providing void spaces. The decision of creating maximum closed areas grants short term advantages, however, given the long-term scenarios, such designs have disadvantages when it comes to the adaptation of educational spaces to any changes. In that sense, most educational buildings with a typical project design cannot meet the expected social distancing measures. On the other hand, voids in the interior spaces and potential open spaces as gardens/courtyards support the adaptability of the educational buildings.

Creating designs where corridors are given more flexibility allows the spaces to be changed as needed, which provides an advantage, in light of Covid-19. Assuming the interior walls as “changeable” (i.e. non-structural elements such as moveable-panels, sliding cabinets, etc.) and “fixed” (i.e. structural elements) in earlier design phases have been providing flexibility prior to Covid-19, and still provides an advantage for the post-pandemic process. Therefore, Karabey (2004)’s “flexibility of interior spaces” principle remains valid for the adaptation of educational buildings to post-pandemic re-use.

In the post-pandemic setting, uses of any kind of circulation area, especially elevators become problematic. Having single entrances to educational buildings when considering health and safety (i.e. disinfecting stations, one-way traffic, etc.) creates a barrier of accessibility for students and staff to open areas (i.e. courtyards). Mechanical heating and cooling systems remain as an unsolved problem and this problem has the potential to grow, with seasonal changes (i.e. winter, time spent indoors, heating, etc.). Based on these shortcomings, it is recommended that regulations and guidelines prepared for educational building design be re-evaluated and updated as necessary.

Long-term adaptation of educational buildings is excluded from the scope of this study. Additionally, the changes in the speed of Covid-19 spread may trigger new and emerging needs that may not have been specified in this study. Adaptation of educational buildings to new needs is primarily related to the number of students. Therefore, similar plan layouts may lead to different results. Turkey’s Nationwide Standardized Examination to Enter Secondary School (LGS 2020) was held on June 20, 2020. The standardized examination process was carried on by solely increasing the number of schools (by 5 times) to meet social distancing measures. However, these measures will not be feasible for the upcoming school year due to limitations in resources (infrastructural; building stock). Adaptation of educational buildings to the emerging needs of post-pandemic scenarios, like Covid-19, can also be considered as an opportunity to revisit past, present, and future approaches and methods of education.

Acknowledgement:

The current research activities of the corresponding author are supported by The Scientific and Technological Research Council of Turkey (grant no: 1059B191900560).

References:

Abbasi, N. (2016). Adolescent identity formation and the school environment, In Kenn Fisher (Ed.), *The Translational Design of Schools* (pp. 81-103). Rotterdam: Sense Publishers.

Akyürek, O. (1973). Bir Orta Okul Binası. *Arkitekt, 350*, 70.

Arkitera (2018, December 18). Retrieved July 30, 2020, from https://www.arkitera.com/haber/the-third-teacher-kitabindan-esinlenen-model-okul-beykoz-koc-ortaokulu/

Arkiv (2020). Retrieved July 30, 2020, from http://www.arkiv.com.tr/proje/fide-okullari/6495

da Graça, V. A. C., Kowaltowski, D. C. C. K., & Petreche, J. R. D. (2007). An evaluation method for school building design at the preliminary phase with optimisation of aspects of environmental comfort for the school system of the State São Paulo in Brazil. *Building and Environment*, *42*(2), 984-999.

Dovey, K., & Fisher, K. (2014). Designing for adaptation: The school as socio-spatial assemblage. *The Journal of Architecture, 19*(1), 43-63.

Dudek, M. (2007). *A design manual schools and kindergartens*. Berlin: Birkhäuser Verlag AG.

Fide Okulları (2020). Retrieved July 30, 2020, from https://www.fideokullari.k12.tr/okulumuz/idealtepe-kampusu

Giray, M. (1967). Ataköy İkinci Mahalle İlkokulu. *Arkitekt, 326*, 58-61.

İstanbul Bahçelievler Kocasinan Çok Programlı Anadolu Lisesi (2020). http://kocasinancpal.meb.k12.tr/meb_iys_dosyalar/34/28/973089/fotograf_galerisi_476394.html#gallery-%20(Eri%C5%9Fim%20Tarihi:%208%20Haziran%202020)

Karabey, H. (2004). E*ğitim Yapıları Geleceğin Okullarını Planlamak ve Tasarlamak Çağdaş Yaklaşımlar, İlkeler.* İstanbul: Literatür Yayınları.

Kalender Mimarlık (2020). Retrieved July 30, 2020, from http://www.kalendermimarlik.com/2018/03/14/beykoz-ortaokul-projesi/

Kızıltan, A. (1967). *Birleşik Amerikada Eğitim ve İlkokul Planlaması Yöntemler ve Eğilimler*. İstanbul: İsmail Akgün Matbaası.

Köse, Ç., & Barkul, Ö. (2012). İlköğretim Yapılarında Tip Proje Uygulama Sorunları Üzerine Bir İnceleme. *Megaron*, *7*(2), 94-102.

Online Etymology Dictionary (2020). Retrieved July 30, 2020, from https://www.etymonline.com/word/pandemic

Pereira, P. R. P., Kowaltowski, D. C. C. K., & Deliberador, M. S. (2018). Analysis support for the design process of school buildings. *Ambiente Construído, 18*(3), 375-390.

Tapkı, S., & Canbay Türkyılmaz, Ç. (2018). İlköğretim Yapılarında Ergonomi Kavramının İncelenmesi: TİP Proje İlkokulu ile Tasarım Projesi İlkokulunun Karşılaştırılması. *Mühendislik Bilimleri ve Tasarım Dergisi*, *6*(ÖS: Ergonomi2017), 220-233.

T.C. Milli Eğitim Bakanlığı (2019). Milli Eğitim İstatistikleri, Örgün Eğitim 2018/'19. Retrieved from https://sgb.meb.gov.tr/meb_iys_dosyalar/2019_09/30102730_meb_istatistikleri_orgun_egitim_2018_2019.pdf

T.C. Milli Eğitim Bakanlığı (2020, March 13). Özel Kurslar da 16-30 Mart'ta Tatil. Retrieved from http://www.meb.gov.tr/ozel-kurslar-da-16-30-martta-tatil/haber/20508/tr

T.C. Milli Eğitim Bakanlığı (2020, March 17). Uzaktan Eğitimde İlk Dersi Bakan Ziya Selçuk Verecek. Retrieved from http://www.meb.gov.tr/uzaktan-egitimde-ilk-dersi-bakan-ziya-selcuk-verecek/haber/20530/tr1

T.C. Milli Eğitim Bakanlığı İnşaat Emlak Daire Başkanlığı (2020, August 26). https://bulut.meb.gov.tr/app/tr-TR/App/Download/MEBBulut/bdabfd9e-0e06-40b7-a8f8-9a877a0d19e3

TRT Haber (2018, January 14). Retrieved July 30, 2020, from https://www.trthaber.com/haber/gundem/ikili-egitim-2019da-tarihe-karisiyor-346471.html%20(Eri%C5%9Fim%20Tarihi:%208%20Haziran%202020)

Woodman, K. (2016). Re-placing flexibility: Flexibility in learning spaces and learning, In Kenn Fisher (Ed.), *The Translational Design of Schools* (pp. 51-79). Rotterdam: Sense Publishers.

Worldometer (2020). Retrieved July 30, 2020, from https://www.worldometers.info/coronavirus/?utm_campaign=homeAdvegas1?%22

World Health Organization (2010, February 24). What is a pandemic? Retrieved from https://www.who.int/csr/disease/swineflu/frequently_asked_questions/pandemic/en/

World Health Organization (2020, March 11). WHO Director-General's opening remarks at the media briefing on COVID-19. Retrieved from https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

Yürekli, F. (1983). *Mimari Tasarımda Belirsizlik Esneklik/Uyarlık İhtiyacının Kaynakları ve Çözümü Üzerine Bir Araştırma.* (Thesis of Associate Professorship), İstanbul: İTÜ Mimarlık Fakültesi Baskı Atölyesi.

Journal of
Design Studio
v:2 n:2 December 2020

Integration of Section and Model: Reflections from a Studio Practice

Ugur Tuztasi
Cumhuriyet University, Faculty of Architecture, Fine Arts and Design, Sivas, Turkey (Corresponding author)
Pınar Koc
Cumhuriyet University, Faculty of Architecture, Fine Arts and Design, Sivas, Turkey

Received: August 12th 2020, Revised: September 2nd 2020, Accepted: September 14th 2020
Refer: Tuztasi, U., Koc, P., (2020), Integration of Section and Model: Reflections from a Studio Practice, Journal of Design Studio, V.2, N.2, pp 23-39,

U. Tuztasi ORCID: 0000-0003-3668-5665, P. Koc ORCID: 0000-0001-8727-2655,
DOI: 10.46474/jds.779647 https://doi.org/10.46474/jds.779647

Abstract: This text discusses an experimental pedagogical method coded as from 'section-model to space'. The theory of the study is the integration of basic design exercises and the architectural project studio. Instead of the disconnected understanding of the architectural project studio with basic design exercises, outputs of the two studios are integrated and design processes come to the fore as a new learning setup. The main idea of the method is to find transformations from basic design models and to benefit from basic design principles in an architectural design of a building. Methods proceed through the various design variables by giving the architecture students a fixed design resource that includes practicing the space through a sectional model. The fixed variable in the design research is the output of basic design exercises. Sectional models, which are open to continuous improvement, are experimental tools that initiate a formal organization. This experiment was adopted with a ritual of repetitions; at the end of the process, practical and survey-based inquiries were carried out to test the theory. As a result, the method leads architecture students to analyze spatial design in terms of relationship between the third dimension and tectonic content. Also, it has been observed that the process offers opportunities for empirical research. It was found that the interaction in the studio environment increased with all these models.

Keywords: Architectural Studio, Design Research, Model, Section, Pedagogical Model.

1. Introduction

The architectural project studio is the core of the curriculum that forms architectural education. This environment, where various pedagogical models or approaches are tried, is a practical area where architectural design research is conducted. The architectural studio, based on the problem and solution relationship, is the most important learning environment for architectural students. In this profession, making critics in design studio can be accepted as a traditional method that advances and improves the architectural project. Although it has contributed to students' architectural project experience, different pedagogical models have been increasing in recent years. The constant element in the studio is that the student learns to make an architectural project or to design a building/urban area. The act of design is shaped by processes such as creativity, problem-solving, thinking, learning, perception, scientific research and their variable components (Ertürk & Ertürk, 2019). In addition, the equipment and methods of architectural design research are more or less clear. Idea sketches, presentations produced by drawing, modelling and computer-based software are concrete representations of design behaviors towards problem-solving, and the direct result focuses on the product. In parallel with the architectural studio, basic design education is based on the concept of discovery. It is assumed that the student will learn by discovering, in line with certain principles, and develop creative thinking skills (Yaşar, 2020). Therefore, while basic design education offers a learning environment where knowledge of how to design is discovered, architectural project studios are designed with traditional or different pedagogical models to produce solutions to design problems on a floor that extends from single building scale to urban scale.

Basic design or architectural design studio explores and experiences at any level of architectural education. Discovering and experiencing is one of the ways to grasp design process awareness and educational process awareness. Experimental learning theory defines knowledge as the information created through the transformation of experience (Kolb & Kolb, 2005). In that case, learning to design throughout design research stems from the potential for experimentation and discovery. The case-study discussed in this text consists of design research in which the potential for experimentation and discovery is increased. Rather than the disconnected understanding of the architectural project studio with basic design exercises, in this study, the integration of the resultant products of the two studios will increase the potential of experience and discovery, so that the architectural project process will move from learning to design rather than being result-oriented.

Basic research idea of this study is to provide an environment which basic principles of design gained in basic design courses can be transferred to upper class architectural design studios. The main framework of the present study consists of increasing knowledge from experience and activating the potential for discovery of design process awareness. For this purpose, integration of basic design exercises and architectural project studios, in terms of final products, has been provided by Sivas Cumhuriyet University's, Department of Architecture, and a new environment has been developed in which the design process tends to reveal design process awareness through knowledge from experience. Such architectural design research is directly related to the curriculum applied by the authors of this study, which conducts both the architectural studio and the basic design studio at Sivas Cumhuriyet University's Department of Architecture. In the basic design studio, as a priority application form, a new method in which a student can grasp three-dimensional thinking through a model is concentrated on. Three-dimensional studies on specific themes are also consistent parts of a methodological framework based on spatial inquiries. The process, starting from the ground-surface-cover concept and continuing with structural analysis, is enriched with spatial readings and formal exercises. In this variety, by studying the basic mass set up as a learning outcome for the first-year students, whose three-dimensional thinking skills are increased with a continuous model, without any search for any function, only by working with sub-base, upper base, lateral surfaces, material relation, structural design and formal attitudes. Thus, the educational output is transformed into a visualized, rich design knowledge. However, such an output of basic design education is left behind in upper-class project groups. Through production models, architectural production for formal composition is abandoned and a return to traditional studio habits is experienced. This attitude is the point that makes this design research useful. Design research implies here that data collection activity is transformed directly and concretely into a series of discovering-experiencing and doing-thinking activity in the studio. Accordingly, it can be here stated that the idea of integration of architectural studio and basic design studio emerged a vertically structured inter studios. Because, thanks to this studio, it aims to develop "the ability to establish functional and aesthetic structural arrangements" (Alangoya, 2015, p. 86), which are expected to spread especially to the architectural project production process.

The origin of the study is based on basic design exercises. The diversity of basic design education helps to obtain different and more comfortable design behaviors; however, since the architectural project groups in the upper classes are presented with more restrictive content such as context, function and location, often design results that cannot go beyond the traditional methods have been encountered. Therefore, the fact that the design behaviors gained in the basic design education in the first year cannot be transferred to the projects in the upper classes reveals the necessity of the research. The most important element of this study, which aims to increase the potential of experience and discovery, is the model; this comes from the outputs of basic design education. Since the basic design exercises provide more flexible and comfortable design outputs, potential of experience and discovery is instinctively progressed in the studio. For example, in a formal exercise, a form is transformed and reshaped countless way according to the limits of cognitive, perceptual and intuitional behaviors. In this study, the integration of the resulting products was carried out as follows: functional, formal, spatial, structural and structural study of the section-models, which were designed as a design exercise by the first-year students as part of the basic design course in the fall semester of the 2017/2018 academic year, are given to the 3rd-year project group in the spring semester of the 2017/2018 academic year. Then, these section-models are transformed into a spatial problem by the 3rd-year project group in an urban space. In short, this experimental studio is a fiction that includes more concrete transformations towards architectural space based on abstract section-models.

2. Conceptual Framework: Integrated Composition of 'Section and Model' in Search of a New Pedagogical Model

The traditional studio environment in architectural education is a teaching format based on a master-apprentice relationship and a process managed with weekly criticisms. According to Ciravoğlu (2014), this system may create some problems such as replicating the tutor's architectural approach, lack of responsibility for the student, lack of assertiveness in the project, lack of self-confidence and awaiting permanent approval. Of course, it should not be overlooked that previous statement depends on the pedagogical approach of the tutors of the studio. Therefore, many pedagogical models for architectural studio education have been developed. The most recent source that presents these models most compactly is Salama's *"Spatial Design Education New Directions for Pedagogy in Architecture and Beyond"* (2015). Instead of focusing on the variety of pedagogical models currently on a quest, this text touches on the student's expectations from the studio. According to Goldschmidt (1983), this expectation is about how to make the design initiative (move), how to start it, how to decide its sequences, as well as the next ones, how to use the previous inferences, how to discover mistakes and how to decide on priorities. This situation can be fulfilled completely by manipulating the design thinking in the studio environment and taking an ameliorative position. Another reason for the emergence of different pedagogical models should be to better analyze the dynamics of the learning processes and to know the design thinking or the ability to design more closely. Oxman (2004) explains that experimental approaches in design education include theoretical foundations for modeling based on cognitive theories of thinking, creativity and learning, and that conceptual knowledge is obtained in design as well as the cognitive process through modeling. In addition to how the student will design, he states that he will work as a design researcher while learning about design. From the perspective of this paper's research problem, previous statement can be commented that thinking, creativity and learning in design can be transferred from a theoretical foundation to practical application. Here, tools for practical application and learning about design are basic design principles and exercises.

In short, the main aim of design education is to provide different design experiences, to take an active role in different design areas, to improve knowledge acquisition, and to provide a strong communication and motivation environment (Paker Kahvecioğlu, 2007). Similarly, the role of the design studio is associated with the learning and application of new skills and a new language, as well as learning to think architecturally. The educational experience in the studio also involves the simultaneous interrelation of these three steps, mentioned above (Demirbaş & Demirkan, 2003).

Galle (2011) argues that it is not possible to teach design without addressing creativity, ideas, and goals. He emphasizes that there should be criteria such as public acceptability, appropriate scope and exploratory potential in the definition of design. Therefore, it is a very challenging task to discover design thinking and to develop the ability to design. The first step of this work is to abandon the traditional studio environment and to construct an experimental new process. Secondly, it is important to make the idea of a design more understandable. According to Goldschmidt (2017), design thinking consists of small steps that carry the designer's reasoning throughout the design process. Reasoning, which includes design thinking, becomes concrete with a design output. This process, which turns into design research, is shaped with different concerns. For example, research methods used to obtain a design output or the degree of contribution of design tools such as drawing and modelling characterize the processes of new pedagogical models. The design process is the constant change between sensory-rational, abstract-concrete, form-content dilemmas. The research based on design is about how the form is produced, what method is used, what are the motivations, how they are used in constructing content, and how the content is defined (Voet, 2013). There is also an effort to make the design process and thought process more understandable in the studio setup, which was designed within the context of this text. In this new experimental pedagogical model, the section-model has been accepted as the primary design tool that enables the production of the shape. These primary design tools were brought directly from the basic design exercises as a requirement of the theory of the study, and the models that have already been produced were used as initial ideas/droplets for formal searches. Thus, three-dimensional models produced through basic design exercises are included in the design process of the architectural project studio. Sensory-rational thoughts, abstract-concrete relations and form-content definitions in other parts of the process are left directly to the student's ability to design. The only constant that does not change here is to provide a formal organization with the use of section-model as design tools. However, the process based on design research was based entirely on existing formal models, which changed the design experience by keeping the exploration potential on the alert throughout the design process.

The use of formal models brought from basic design exercises, as an initial idea in the architectural studio is, of course, closely related to the qualities of basic design products. Three-dimensional models produced as part of a formal and material-based exercise are open to development like all models and have a clear spatial layout and formal structure. Although the model is generally associated with architectural representation, it has been accepted as an immediate design tool for doing and thinking in this study. The model expresses the illusion of reality and is the most intimate manifestation of the architectural concept (Reynolds, 2015). The models that are the subject of the study are sectional models that appear as design exercises in the basic design education process. A model in this pattern consists of an unfinished and exposed wall, floor, material, facade pattern, structure, or circulation elements in a mass organization. Therefore, such a model is a way of learning structural components, structural elements and formal composition for first-year architecture students. This model, which can be called the section-model, ultimately offers a formal composition. The reason why the section-model is preferred in this process is that it provides more insight into the details such as a converging lens regards the third dimension of a mass mechanism. According to Arnheim (2009), the section does not have integrity in the plan, but it has distinctions between the upper-lower-lateral surfaces and offers only vertical integrity. In other words, the section contains details on formal-structural relations, on the one hand, and it carries inspirational tips for mass organization. Sections are the product of a design exercise where many structural components are exposed. More specifically, the section-models used in this study are like a design object ready to add, remove, deform and reshape. In this context, as the architectural research progresses through the process, constantly changing design ideas can express themselves as an architectural concept in the working model. Instead of finished, completed mass assemblies, working models that are open to continuous development are a manifestation showing how design thinking has taken the lead. As Asar (2018) emphasizes, the model provides intuitive processing of blurry mental images and establishes them in three dimensions as a design tool that enables discovery in architectural design and appeals to visual and tactile senses simultaneously. Thus, when the working model is combined with a level where the cross-sectional relations in the mass assembly can be read, the architecture gives way to a new learning method in the studio.

3. Method

The main idea of the method is to find transformations from basic design models and to benefit from basic design principles in an architectural design of a building in the same section-model in multiple different phases by different students who continue working on the same model. In the process of applying the method, which we will encode from 'section-model to space', the design tool that enables the re-formatting of the section-model as an architectural production is directly the fiction of the 'section'. The most direct way to analyze the three-dimensional formal composition that we encounter as an incomplete mass arrangement is to establish sectional relationships, as one way to create an architectural correlation among many exposed components is to resort to various deformations and transformations; another way is to reveal sectional relations between structural-constructional-formal mechanisms because of the cognitive and perceptual processes.

This method can be interpreted as a top-down attitude: as a model designed to test the theory referred to as from 'section-model to space' code. In the experimental studio, the basic design outputs of the first-year students, in the 2017-2018 fall term, were compared with the third-year students in the spring term of 2017-2018. In other words, the group that makes the 'models' is comprised of first-year students; the groups that study the 'models' and turn them into 'spaces' are comprised of third-year students. The stages of the experimental process were managed as follows: the process was arranged with three intermediate deliveries of three weeks and the final delivery of three weeks. The section-model, which was the subject of the final delivery only, was not brought from the first-year students; the third-year students were asked to perform spatial analysis on a new section-model with a similar design behavior from the 'section-model to space' code. In summary, the models used in the interim submissions consisting of three-week processes were the basic design outputs of the first-year students, and the same method was expected to be obtained by trying these models in the third-year students three times with three different models.

In the first phase, 16 sectional models were distributed among randomly created groups of students (Figure 1). These groups consisted of 2-4 people and care was taken to create a differentiated combination of students in terms of ability. The aim was to determine how the differentiated students comprehended the same model. Another aim was to determine whether student's ability was positioned in line with the habits in the traditional studio, whether it would change when a different design method was encountered. Another point to note is that since there were three intermediate stages until the final delivery, the three section-models were distributed between different groups to obtain more diversified results. For example, the group using section-model 1 in the first phase considered section-model 13 in the second phase, and section-model 11 in the third phase. Likewise, the group using section-model 13 in the first phase designed section-model 6 in the second phase and section-model 1 in the third phase. Again, in the first phase, the group that used section-model 11 considered section-model 7 in the second stage and section-model 13 in the third stage as the design object. Despite partial intersections in the distribution of models, this difference facilitated the method to provide more consistent results. This eliminated the concern that the architectural production made by three different groups of students through the movement of the same three section-models in each phase could lead to similarities.

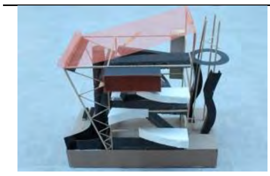
The evaluation of the design program, consisting of three interim deliveries of three weeks, was as follows: first, the most successful examples of the 16 section-models, regardless of the group, at the end of the first, second and third phases, were determined; secondly, a comparison was made between the first, second and third phases of the 16 section-models and the resulting product in the final phase. Comparison parameters for three phases and final phase are defined by the relationship between architectural solution's feature and ability of transformation section-model. This relationship is comprised of holistic architectural view. Criteria for evaluation of section-models is identified with formal organization, spatial-structural consistency, intelligibility of mass and appropriateness of functional solution. Thus, the evaluation tried to determine what impact the first three phases might have on the final product and how the method contributed to the design skill was discussed. More specifically, since the model subject to the final delivery was not brought from the first-year students, in the final phase, we tried to determine whether the section-models, which were considered as design objects in three phases, were used and how much the three phases contributed to the final study so far. In fact, with this comparison, scenarios related to the situation in the improvement and decline were examined. Thirdly, the study analyzed how the same model was handled by different students. Thus, through the findings obtained, it was discussed whether any design behavior could be developed in the method we encode as from 'section-model to space', and whether this could be constructed as a learning model in architectural education.


model 1

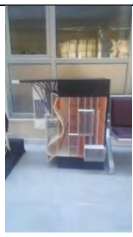

model 2


model 3


model 4


model 5


model 6


model 7


model 8

 model 9	 model 10	 model 11	 model 12
 model 13	 model 14	 model 15	 model 16

Figure 1. Section-models that constitute the basic design output and given to the third-year students.

4. Findings of Experimental Study and Discussions

4.1. First Discussion of Method

In this method, which we encode as from 'section-model to space', the first research area that the findings will come from will focus on examining the most successful results in any stage among the 16 section-models. The purpose of examining successful examples is to determine whether there is an internal design behavior or a common design decision in the final product. Successful examples are defined by using comparison parameters and evaluation criteria such as formal organization, spatial-structural consistency or appropriateness of function. In the first evaluation among the 16 section-models, it was determined that nine of them were turned into a successful product in any design phase. Accordingly, three successful products were obtained in design model 1, two in models 6 and 12, and two in models 2, 5, 8, 13, 14 and 15. This result showed that two students (**Student 1; Student 2**), among those who reached this final product, exhibited successful results also in the three design phases of the method. This situation is related to the achievements of the relevant students above the average of the class in the traditional studio environment; they also showed the same level of success in their studio from 'section-model to space'. Similarly, two students (**Student 3; Student 4**) provided successful examples in two of the three design phases. Hereby, the following determination should be included. Namely, unlike those who achieved successful results in all three design phases in this group, only one of the students had a higher than average class level in the traditional studio setting. In other words, discussing the successful products produced by considering the three design phases, it has been determined that the students with a success level above the average of the class in the traditional studio environment continued the same success level from the 'section-model to space' studio. This method also contributed to the production of more successful products among several of the intermediate students.

Some examples of the first phase of the studio are presented here. It was stated that **Student 1** was successful in all design phases among the three students who took section-model 1 at any stage during the studio process and took it to a successful result. The other two students (**Student 5; Student 3**) who achieved successful results with section-model 1 were able to achieve successful results in two of the three stages of the design phases. To clarify this situation, the way of handling section-model 1 will be discussed. Accordingly, **Student 5**, who treated the model as a design object in the first design phase, adopted a solution strategy in the axis of mass and front movements. The project was designed as the Cultural Center and the Performance Hall and was located in the south-west line of Sivas city center, known as Gültepe District, where there are more slum buildings, remained strictly connected with the model's dynamism (Figure 2).

Figure 2. The first successful product in the design of section-model 1.

Student 3, who studied model 1 in the second design phase, stated that she used the occupancy-space balance in the model as his analysis strategy. Again, in the south-west line of the city, in Karsiyaka region, which consists of low-rise houses as a texture detached from the urban area, section-model 1 was designed as the Expo Tower. The student grasped the black colored parts, which express that the three models were filled as closed spaces and the white colored surfaces that provided the vertical elevation as open-semi-open spaces (Figure 3). Taking section-model 1 in the third design phase, **Student 1** designed the Architectural Heritage Museum inside the park behind the historic governorate building in Sivas city square. As the analysis strategy, the V-shaped area connecting two separate parts of the model was abstracted and a more rational cult arrangement was adopted at the base (Figure 3). While **Student 5** saw the existence of different facade and floor combinations in each level as a compelling factor during the massing of the model. The compelling situation for **Student 3** was that there are too many gaps in terms of full-empty rhythm and its location in the plan organization. **Student 1** emphasized the differences between the floors and stated that it was difficult to establish the connection between the floors. However, with the interventions made in terms of space and facade, successful solutions were achieved even though the model was changed. In other words, instead of accepting the section-model as it was, a consistent result was pursued by considering all the formal, spatial, functional, contextual and structural components. For example, **Student 3**, who transformed the model into the Expo Tower, stated that formal interventions were made in the interior solution under spatial operability. Similarly, **Student 1** performed a more rational intervention for indoor solutions and most of the openings on the vertical line of the model were turned into a closed space. All three students did not make a comprehensive change in terms of the facade (Figure 3)

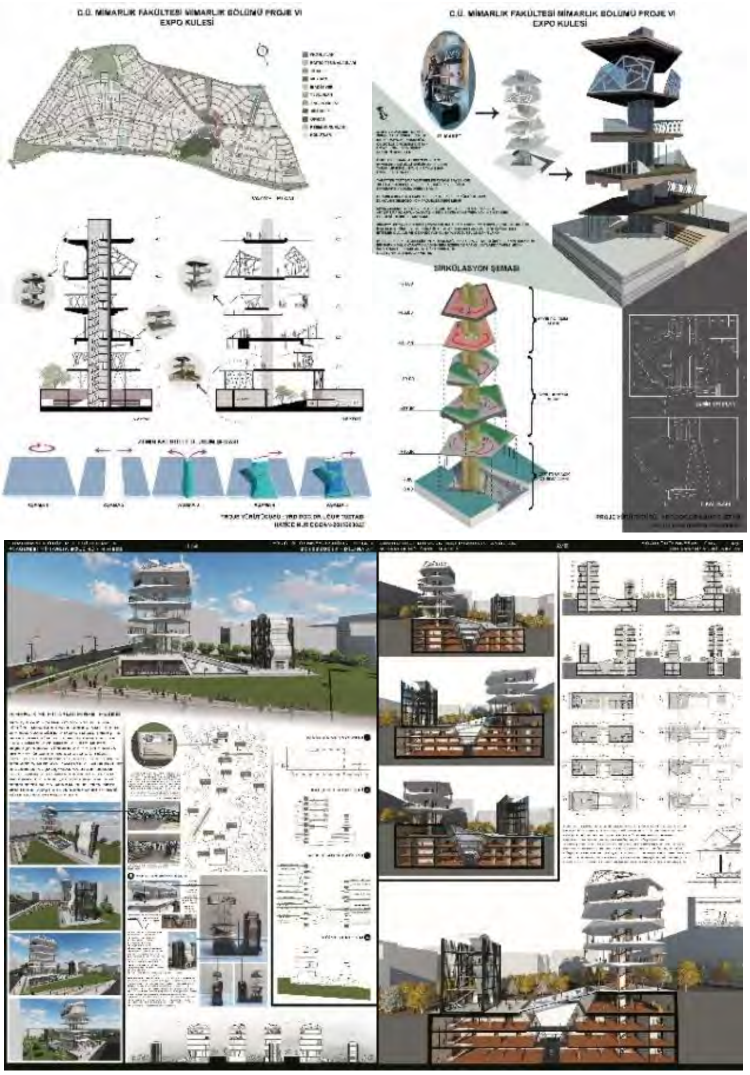


Figure 3. Examples of other successful final products in the design of section-model 1.

In section-models 6 and 12, the main lines of the current model were used as a common design attitude. Although the model was designed with different programs by each student, the deformation of the existing floor path appeared a common attitude in the formation of the shape (Figure 4). According to the relevant surveys, weak correlations in circulation and spatial configuration were defined as the difficulties encountered. Although section-model 2 was handled by a total of 10 students in the three design stages, only one student was found to be successful. One reason for this may be that the present model offers an undefined inner space. However, this uncertainty has been shown as a comfortable workplace in a successful product. According to the survey, **Student 2** stated that he could think more freely thanks to the absence of a pronounced floor arrangement. Despite the difficulty in constructing a consistent circulation, more flexible interventions were made to the lacunar model (Figure 4).

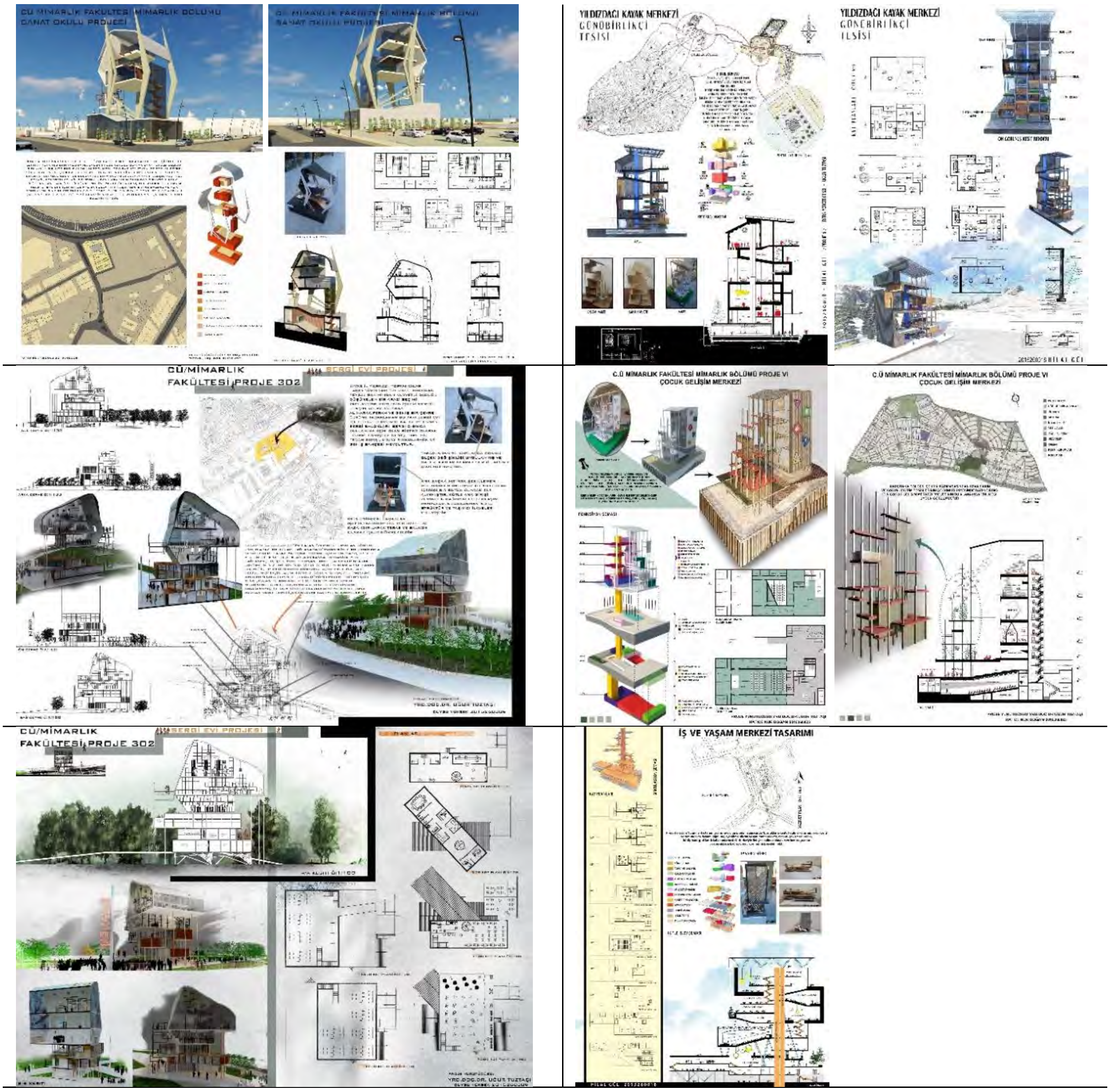


Figure 4. Examples of successful final products from section-models 6, 12, and 2.

In short, the common design behavior in all section-models that emerged as a successful result at the end of the first phase was due to a good reading of the formal layout of the existing model and the use of design tools such as abstraction, addition-extraction or deformation when necessary. Firstly, organizing the format was pursued. The functional mechanisms of the formal-spatial arrangement such as circulation, wet volume or layouts remained secondary design problems.

4.2. Second Discussion of Method

Apart from the evaluations made in the first part, another method of evaluation is to create a scenario on progress and decline/pause. In this sub-section, the first, second and third phases, as well as the final product will be compared over the appropriate samples to be selected from the 16 section-models. There are two main goals to be achieved in this comparison. The first is to determine how effective the 'section-model to space' method can be in the final study. The second goal is to reveal whether there is any progress and/or decline/pause over the student's performance and motivation throughout the process.

Accordingly, an example that shows improvement will be presented first. **Student 6** worked with section-model 6 in the first phase, section-model 2 in the second phase, and section-model 4 in the third phase. Although the lacunar structure of the model in the first phase was a challenging factor for **Student 6**, in this way, space organizations with different dimensional and formal variability were realized on the inner surfaces. **Student 6**, who faced a lacunar model in the second phase, showed a design approach similar to the first phase and stated that it was more challenging to deal with the circulation and analysis of wet volumes in model 2. In other words, **Student 6** experienced the establishment of a solid-void balance in a formal organization in the first stage; when she encountered a similar design model in the second stage, she easily applied the design information he had internalized in the first stage to the functional concerns in the second stage, and the compelling factors were replaced by functional concerns. While the final product of the model in the first stage had a very uneven mass arrangement, the final product of the model in the second stage turned into a more consistent mass organization and even the front layout was designed to be more readable. In the third stage, **Student 6**, who worked on a model with more clearly defined surfaces, was able to easily make changes in the interior layout of the model in accordance with the functional requirements in the last stage (Figure 5). **Student 6**, who designed a new section-model for the final project, proposed a Business and Life Center in the city center. **Student 6** stated in the survey that the other three phases did not limit her in the final stage. Stages of section-model 2 and section-model 4 were determined as the most effective models on the final process.

In this architectural design experiment, some students developed at every stage, as well as students who experienced decline/pause. For example, **Student 7** used the existing pattern of models in all three stages as they were, she designed them for three stages by preserving the structural and textural properties of the material on the model surface. As a result, formal organizations obtained through the dynamics of the mass order of the present model emerged. Sticking to the existing model to such an extent sometimes led to the development of false structural-functional-spatial solutions in the final products. The subject that **Student 7** struggled with in the first stage was how to use the metal mesh that provides the mass end of section-model 9; in the second stage, while there was an indoor organization problem arising from different flooring paths, in the last stage, there was a difficulty in functioning the model (Figure 6). In other words, **Student 7** had difficulty in perceiving the section-models in each phase and had difficulty in transforming the mass mechanisms of the models into design information. In final project, **Student 7**'s design was a formal organization that had lost its dynamism. As stated in the final survey, **Student 7** was not affected by the other three intermediate stages in the final study and handled the final product independently of the intermediate stages.

Figure 5. An advancement scenario through section-model and final project.

Figure 6. A decline/pause scenario in design through section-model and final project.

Considering the final study of **Student 7** and **Student 6**, the contributions of the other three intermediate stages were as follows (Figure 7): according to **Student 6**, who learned something from every different section-model in each phase and put it above design knowledge in the next stage, the final work was entirely the result of the previous three phases. According to **Student 7**, the three intermediate stages did not make any contribution to the final study. Comparing the final studies, **Student 6** demonstrated consistent and nourished design behaviors in terms of the interior organization, the sectional relationships of the building, and the dynamic shell of the mass. While the interior layout ensured the establishment of a richer sectional relationship, a facade pattern that flowed from the inside to the outside and developed spontaneously emerged in the balance between interior and exterior. In the project of **Student 7**, because the mass and section were not studied sufficiently, superficial relations were established, just like in the intermediate stages, and new surfaces were designed for the facade pattern that did not feed on the rhythm between the interior and the exterior.

When you evaluate the contribution of your 3-stage design work to your final design in the studio experience, rate the options presented below (5: too much, 4: too, 3: partially, 2: less, 1: very low, 0: none).	Student 6 (advancement)	Student 7 (decline/ pause)
Contributions to space design through section reading	5	4
Contributions to associating material and space design	4	4
Design achievement in the practice of thinking space with a model	4	4
Design achievement in constructing place-space relationship	4	3
Achievement in functional analysis skills	4	3
Contribution to the resolution of facade and mass legibility	4	3
Contribution to tectonic (constructive-structural) thinking	4	3
No design achievements	0	4

Figure 7. The way the subject was perceived by students with a progress and decline/pause scenario.

4.3. Third Discussion of Method

Third, how the same model was handled by different students will be discussed, and section-model 11 is used as exemplary model for this discussion. Section-model 11 had three distinctive features; the first was the sub-base plane. The base plane consisted of two elements: one was the raised floor line on which the main body of the model sat; the other was the intertwined top covered side area that continued at ground level and was described as wood material. The second distinctive feature of the model was the floor paths of different heights that made up the main body. At the same time, the position of the columns holding the floor traces of varying shapes and sizes and prisms attached to them at different levels and in different ways were also prominent features on the inner surface of the present model. The third distinctive feature of section-model 11 was the outer shell framing the inner surface on both sides and their junction, depicted, again, with wooden material (Figure 8).

Figure 8. Section-model 11.

Student 8, who dealt with section-model 11 in the first phase, was at the top of the class average in the traditional studio experience. However, **Student 8** showed a weak performance with section-model 11 in the first phase when she started working. Designing a cultural center on the busiest street of the city, **Student 8** set out from the prisms on the inner surface of the model as her analysis strategy. The existing flooring themes were used as they were and were considered as a way to obtain spaces with galleries. However, the interior section of the resulting product offered a mass space defined by very lacunar and weak relationships. The facade was also differentiated from the existing model and gained a more composite appearance. In the survey, **Student 8** stated that she had most difficulty in organizing the gaps in this model. Although she reported that working with three different models led her to do more research, the section-model experience for **Student 8** resulted in difficulty in reading the mass organization of the model and transforming formal relationships beyond functional-spatial concerns (Figure 9).

Student 9, who tried section-model 11 in the second phase, was at the average level in the class. Designing a technology school in the area known as the school district in the city, **Student 9** started by reading the mass order of the existing model as the analysis strategy. **Student 9**, who started to design from a correct point, had difficulty in finalizing the model. This difficulty was probably because he handled the model in the second phase, although he initially achieved a correct starting point. **Student 8**, on the other hand, could not determine how to deal with the model she encountered in the first phase, while **Student 9** learned from the design experience in the first phase and found a more successful starting point in the second phase. Accordingly, using the thickness of the lower floor, he divided it into units that functionally needed larger volumes. The spaces in the interior area of the model were reshaped and the prismatic masses attached to the support legs in the existing model were removed. In other words, under functional requirements, spatial solutions were realized by undergoing existing model deformation, which resulted in the product emerging as a solution that denied the relations of the existing model. On the other hand, section-model 11 for **Student 9** offered a mass that was more suitable for spatialization than the other models he worked with (Figure 9).

Finally, **Student 10** experienced the section-model 11 in the third phase and produced an outcome defined by more consistent relationships both in the traditional studio and in other projects of the section-model process in the other two phases. Section-model 11 was designed as a library building within the university campus. **Student 10** designed his analysis strategy on preserving the existing lower floor, reshaping the floor paths inside the model and removing prismatic bodies attached to the columns from the model. Just like **Student 9**, **Student 10** went through a formal deformation; however, unlike **Student 9**, he added a strong vertical circulation body to the model. When the interior is examined in the context of sectional relations, it can be said that **Student 10** reached the best solution. However, **Student 10** was not able to reflect the skill level captured on the inner surface of the model in terms of the facade (Figure 9).

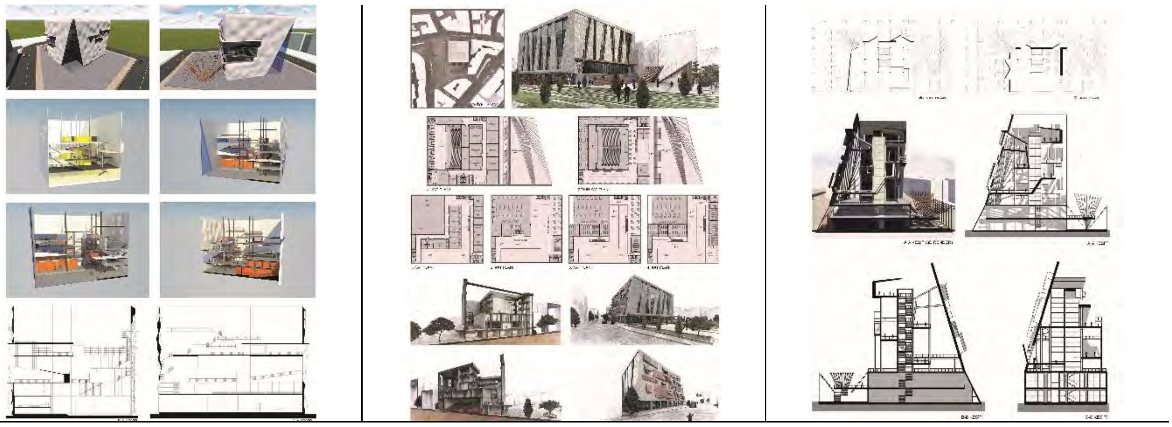


Figure 9. Examples of how section-model 11 was handled by different students: student 8 in the first phase, student 9 in the second phase and student 10 in the third phase.

At the end of this experimental studio, a questionnaire about the process was carried out (Figure 10). The questionnaire was focused to reveal that to what extent this experimental studio was contribute to student's design process awareness and educational process awareness. For example, this studio process was caused students to think with models. While models were formed and deformed and reformed, student's ability of seeing and thinking three-dimensionally was increased. In the questionnaire, this contribution was marked mostly as well as free and flexible design practices. On the other hand, holistic design grasp is improved and thus, plan, section and elevations were integrated more genuinely. According to the questionnaire, spatial compositions were seen purely since the section-models were played a role to analyze three-dimensional structures easily. Thus, functional, spatial and structural organizations were analyzed better. Contrary to traditional studio practices, this experimental studio was led students to do more research than other terms. Moreover, student's attention was turned into the studio completely since the models and phases were differantiated during the whole term. Thus, curiosity was emerged and interaction in the studio was increased automatically. These contributions were marked mostly in the questionnaire although some of the students did not pay attention to interact with others. As a matter of fact it was revealed in the questionnaire that 'section-model to space' studio was seen from the point of quite diversified views. In figure 10 it should be understood that a confusion between the 'section-model to space' studio and previous studios was emerged since the common design strategies were employed because of the resemblances were derived from the nature of architectural studio.

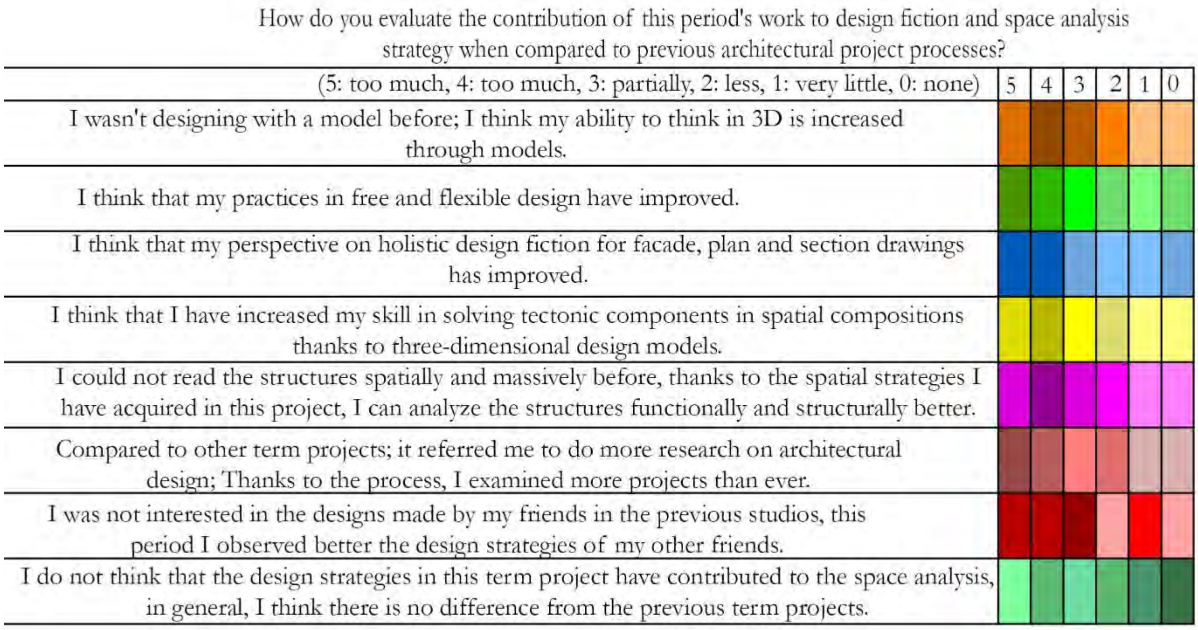


Figure 10. Evaluation of the process by the students (dark parts indicate that the answers are concentrated and light-colored parts indicate that the answers are diluted).

5. Conclusion and Implication for Practice

This study, which was theoretically coded 'from section-model to space' and was put into practice with studio work, carried out a different pedagogical model than the traditional studio. First of all, this difference started with the abandonment of traditional studio habits and then continued with the transfer of design outcomes based on basic design exercises in the studio. So that the students could internalize the subject, a repetition-based experience area consisting of three weeks was designed. This 3-step method provided a dynamic studio setting since the models and phases were changed and interwined. In addition to this, 3-step method was derived from a concrete starting point. This was entirely based on basic design exercises, called as section-model. While section-models were analyzed, deformed and reformed by students in each phase, 3-step method was functioned as a new learning setting. 3-step method contributed to the design process awareness and educational process awareness as a catalyst. Although the section-models were stable, architectural design process and product emerged in a flexible setting since the ability of thinking and doing was changed. Thus, students discovered that how they approached a model and an architectural problem. Design and learning processes were transformed into a research laboratory and at this point, experience was become a primary awareness tool. For example, the process directed the students to do more research in the context of spatial analysis, tectonic and material relations, and further increased the level of interaction in the studio environment. The increased interaction in the studio environment was due to the unique way the same model was analyzed in the other phases. So the process also aroused the phenomenon of curiosity in the studio. On the other hand, the process recalled the basic design exercises (abstraction, deformation, hierarchy, rhythm, etc.) required to bring the current section-model to a consistent formal order. While the process started a thought process on how to organize the form tectonically in the student, students also came to understand that the plan-section-elevation relation should be handled as a whole.

Briefly, this method, which was coded from 'section-model to space', encouraged a new learning environment that differs from traditional studio habits in practice. Thus, the method of the integration between basic design exercises and architectural studio, mentioned in the beginning, enhanced the potential of experience and discovery. Architectural studio practice evolved into a learning setup based on design processes. While architectural students were working on different models in different phases, they interacted each other intensely. They shared their experiences on a model which they worked before. This cause learning setup to be interactive and participative milieu. The method enabled more effective processes such as interaction and research to be expected in the architectural studio. Since design stragtegies and design knowledge emerged in the studio, formal analyses and design approaches derived from discovering-experiencing and thinking-doing processes. From all these aspects, the method from 'section-model to space' has emerged as an applicable process of a learning model in architectural education. For further studies, 'section-model to space' method can be also ameliorated. For example, section-model as a catalyst can be increased or reduced the diversity of architectural production. To provide this, it can be benefitted from behavioural and psychological studies. Thus, design strategies can be analyzed in detail with regards to cognitive, perceptual and formal studies. Apart from this, section-models can be also investigated in terms of building materials as well as tectonic components. Integration details of diffrent materials can be studied more concentrated way. Eventually, 'section-model to space' method can be grasp as a research laboratory on design.

References:

Alangoya, K. A. (2015). 'Tasarımcı düşünce' geleneğinin maceracı yapısı ve kentsel tasarım eğitimine katkısı üzerine deneysel bir kentsel tasarım stüdyosu: "iz üstünde taksim meydanı" *METU JFA*, *32* (1), 65-89.

Arnheim, R. (2009). *The dynamics of architectural form*. (2nd ed.). Berkeley-Los Angeles-London: University of California Press.

Asar, H. (2018). Mimari temsil araçlarından maketin tasarım düşüncesindeki yeri. *Tasarım ve Kuram Dergisi*, *26*, 24-35.

Ciravoğlu, A. (2014). Notes on architectural education: an experimental approach to design studio. *Social and Behavioral Sciences*, *152*, 7-12.

Demirbaş, O. O., & Demirkan, H. (2003). Focus on architectural design process through learning styles. *Design Studies*, *24*, 437-456.

Galle, P. (2011). Foundational and instrumental design theory. *Design Issues*, *27*(4), 81-94.

Goldschmidt, G. (1983). Doing design, making architecture. *JAE*, *37*(1), 8-13.

Goldschmidt, G. (2017). Design thinking: a method or a gateway into design cognition? *The Journal of Design, Economics, and Innovation, 3*(2), 107-112.

Oxman, R. (2004). Think-maps: teaching design thinking in design education, *Design Studies*, *25*, 63-91.

Paker Kahvecioğlu, N. (2007). Architectural design studio organization and creativity. *ITU A/Z*, *4*(2), 6-26.

Reynolds, C. (2015). *The fourth register of architecture: 'model as…'*. (Unpublished M.Arc thesis), The Bartlett School of Architecture, UCL, England.

Salama, A. M. (2015). *Spatial design education new directions for pedagogy in architecture and beyond.* England & USA: Ashgate Publishing.

Voet, C. (2013). Research on space as a productive design tool. Proceedings of the Conference Theory by Design Architectural Research Made Explicit in the Design Studio (29-31 October 2012), Antwerp/Belgium: Faculty of Design Sciences, Artesis University College, pp.101-110.

Journal of
Design Studio
v:2 n:2 December 2020

Comprehending the Psychosocial Characteristics of Space through an Elective Course: The Experience of the Body and Cognitive Mapping in Design Education

Nevset Gul Canakcioglu
Ozyegin University, Faculty of Architecture and Design, Istanbul, Turkey

Received: October 5th 2020, Revised: November 8th 2020, Accepted: November 9th 2020
Refer: Canakcioglu, N. G., (2020), Comprehending the Psychosocial Characteristics of Space through an Elective Course: The Experience of the Body and Cognitive Mapping in Design Education, Journal of Design Studio, V.2, N.2, pp 41-55,

ORCID: 0000-0002-8289-3601
DOI: 10.46474/jds.805377 https://doi.org/10.46474/jds.805377

Abstract: Architectural studio courses are structured for students to comprehend an existing urban fabric with its physical and social components for the purpose of solving a specific design. In this context, as students develop their conceptual ideas, they are also expected to assume probable interactions that are supposed to occur between users and space. However, students often face with difficulties in embracing the space with its psychological, social and sensual dimensions and occasionally ignore these unseen parameters of space such as spatial perception, user needs, privacy, user satisfaction, and etc. In this regard, elective courses become essential in supporting the student's interdisciplinary comprehension of space. An elective course titled Spatial Perception and Cognition is structured with this intention to support the student's interdisciplinary understanding of space both in theoretical and kinesthetic means. Thus, in the context of the course, the concept of space is not only introduced through theoretical seminars, but also through an experiential participation of the students themselves where they can actively perform daily activities by the guidance of a blind guide, in Dialog in the Dark which is a thematic dark environment where students experience various urban nodes through scent, sound, wind and texture. Upon completion of the experience, students are invited to a cognitive mapping session through which they reflected their spatial experiences grasped via their senses. In conclusion, cognitive maps show that when eyesight is eliminated, other senses also play a very important role in comprehending the sensual and psychological characteristics of space.

Keywords: Architecture Studio, Cognition, Cognitive Mapping, Design Education, Spatial Perception.

1. Introduction

The students in architecture departments, in every upcoming semester, are expected to cope with the problems arising from the multi-faceted parameters of urban life and think of these parameters through a multidisciplinary perspective. During the stage of design, the designer candidates go through such a process that while they attempt to define the spatial relations between the spaces hierarchically, they also try to determine and anticipate the user groups, the frequency of their use of the spaces, public, semi-public, private shift between indoor and outdoor spaces according to the theme of the project.

At every stage of the design process, the student as a designer candidate is expected to be aware of the emerging structure of the upcoming artefact regarding how the inseparable unity of the spatial component is perceived by its users, what sort of dialogues tend to be established between diverse user groups, what kind of changes the spatial organization will cause in the emotional states of the users. Within this context, elective courses which students select to make themselves more specialized in specific subjects, can provide cognitive support in understanding the interaction between space and user.

The elective course titled Spatial Perception and Cognition which is structured with such an aim, aspires to support students embrace the space not only with its topological and geometrical characteristics but also with its psychosocial characteristics. As a result of the case study conducted in this research, based on the bodily experiences of the students taking the course in a totally dark thematic environment and a cognitive mapping session afterwards, it was found that students define the concept of space not only through the physical parameters such as dimension, area, scale and etc. but also through its psychosocial characteristics such as its tactile, auditory, olfactory and even gustative characteristics.

2. The Aim and Process of the Course Spatial Perception and Cognition

The aim of the Spatial Perception and Cognition course is to convey an interdisciplinary thinking in architecture focusing on the reciprocal interaction between the individual and space within the scope of environment and behaviour theories through the concepts of perception and cognition. In this context, in the scope of this course, besides conveying the theoretical studies in spatial perception and cognition (Hall, 1966; Hart and Moore, 1973; Canter, 1977; Moore, 1979; Moore, 1985; Piaget and Inhelder; 1967; Rapoport; 1969) the concept of space is also embraced with its sensual attributes that have an effect on user experience such as visual, auditory, kinaesthetic, tactile and olfactory attributes (Lynch, 1960; Lawson, 2001; Merleau-Ponty, 1961; Merleau-Ponty, 1982; Pallasmaa, 2005). Additionally, the concept of spatial cognition which relates to how the individual learns, comprehends and constructs the space through distinctive cognitive maps is also covered through the researches of scholars beginning from the time that the theory of environmental psychology was first introduced (Tolman, 1948; Kaplan, 1973; Downs and Stea; 1973; Piaget and Inhelder; 1967).

Through these aims, by completing this course, it is aimed the students to gain the following learning outcomes:

- Comprehend the parameters affecting the behaviour of the individual within various physical environments.
- Internalize the existence of a reciprocal relationship between space and individual as a user.
- Comprehend the concept of space as a multi-dimensional component of the physical environment including social, cultural, physiological and psychological constituents.
- Internalize the concept of space as a perceptual product generated by ongoing cognitive processes of the individual through the construction of knowledge resulting from the spatial experiences of the individual.

The course is regularly carried out for 14 weeks during a semester, once a week, for two hours. In the first lecture of the course, the course is introduced to arouse curiosity about the multi-dimensional meanings of the concepts of spatial perception and cognition. Therefore, in order to give hints about the reciprocal relationship between the space and the user, various visuals that represent different kinds of spaces, including urban, rural, centuries-old, built in the late modern era, private, public, semi-public and etc. are shown so that the students can grasp an initial idea of the concept of spatial perception and actually understand that this course may also have an aspect affecting and developing their cognitive processes in design for the benefit of their design studio courses.

In the next four weeks, a series of theoretical seminars are held for the purpose of increasing the students' level of knowledge on environment and behaviour theories. In this context, it is worthwhile to remember the important quotation of Winston Churchill which read as follows, "We shape our buildings; thereafter they shape us", which specifically emphasizes that every space we live and work in our daily lives has various impacts on us, while these spaces also affect us. The theoretical part of the inseparable relationship between space and the user is conveyed through consecutive seminars every week.

Discussions on the theoretical background of environment and behaviour theories start based on the arguments of Moore (1979, 18) emphasizing that, "architecture is the art, which above all others, combines expression, technology, and the satisfaction of human needs. Its purpose is to make places where people feel more human, more alive, more fulfilled" while trying to describe what decent architectural artefact actually is. During these discussions, students take a deeper look into and try to find an answer(s) to the question of "how often do we really pay serious attention to the needs of the user, to the behavioural, social and cultural determinants of the design, and to the role of the good design in affecting human behaviour?" which was put forward by Moore (1979, p.18) through students' active participation and group discussions.

Soon after two weeks, the students are asked to select specific articles and make presentations in groups on the key concepts of the course for the purpose of making active participants in the following weeks. The key concept of environmental perception is embraced based on Gestaltian (Smith, 1988; Rock and Palmer, 1990), transactional (Ittelson, 1976), ecological (Gibson, 1966) and cultural approaches (Rapoport, 1969) while the other key concepts such as environmental cognition (Piaget and Inhelder, 1967), behaviour setting (Barker, 1968), personal space (Sommer, 1959), privacy, territorial space (Hall, 1966) and environmental stress (Lawton and Nahemow, 1973) are embraced through theoretical backgrounds put forward by the scholars as well as through concrete examples in the history of architecture. While the topic of visual perception is embraced through the theory put forward by Kevin Lynch in his book -The Image of the City- in 1960, and other sensual characteristics of space are embraced through significant examples in the architectural history.

2.1. Theoretical Background: The Dominancy of the Eye in Perception

Merleau-Ponty (2004, p.50) opposes the precise distinction that classical science keeps a distance between space and the physical world. Space, according to Ponty, has a dimensionality through which it affects the beings involved in space, and is also affected by the beings themselves. Instead of a world where the distinction between identity and change is clearly defined, he asserts that we have a world where the "form and the content are mixed" and the boundary between them is blurred. In parallel with this phenomenological way of thinking about space, Bachelard (1994) states that in order to gain a holistic understanding of the concept of space, it is necessary to comprehend that there is a dialectical relationship between the empirical world of space and the way of thinking about space.

However, according to Lawson (2001), the sensory organ that is at the forefront in spatial perception is the eye since the perception of a person with a complete physical competence is heavily dependent on the sense of vision (Lawson, 2001) due to the instant delivery of a large environmental information even in the blink of an eye (Ungar, 2000). In parallel to this approach, according to Pallasmaa (2005), the eye has become the centre of both architectural and spatial perception and accordingly the representation of space due to the fact that the eye, compared to the other sensual modalities, collects the largest amount of perceptual data generated by the environment. This dominating effect of visual perception both in individual perception and in the field of design, the auditory, olfactory and tactile characteristics of space that also have strong impacts on human psychology to be sometimes ignored even by designers. In addition to that, as Ünlü mentions (1998), sensory perception through vision cannot only be a purely visual matter of fact but actually is related to how the individuals perceive their environment through their kinaesthetic experiences such as body movements which also include postures, gestures and actions.

Therefore, for a holistic perceptual process, it is necessary to perceive through all sensory organs, regardless of whether the perceived thing is an object or a spatial component. In parallel with this view, according to Ittelson (1951), action and perception are inextricably related to each other, because changes in one's perception processes cause changes in one's actions, and changes in one's actions cause new changes in perception processes. Gibson (1979), supporting this view, states that the process of comprehensively understanding space is an extension of perception, because the essence of knowledge about space is obtained as a result of perceptual process which results as an abstract concept in the mind.

Therefore, the holistic understanding and representation of space can also be expressed as the replication obtained through the recall of the perceptual inputs collected in the mind as a result of the individual's kinaesthetic experience and sensual perception (Downs and Stea, 1973; Jacobson, 1998). One of the studies that demonstrated the importance of the visually impaired individuals' kinaesthetic experiences in spatial perception (Passini and Proulx, 1988), showed that congenitally blind participants were able to represent the route they followed at a level very close to the sighted individuals who were the control group in the study. Another cognitive mapping research with the blind (Jacobson, 1998, p.303) showed that these visually impaired people achieve direct or indirect spatial and geographic awareness through their "language, audition, haptics, smell and taste" skills, as well as through understanding the "flow and motion" in space.

Consequently, as it is stated within the scope of the objectives of the course and this paper, it is hypothesized that the holistic perception of any space with all senses and the comprehension of this issue by the students is assumed to be very vital and essential in addressing the design problems that the students are working on in their design studios. For this reason, it is one of the primary objectives of this course that students experience this involvement through their own bodies and perceive the place thoroughly through all of their senses that they usually forget or ignore in their daily lives.

3. Methodology

In order to fully test the hypothesis of the study, an out-of-school visit to a thematic experiential setting called as Dialogue in the Dark has become an important content of the course for the purpose of making students become more aware of the dominant state of the sense of vision, as well as making them realize the importance of other sense organs for a holistic spatial perception.

3.1. Case Study Environment

Dialogue in the Dark, as it is mentioned on its web site (Url-1), is defined as "an exciting journey of exploring daily environments & routines through the senses of touch, taste, smell and sound. With the help of white cane and guide you get a chance to explore the unseen, and learn to see in darkness. As you travel through Dialogue in the Dark exhibition, an invisible landscape emerges, composed out of sounds, scents, wind and textures. In tours that can last up to 1.5 hours you explore a park, a city, embark on a boat ride and enjoy coffee & appetizers in a café. The experience allows you to have great fun and to discover how to find orientation and move in the dark, how to identify the world through the remaining senses, how to interact and communicate by relying on other senses, how to generate trust and cope with the unknown." Dialogue in the Dark, which is experienced in more than 30 countries and 130 cities with visitors over 8 million, has been serving at Gayrettepe Metro Station in Istanbul since 2013 (Url-2). In the thematic environment that hosts visitors in a total area of 1600 square meters, the visitors experience the daily life of Istanbul in a completely dark place in groups with the help of a blind guide.

After the participants are given white canes at the entrance, they follow a narrow and labyrinthine corridor and gradually step into a totally darkened environment (Figure 1), where they meet their blind guides in the total darkness. Visitors, who continue their routes under the guidance of their guides, experience a total of 12 different nodes including the entrance and exit areas. The experiential nodes can be summarized as follows (Figure 2):

- Entrance
- Meeting point with the guide
- Park
- Bicycle
- Market
- Car
- Crossing the street
- Tram
- Boat
- Braille Alphabet
- Café
- Exit

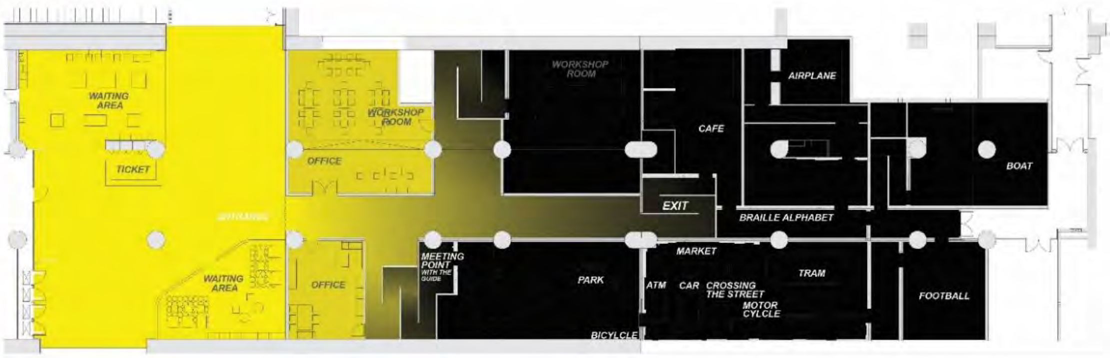


Figure 1: Transition from Bright Areas to Darkness in Dialog in the Dark
Source: Sarıberberoglu et al., 2017

Figure 2: An Infographic Showing the Experiential Nodes in The Thematic Environment
Source: Sarıberberoglu et al., 2017

In the setting, where each different node is equipped with various stimuli that arouse auditory, olfactory, tactile and gustative senses, the visitors respectively experience a park and a market of Istanbul, cross a road that is specially designed for the blind, take the well-known tram on Istiklal Street, cross the Bosporus with the ferry and finally, by ordering a drink or food in a cafe, they socialize with friends in the group. Participants who experience the daily life of Istanbul during the 90-minute experience, like the blind people who live the city's outdoors, experience the difficulties they have never experienced before, such as walking and getting off the sidewalk, getting on the tram, finding a place for themselves with the help of a white cane, they also notice the stimuli that they do not normally pay attention to in their daily lives, such as the music coming from the Flower Passage in Istiklal Street, a wide variety of sounds of the city, the horns, the traffic light with sound signal, or dangers including burns and injuries caused by a cup of hot tea.

In such a nonvisual thematic environment the aim is to enable students to discover various spatial components and other senses without relying on and using their visual abilities that they normally use in their daily lives, while also being aware of the potential of these senses in spatial perception.

3.2. The Methodology of Cognitive Mapping Applied and its Outputs

The participants of the study are selected from the group of students who have been taking the Spatial Perception and Cognition course and voluntarily would like to experience the thematic environment of Dialogue in the Dark right after the students' experience in the setting for about 90 minutes, the students are invited to a cognitive mapping session through which they are asked to draw their route in the setting. In summary, this study is conducted by the analysis of a total of 76 cognitive maps represented by students, of which 29 were male and 47 were female.

Before starting the cognitive mapping session, it is announced to the students that they are free to draw and use any kind of text and graphical notes while representing their experience onto an A4 size of paper (Figure 3 and 4). The reason why they are asked to add text and graphical notes onto their cognitive maps is not only to reveal the experiential nodes they remember, but also to uncover the sensual data they have constructed in their cognition while they are experiencing these nodes (Figure 5 and 6). At the beginning of the cognitive mapping session, which lasts 20 minutes in total, in the first place, each of the students is given a pencil and they are allowed to work only with this pencil for about 10 minutes, after which the pencils are taken away from them and then each of the students is given a red pencil and allowed to work for another 10 minutes. The reason for carrying out the study in this way is to understand and differentiate which experiential nodes and what kind of sensual data –auditory, olfactory, tactile or gustative- the students remember in the first and second 10 minutes' sessions of the cognitive mapping process.

Figure 3-4. Students drawing during the cognitive mapping session right after the Dialog in the Dark experience.

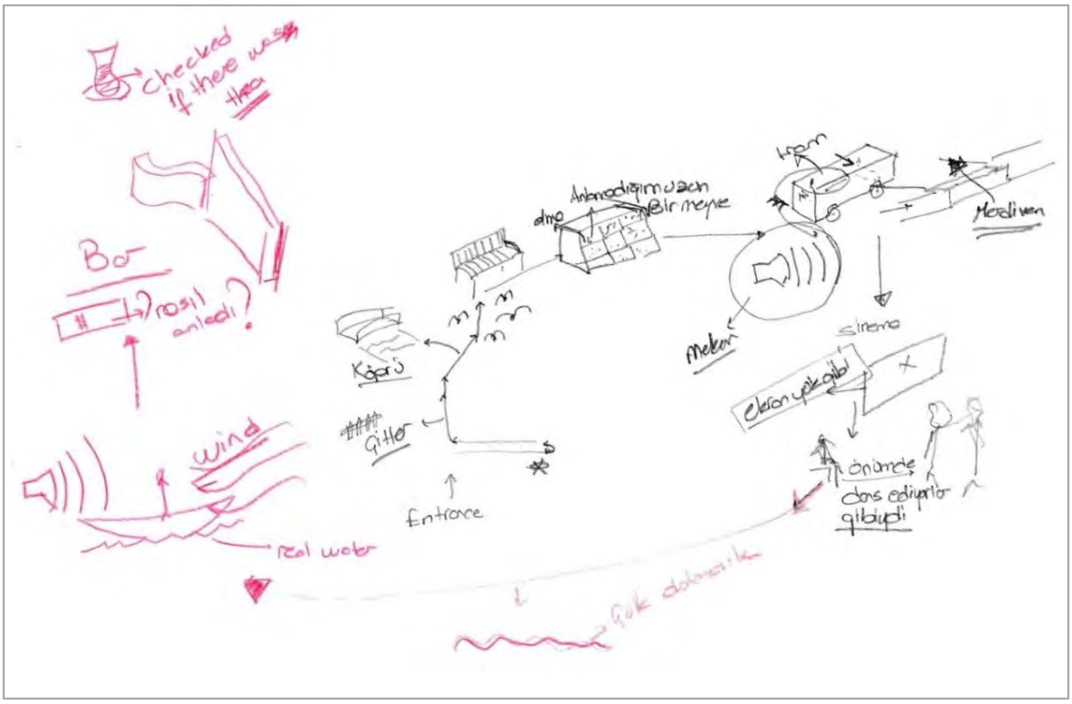


Figure 5. An example of a cognitive map (Male).
Source: Image Courtesy of the elective course titled Spatial Perception and Cognition

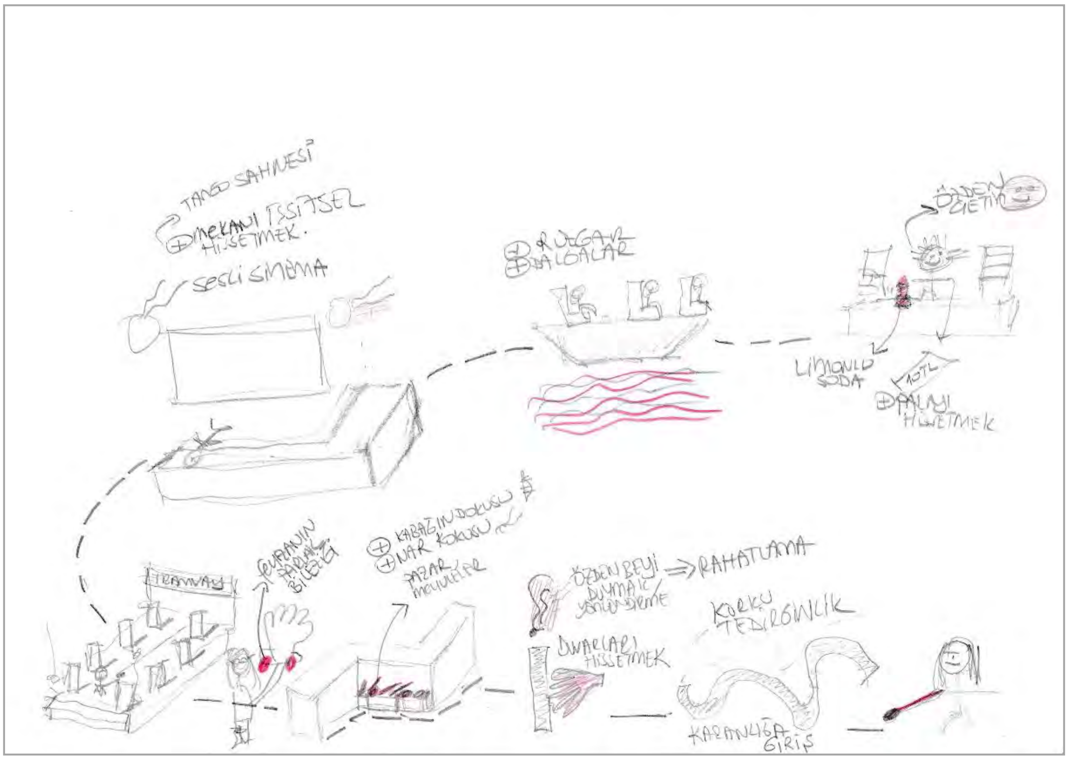


Figure 6. An example of a cognitive map (Female).
Source: Image Courtesy of the elective course titled Spatial Perception and Cognition

Besides, the procedure in the analysis phase of the study is carried out as follows (Table 1);

- In the first place, the experiential nodes shown up on each cognitive map are counted one by one, and accordingly the total frequency of each experiential node represented on the maps is obtained. This information constitutes the dataset –one of the dependent variables- that reveals which nodes are more recalled and represented on cognitive maps based on the participant's experience.
- Next, if any olfactory, auditory, tactile, or gustative sensual data is added regarding each experiential node, this data is also counted independently so that the total sensual frequency of every experiential node is revealed. This information constitutes the dataset –the other dependent variable- that reveals the sensual data frequency of each node in cases where there is no visual perception.
- Besides, the sensual datasets are also recorded whether they were drawn with a pencil or a red pencil to understand in which session the drawing was completed, in the first ten minutes' session or the second ten minutes' session. This information constitutes the dataset that reveals whether the sensual data is recalled and represented in the 1st or 2nd drawing stage.

It should be mentioned that this methodology had also yielded fruitful results in the research of Sarıberberoglu et al. (2017), through which they made the research with 25 architects to understand which sensual characteristic is more dominant in spatial perception in such a nonvisual environment. In parallel to the methodology and analysis phase of this study, the results of Sarıberberoglu et al. (2017) also showed that the participants rely heavily on their tactile senses in such a place where they do not use the sense of sight and the syntactic characteristic of the spatial organization is not correlated with the frequency of cognitive representation of the individuals.

Table 1. Datasets accumulated through cognitive maps.

Experiential nodes shown up		*Sensual data*											
		Olfac-tory	*Draw order*		*Audi-tory*	*Draw order*		*Tac-tile*	*Draw order*		*Gust a-tive*	*Draw order*	
			1st	*2nd*		*1st*	*2nd*		*1st*	*2nd*		*1st*	*2nd*
Entrance	69	0	0	0	0	0	0	54	51	3	0	0	0
Meeting point with the guide	4	0	0	0	3	1	2	0	0	0	0	0	0
Park	54	2	1	1	29	18	11	172	135	37	0	0	0
Bicycle	7	0	0	0	0	0	0	1	0	1	0	0	0
Market	41	20	16	4	1	0	1	19	15	4	0	0	0
Car	0	0	0	0	0	0	0	0	0	0	0	0	0
Crossing the street	28	0	0	0	25	16	9	23	18	5	0	0	0
Tram	68	0	0	0	40	24	16	38	29	9	0	0	0
Boat	61	0	0	0	44	20	24	91	50	41	0	0	0
Braille alphabet	1	0	0	0	1	0	1	0	0	0	0	0	0
Café	74	5	2	3	11	3	8	67	17	50	25	5	20
Exit	45	1	1	0	1	1	0	21	6	15	3	0	3
Total frequ-ency	452	28	20	8	155	83	72	486	321	165	28	5	23

4. Analyses and Results

The analysis phase and the results of the study are presented in two parts. In the first part, numerical distributions of the datasets are shown and comparative bar graphs are presented (Figures 7,8 and 9). In the second part, simple regression test results conducted via SPSS (2018) between the two dependent variables are revealed. The two variables in simple regression correlations as described in the methodology section are as follows: (1) total frequency of each experiential node represented on cognitive maps, and (2) total sensual frequency of each experiential node represented on cognitive maps. Depending on the significance levels of the statistical data obtained, the hypothesis of the study is discussed in conclusion section.

In the first part of the analysis procedure, frequencies related to how many times each experiential node are drawn are calculated. When the total frequencies of the experiential nodes in the cognitive maps (Figure 7) are considered, it is found that the node that appeared with the highest amount of 74 is the café. In other words, after the students completed their experience in Dialog in the Dark, they have remembered and represented the node of café at the highest amount. The node of café is the last visited node of the thematic environment where food and drinks are ordered in the darkness, where money exchange is experienced and also a slight tension against the danger of burning is experienced when a hot drink is bought from the bar. At the same time, this node is the first place for the participants to have a seat for the first time after a 90-minutes of stressful experience where they socialize and chat with the group and the guide as if they are in a real café environment. Briefly, the reason why the node of café appeared at the highest amount could be that the participants had many sensual experiences in this setting that make them recall this node.

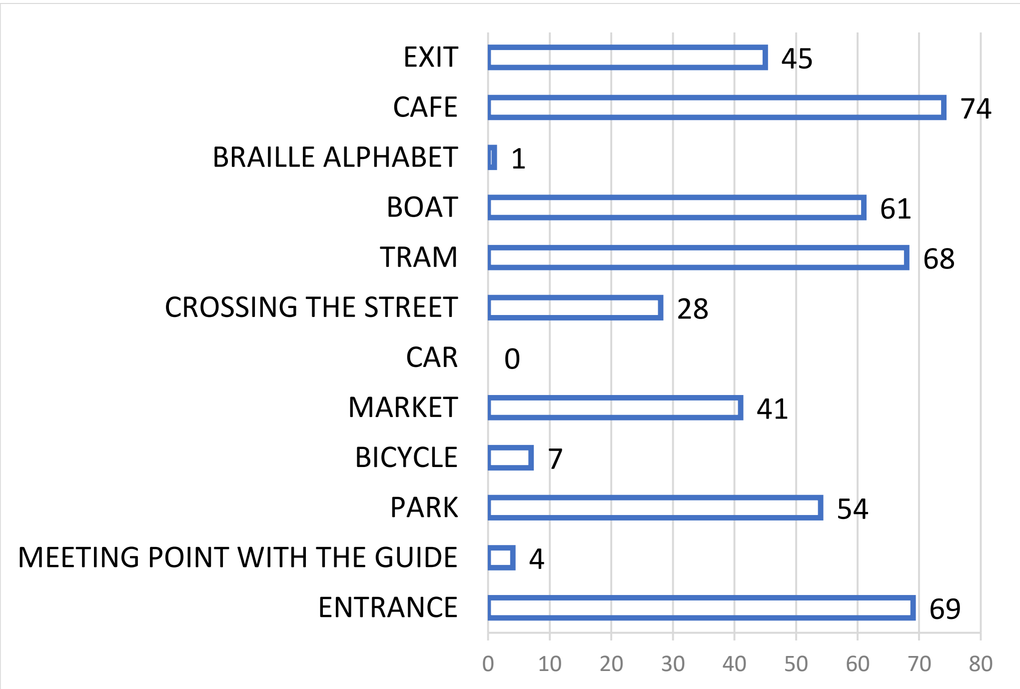


Figure 7. The frequency of each experiential node represented by students on their cognitive maps.

When the café node is examined through the observation of the notes written by the participants on their cognitive maps, it is encountered with some details that appeal to many olfactory, auditory, tactile and gustative senses; olfactory details such as smell of drinks and perfume, auditory details such as music, sound of people and kettle sound, tactile details such as wooden countertop, money/coins and warmth of drinks, gustative details such as tea, mineral water, chocolate and coke. Moreover, since this experiential node is the place where the blind guides share their memories with the group that cause them to be blind and the difficulties they experience in their daily lives, the participants may be keeping this striking experience in their memories through this experiential node.

The second node which is reflected on the cognitive maps at the highest frequency is the entrance node with 69 (Figure 7). Entrance node is the place where the participants are directed into the setting by a staff, take their walking sticks, and then cross the labyrinthine corridors and switch from light to total darkness alone within the group. This node may have been kept in the memories of the participants as the node where they experienced such a total darkness for the first time and the tension started. Because this is the place where the feeling of security provided by the group of people you are moving with when you are in the light gradually disappears and the feeling of loneliness prevails as you get immersed into the darkness although you keep moving with the same group. Moreover, when the notes written down as sensual details are examined, the labyrinthian walls and height difference detail, which are the tactile sensual details represented, attract particular attention.

Third node represented on the maps at the highest frequency is the tram with 68 as it is stated in the same figure (Figure 7). When the node of tram is examined by observing the notes written by the participants on the cognitive maps, it is noticed that the auditory and tactile details appear strikingly in the cognitive maps; auditory details such as city sounds, music, sound of people and tactile details such as height difference, seats, metal railings and hard flooring apparently kept this node in mind of the participants.

When the cognitive maps of the participants are examined in detail, it is also noticed that the participants not only represented the nodes they visited, but also represented many sensual details that they recognised at these nodes. When the distribution of the frequencies of these sensual data dependent on the sense of smelling, hearing, touching and tasting is correspondingly examined as it is specified in Figure 8; the tactile sensual details are significantly higher in cognitive maps with the amount of 486 compared to other senses of smelling, hearing, and tasting.

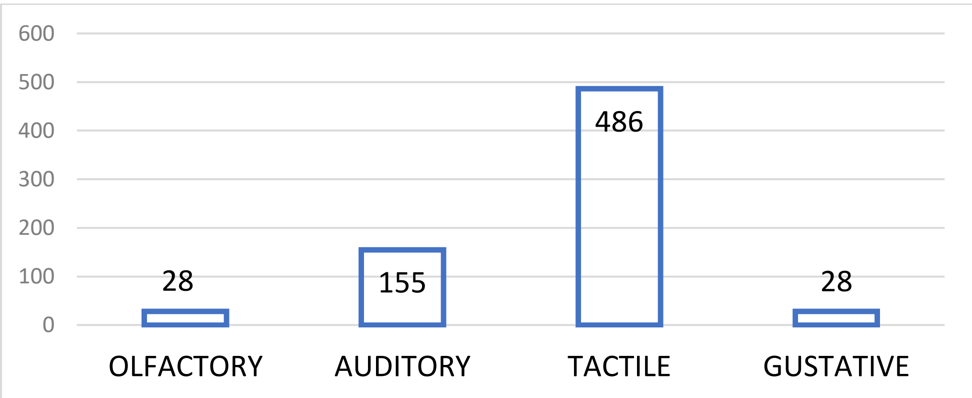


Figure 8. The amount of sensual data on students' cognitive maps.

The dominant result regarding the tactile data as it is stated above (Figure 8) might be showing the fact that when participants are intertwined with such a complete darkness, they could possibly be recalling the nodes which they have accumulated the greatest amount of tactile data so that they reflect those experiential nodes the most on their cognitive maps. Moreover, when the distribution of the emergence frequency of the sensual data is examined (Figure 9), it is found out that most of the tactile data appeared in the cognitive maps is represented in the first 10 minutes of the cognitive mapping session. This result reflects that the participants might be conveying tactile data primarily while they are representing their experiences in Dialog in the Dark.

Table 2. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
freqofplace	.191	12	.200*	.882	12	.092
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

4.1. Statistical Correlations

The last step of the research is composed of statistical analyses which are performed using the SPSS (2018). To choose whether a parametric test or a non-parametric test to be applied, firstly a normality test is performed. When the result of the normality test is analysed (Table 2), the Shapiro-Wilk value is obtained since sample number is less than 50 (the number of experiential nodes: 12<50). Since the Shapiro-Wilk value is 0.092 (> 0.05), the sample size is normally distributed so that a parametric test can be applied. Thus, simple linear regression analyses are conducted in the study since the difference between two dependent variables is sought to be analysed.

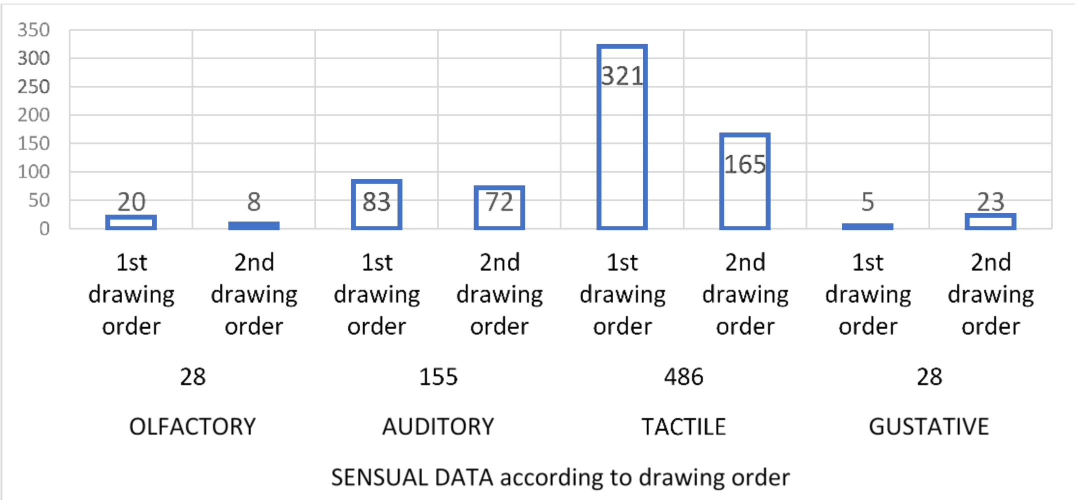


Figure 9. The frequency of sensory data in the 1st and 2nd cognitive mapping sessions.

Simple linear regression analyses are conducted between two dependent variables which are, (1) the total frequency of each experiential node represented on cognitive maps, and (2) the total sensual frequency of each experiential node represented on cognitive maps. When the results of all linear regression analyses conducted in the study are examined (Table 3), it is seen that 2 out of 12 correlations are significant.

According to the table below (Table 3), no significant relationship is found between the frequency of representation of experiential nodes by the participants and the total frequency of olfactory, auditory and gustative data representations. Additionally, regarding these sensory datasets, there are no significant results neither in the first nor in the second drawing stages. Although these results indicate that smell, olfaction and taste data are somewhat effective in remembering, they are not significantly effective in remembering in such a completely dark environment.

But unlike the results of those three sensory datasets, two significant relationships are found (Table 3) between the frequency of representation of experiential nodes by the participants and the total tactile data representations on cognitive maps. There is a significant relationship between the total frequency of the experiential nodes represented in cognitive maps and the tactile characteristics of these nodes (r^2=0.636, p=0.026<0.05). In other words, tactile accumulated data of the participants were significantly influential on their recalling behaviours.

When the correlation between the frequency of representation of the nodes and the frequency of the tactile dataset according to the drawing stages is examined, it can be mentioned that the frequency of tactile characteristics of the nodes significantly appeared at the 2nd stage of cognitive mapping session (r^2=0.660, p=0.020<0.05). When the researcher's own observations regarding the cognitive maps are

Table 3. Chart showing the simple linear regression correlations between the frequency of the places (experiential nodes) in cognitive maps and the frequency of sensual data.

	Pearson correlation value (r^2)	*Sig. (2-tailed) p value*	*significance*
Frequency of nodes; total olfactory data	0.156	0.628	insignificant
Frequency of nodes; olfactory data in 1st stage	0.100	0.757	insignificant
Frequency of nodes; olfactory data in 2nd stage	0.317	0.315	insignificant
Frequency of nodes; total auditory data	0.516	0.086	insignificant
Frequency of nodes; auditory data in 1st drawing stage	0.472	0.121	insignificant
Frequency of nodes; auditory data in 2nd drawing stage	0.540	0.070	insignificant
Frequency of nodes; total tactile data	0.636	0.026	significant
Frequency of nodes; tactile data in 1st drawing stage	0.523	0.81	insignificant
Frequency of nodes; tactile data in 2nd drawing stage	0.660	0.020	significant
Frequency of nodes; total gustative data	0.410	0.185	insignificant
Frequency of nodes; gustative data in 1st drawing stage	0.399	0.198	insignificant
Frequency of nodes; gustative data in 2nd drawing stage	0.142	0.183	insignificant

also added, this result might be showing the fact that the participants firstly represented all the nodes they experienced from the beginning to the end within the first ten minutes, and in the second ten minutes which is the second stage of the session, they depicted these nodes with a significantly high amount of tactile data.

When these two significant results are to be evaluated together, it can be discussed that in cases where the sighted individuals are forced to navigate through in a totally dark environment, they tend to rely on their kinaesthetic perceptions through their bodily experiences so that they try to grasp the environment predominantly through its tangible characteristics and trust on their tactile perceptions.

5. Conclusion and Discussion

Elective courses are the ones in architecture and design schools through which students explore the physical, social, cultural and psychological aspects of the space with various methodologies and contribute to their development in architectural project studio courses with these aspects. The courses that enable students to discover the invisible dimensions of the space, to help students perceive the space and to realize the interaction between different uses, are the courses that try to reflect the psychosocial characteristics of space. In this context, *The Spatial Perception and Cognition* course is an elective course that helps the students to grasp that the space is not only composed of topological qualities like x, y and z dimensions and certain square meters but additionally is also composed of psychosocial characteristics that can be comprehended through a holistic perception.

In order to better understand and teach that the space has an invisible psychosocial aspect, this elective course invites its participants to a kinaesthetic experience based on a voluntary participation that the students can explore and navigate in a totally dark environment where the visual perception has become dysfunctional so that they are forced to use their other senses to uncover the psychosocial aspects of space.

When the results obtained at the cognitive mapping session after the students' kinaesthetic experience are considered, it is revealed that when the eyesight -which is the dominant sense in spatial perception- is eliminated, other senses also play a very important role for the individuals in grasping, perceiving, comprehending and recalling any space and accordingly effecting the construction of a cognitive map. Additionally, it is noticed that the tactile sense, compared to the auditory, olfactory and gustative senses, stands out significantly in the perceptual production of space. Additionally, it was revealed via some text notes and graphics that the participants used on their cognitive maps that students are still able to perceive, represent and achieve to uncover the concept of space through many sensory data such as voice, music, wind, material quality of surfaces, temperature, height difference and etc.

In conclusion, it is found out that the elective course *Spatial Perception and Cognition*, in line with the objectives of the course, have an act as a means to comprehend the psychosocial characteristic of space for the purpose of supporting the students to acquire a more holistic approach in the design process and design thinking and develop their skills helping them to achieve better in their design studio works. Therefore, this study showed that an elective course on spatial perception and cognition within the architecture curriculum in order to examine the concept of space in a multidimensional way thanks to a bodily experience and a subsequently held hands-on experience of a cognitive mapping session, may have an effect in contribution to the students' spatial organization skills in architecture design studios. Additionally, the question of whether students who are considered to have a better understanding of the multifaceted relationship between space and the individual through this course achieve higher success in design studios may also be an important research topic in future studies.

Acknowledgement
I thank all the students who have taken Spatial Perception and Cognition course and voluntarily participated in the Dialogue in the Dark event.

References

Bachelard, G. (1994). The poetics of space Beacon Press. Boston MA.

Barker, R.G. (1968). Ecological Psychology; Concepts and Methods for Studying Human Behavior. California: Stanford University Press.

Canter, D. (1977). The Psychology of Place, London: The Architectural Press Ltd.

Downs, R. M. and Stea, D. (1973). Cognitive maps and spatial behavior: Process and products. In M. Dodge, R. Kitchin, and C. Perkins (Eds.), The Map Reader: Theories of Mapping Practice and Cartographic Representation, (p.312-317). London: John Wiley & Sons.

Gibson, J. J. (1966). The Senses Considered as Perceptual Systems, Boston: Houghton Mifflin.

Gibson, J. J., (1979). The Ecological Approach to Visual Perception, Boston: Houghton Mifflin.

Hall, E. (1966). The Hidden Dimension, New York, US: Doubleday & Company, Inc. Garden City.

Hart, R. A., & Moore, G. T. (1973). The development of spatial cognition: A review. In R.M. Downs, D. Stea (Eds.), Image & environment: Cognitive mapping and spatial behavior, (pp. 246-288). New Brunswick, NJ, US: Aldine Transaction.

Ittelson, W. H. (1951). The constancies in perceptual theory. Psychological Review, 58(4), 285.

Ittelson, W., Rivlin, L., Proshansky, H. M. (1976). The use of Behavioural Maps in Environmental Psychology. New York, NY: Holt, Rinehart and Winston.

Jacobson, J. L., (1998). Cognitive Mapping Without Sight: Four Preliminary Studies of Spatial Learning, Journal of Environmental Psychology, 18, 289-305.

Kaplan, S. (1973). Cognitive maps in perception and thought. Image and environment: Cognitive mapping and spatial behavior, 63-78.

Lawson, B. (2001). Language of Space, Oxford: Architectural Press.

Lawton, M. & Nahemow, L. (1973). Ecology and the aging process. In C. Eisdorfer and M. Lawton (Eds.), The psychology of adult development and aging. (pp. 619-674). Washington: American Psychological Association.

Lynch, K. (1960). The Image of the City, Cambridge: MIT Press.

Merleau-Ponty, M. (1961). Eye and mind, Images: A Reader.

Merleau-Ponty, M. (1982). Phenomenology of perception, London: Routledge.

Merleau-Ponty, M. (2004). The world of perception, London: Routledge.

Moore, G. T. (1979). Architecture and human behavior: The place of environment-behavior studies in architecture. Wisconsin Architect, 18-21.

Moore, G. T. (1985). Environment and behavior research in North America: History, developments, and unresolved issues. Center for Architecture and Urban Planning Research, University of Wisconsin-Milwaukee.

Pallasmaa, J. (2005). The eyes of the skin: Architecture and the senses. NJ, USA: John Wiley & Sons.

Passini, R., & Proulx, G. (1988). Wayfinding without vision: An experiment with congenitally totally blind people. Environment and behavior, 20(2), 227-252.

Piaget, J., Inhelder, B. (1967). The Child's Conception of Space. New York, USA: The Norton Library.

Rapoport, A. (1969). House form and culture. Engelwood Cliffs, NJ: Printice-Hall.

Rock, I., Palmer, S. (1990). The legacy of Gestalt psychology. Scientific American, 263(6), 84-91.

Sarıberberoğlu, M. T., Turgay, Z. T., Canakcioglu, N. G. (2017). Cognition through a nonvisual experience, Iconarch III International Congress of Architecture Memory of Place in Architecture and Planning Congress, May 11-13, 2017, Konya, Turkey.

Smith, B. (1988). Foundations of Gestalt theory, Philosophia Resources Library, Münich: Philosophia Verlag Gmbh,

Sommer, R. (1959). Studies in personal space. Sociometry, 22(3), 247-260.

SPSS (Statistical Package for Social Sciences) software, IBM [Computer Software], (2018). Retrieved from https://www.ibm.com/tr-tr/products/spss-statistics

Tolman, E. C. (1948). Cognitive maps in rats and men. Psychological review, 55(4), 189.

Ungar, S. 2000. Cognitive mapping without visual experience. In Kitchin, R. & Freundschuh, S. (Eds.), Cognitive Mapping: Past Present and Future. London: Routledge.

Url-1 https://www.dialogue-in-the-dark.com/about/exhibition/

Url-2 http://turkcelldiyalogmuzesi.com/karanlikta-diyalog

Ünlü, A. (1998). Çevresel Tasarımda İlk Kavramlar (First Concepts in Environmental Design). Istanbul, Turkey: ITU Architecture Faculty Press.

Journal of
Design Studio
v:2 n:2 December 2020

An Introduction to Design Studio Experience: The Process, Challenges and Opportunities

Sehnaz Cenani
Istanbul Medipol University, Department of Architecture, Istanbul, Turkey, (Corresponding author)
Yazgı Aksoy
Istanbul Medipol University, Department of Architecture, Istanbul, Turkey,

Received: October 20th 2020, Revised: November 6th 2020, Accepted: November 8th 2020
Refer: Cenani, S., Aksoy, Y., (2020), An Introduction to Design Studio Experience: The Process, Challenges and Opportunities, Journal of Design Studio, V.2, N.2, pp 57-69,

S. Cenani ORCID: 0000-0001-8111-586X, Y. Aksoy ORCID: 0000-0002-8840-6720,
DOI: 10.46474/jds.813689 https://doi.org/10.46474/jds.813689

Abstract: This paper explores design education in studio settings and presents insights from a design studio based on parametric design thinking. The first-year design studios are essential parts of the architectural education. In these studios, design decisions are taken on a more abstract level, there are less constraints, and the exercises are designed to explore the potentials of design, within the framework of various scales, ranging from human to building, and then to urban. The Introduction to Design course is constructed with interconnected exercises based on concepts such as modularity, the parameters of the human body and spatial perception. The first exercise is designing an architectural structure through parametric thinking. The second exercise is about exploring the design potentials of cube modules with each other, with a rule-based design approach. To better understand the importance of ergonomics in design, the third exercise focuses on the concept of movement through the human body. The aim of the fourth exercise is to study a physical environment and to investigate spatial perception in the built environment. The main aim of this design studio is to teach design with parametric design thinking while focusing on improving the cognitive skills of the students. An Introduction to Design studio experience that is formulated according to these features is described in this study.

Keywords: Design Studio, Parametric Design Thinking, Computational Design Approach, Design Education.

1. Introduction

The studio culture is an essential part of the design education. A report prepared by Koch and colleagues (2002) on studio culture explores current studio education and suggest a change in studio culture. They propose a studio culture that promotes several features as can be seen on Table 1. Hacihasanoglu's study (2019) examined a correlation between these studio culture's features and the studio culture approaches of 10 architectural schools of the USA at bachelor and graduate level. Similarly, Table 1 shows the scores of the university explored in this paper based on Koch and colleagues' study (2002). Please note that the below-mentioned scores are given by the authors based on the contents of the first-year design studio curriculum. (URL-1; URL-2). For example, "Interdisciplinary and cross-disciplinary learning" was scored as 1, because the contents of the first-year design studio curriculum as well as the aim of all four exercises done in this studio were designed to achieve cross-disciplinary learning. These exercises were specifically designed for students from different disciplines. On the other hand, “Collaboration over competition” and “Leadership development” were scored as 0, because the first-year design studio curriculum and all exercises were organized as individual assignments, and no group assignment was done. Among the universities analysed on Hacihasaoglu’s study, the university explored in this paper and MIT have the most similar scoring (only three features have different scores), based on their studio culture policies.

diagrams are used to express and improve a design idea during the critiques. Design critiques create an essential moment in the students’ design learning experience. These critiques contain several steps such as students presenting their designs, tutors giving feedback on their designs and both discuss potential problems and solutions (Oh et al., 2013).

When developing a curriculum targeting a new approach for teaching how to manage/handle the design process, the role that design thinking plays within a design-based learning environment is of particular interest (Saulnier, Bagiati and Brisson, 2016). The Introduction to Design studio described in this paper, which is held in the first semester of the first year, is constructed with interconnected exercises based on concepts such as modularity, the parameters of the human body and spatial perception. In this studio, it is intended to improve students’ “computational thinking” (Wing, 2006), “parametric design thinking” (Oxman 2017; Rowe, 1987) and “algorithmic thinking” (Denning, 2009) processes via explicitly designed exercises. These three methodologies seem similar, however there are minor

Table 1. Studio Culture Evaluation Parameters (Koch et. al., 2002) and scores of the case study university

Design-thinking skills	1
Design process as much as design product	1
Leadership development	0
Collaboration over competition	0
Meaningful community engagement and service	0
The importance of people, clients, users, communities, and society in design decisions	1
Interdisciplinary and cross-disciplinary learning	1
Confidence without arrogance	0
Oral and written communication to complement visual and graphic communication	1
Healthy and constructive critiques	1
Healthy and safe lifestyles for students	1
Balance between studio and non-studio courses	1
Emphasis on the value of time	1
Understanding of the ethical, social, political, and economic forces that impact design	0
Clear expectations and objectives for learning	1
An environment that respects and promotes diversity	0
Successful and clear methods of student assessment	1
Innovation in creating alternative teaching and learning methodologies	1

As Milovanovic and Gero (2020) states, design studio pedagogy is project-based and functions as a mentorship between tutors and students. Accordingly, first-year design studios are essential parts of the architectural education. In these studios, design decisions are taken on a more abstract level, there are less constraints, and the exercises are designed to explore the potentials of design, within the framework of various scales, ranging from human to building, and then to urban. Schön (1985) describes a design studio as a prototype of collective and individual learning by doing, influenced and mentored by the feedback of a tutor. Sketches are often used early in the design process (Purcell and Gero, 1998). Sketches and differences between them. According to Wing (2006), "computational thinking builds on the power and limits of computing processes, whether they are executed by a human or by a machine". Moreover, Wing (2006) states that computational thinking uses abstraction and decomposition for solving a complex task or designing a large complex system. Parametric design is a subcategory of algorithmic design and is based on the construction of logical sequences (Betancourt et al, 2014). We can say that computational thinking is the umbrella term that includes other terms; also, it is not necessary to use a software to apply computational thinking in a design. In this design studio, the students did not use any software, they were instructed to use these methodologies and to construct logical sequences in their designs. In this paper, four design exercises will be explained and be discussed through student projects. The first exercise is designing an architectural structure through parametric thinking. The second exercise is about exploring the design potentials of cube modules with each other, with a rule-based design approach. To better understand the importance of ergonomics in design, the third exercise focuses on the concept of movement via the human body. The aim of the fourth exercise is to study a physical environment and to investigate spatial perception in the built environment. Briefly, the main aim of this introductory studio is to teach design with parametric design thinking while focusing on improving the cognitive skills of the students. Another important feature of the Introduction to Design studio is, the syllabus of the course is completely the same for students from the department of architecture, the department of interior architecture and environmental design, and the department of urban design and landscape architecture. Therefore, each design exercise is aimed to focus on one of the above-mentioned programs. The impact of recent advances in technology (such as BIM, digital fabrication and learning by making) and changes in pedagogy (gamification, design thinking and computational design approach) on design education is undeniable. Today, these new priorities are guiding design education and studio culture.

The rest of the paper is organized as follows. An "Introduction to Design" studio experience that is formulated according to these recent advances and changes in design studios is described in the following section. Each sub-section, respectively, describes one exercise. Finally, the last section discusses the impact of design exercises and draws some conclusions.

Methodology

Based on the learning objectives of the course, Introduction to Design studio introduces the fundamental skills, concepts, and approaches essential for understanding and engaging with architecture, interior architecture, product design, landscape architecture and urban design. The course learning objectives are aligned with the content of the studio exercises, and the objectives of the tasks. Below-mentioned design exercises involve knowledge acquisition and the preliminary development of skills to conceptualise, resolve and present well-reasoned design ideas through drawing and model making. This design studio introduces techniques of analysis and critique of design outcomes as well as parametric design principles applicable to all above-mentioned design disciplines. The studio engages students with learning to design through iterative processes incorporating considerations of human, building and urban scales. In this section, four exercises will be explained and discussed, based on these learning objectives.

Exercise 1: Parametric Design Explorations

As the first project of the first semester, students were asked to create a rule-based composition by using wooden rods up to 2 mm in diameter (Table 2). The time given for this project was approximately four weeks. The design area was composed of two 20x40 cm rectangular plates perpendicular to each other. The printout of rectangular and diagonal grid was given to the students to cover the rectangular plates (Figure 1).

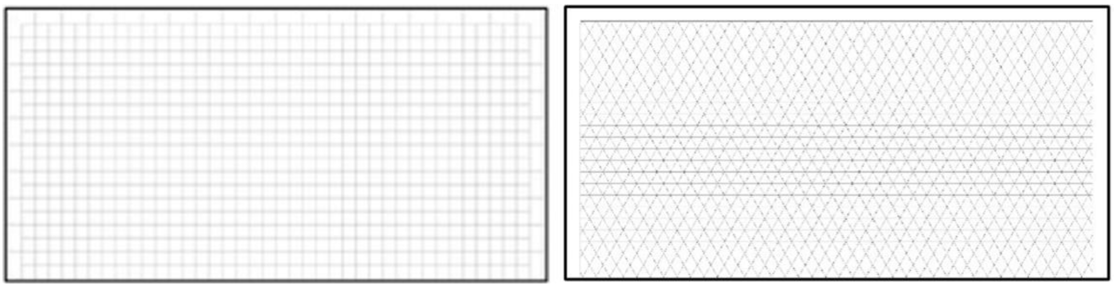
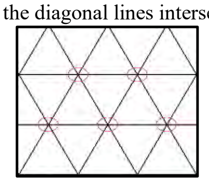
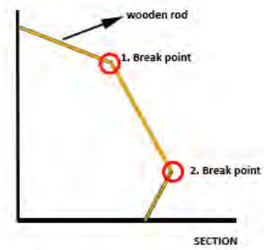
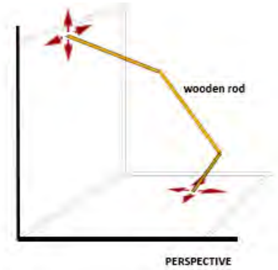
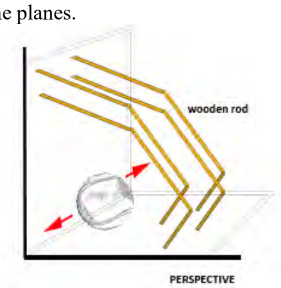


Figure 1. The 20x40 cm rectangular and diagonal patterns given to cover each rectangular plate

At the first stage, rectangular grid was used to create linear compositions. At the second stage of the exercise, diagonal pattern was used to create curvilinear compositions. At first, students were asked to place rods on the rectangular grid. Then each student started to make compositions according to the rules given in Table 2. They could adopt some principles and add new rules to their composition such as repetition which opened the doors of creating a rhythm. It was the point that each composition started to differentiate from each other.

In design, rhythm is made with repetitions. If the basic element is repeated in a sequential sequence, a pattern will be created and defined as a rhythm. Such a phenomenon of visual attraction will create a pleasant solution (Chan, 2012). This exercise had two stages. First productions were focused only on linear structure by using wooden rods by using a rectangular grid, no other flexible materials were added. The aim of the first stage is to create a structural system by using ruled based exploration that produces parametric compositions of the rods. By the help of iterations of the rules, the students develop expertise to engage creatively in design in an unexpected way. Secondly, students tried refining the solution by using flexible elements and diagonal grid cover instead of the linear rods. And then, improving the system with necessary supporting elements such as covering materials, was experienced during the design process. Discovering the possibilities of the structural systems by the help of parametric exploration, gave students new visions for their for their future designs, and how to incorporate structural systems with other materials.

Table 2. Contents of Exercise 1

Duration	Title	Keywords	Rules	Objectives	Materials
Four weeks	Linear Elements	Point, Line, Surface, 3D Cartesian Grid, Structure, Rhythm	1. Rods only can touch each rectangle surface from one point where the diagonal lines intersect.  2. A node can have up to two rods. 3. The profile to be formed in the side view can be broken in several points, which means rods can have several break points.  4.The linear profiles to be placed from the horizontal plane to the vertical plane only can move on the same axis according to a repetitive movement rule defined by the student.  5.At least the tennis ball must be able to pass through the gap between the planes. 	1- To create a composition according to the given rules 2- To start design with model instead of a sketch 3. To draw a completed 3d composition in 2d 4. To do collages by using final product as a place	**Stage 1** 1- 2 pieces of 5mm 20x40 cm photo-block 2- Wooden rods up to 2mm **Stage 2** 1- 2 pieces of 5mm 20x40 cm photo-block 2.Flexible linear materials, plastic rods 3- Strings 4- Covering materials such as acetate paper, sketches paper, tulle, etc.

Free hand and technical drawings were done afterwards. Technical drawings showed a major progress during the exercise. And finally, a collage was designed by each student to represent his/her project as a human scale passageway. At the end of this period, students exhibited their models, technical drawings and collages which summarized their ideas and design process. Figure 2 demonstrates final products of both first, second and final stages of student projects.

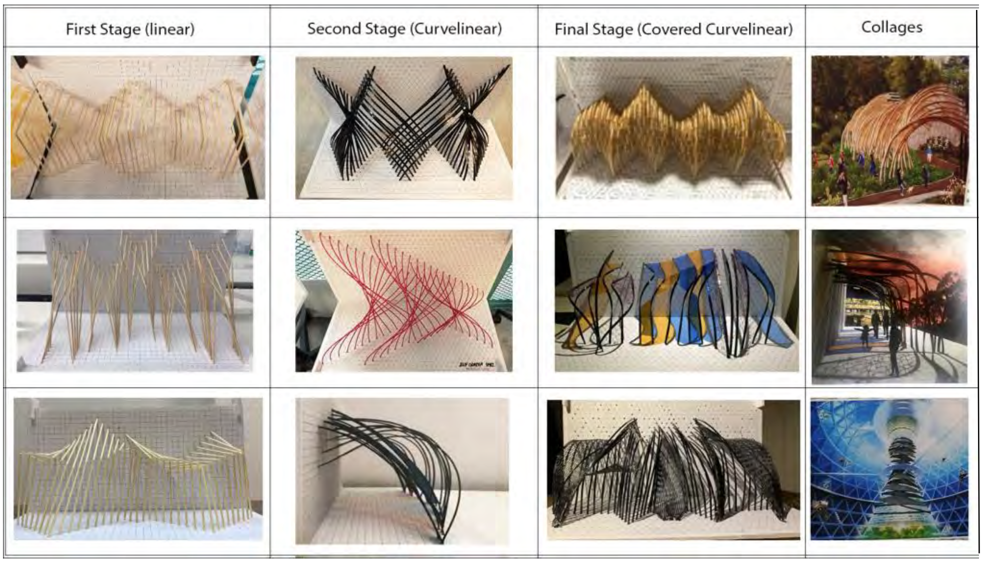


Figure 2. First stage and second stage and final examples of student models and collages

The goal of the exercise was not only to introduce students to parametric design also to introduce students to the major structural principles of design. Designing an architectural structure through parametric design thinking made the students be aware of the different design principles.

Exercise 2: 3D Shape Grammar Based Design Explorations

Second exercise aims at introducing new ways of thinking as well as introducing students to the new pattern of design (Table 3). A grammatical approach was chosen to develop the model, based on the shape grammar rules in general, and on one of its basic skills of perceiving shapes by extracting elements of the visual models. In the past forty years, formulating design science efforts has produced ideas that challenge traditional design practice. The research community sought to achieve rigorous design logic models based on hard analytical design science rather than soft traditional strategies such as intuition and use of formal knowledge (Goldschmidt, 2001). The teaching methodology is loosely based on the concept of grammatical design developed by Stiny. He thought that calculating with shapes would help to address a visual approach to education. It is possible to be formal with eyes without losing anything that is creative in the process (Stiny, 2006).

At first, students were asked to design at least four, at most six different modules by using 2x2x2 cm cubes according to the rules given. Modules should consist of more than one cube combination (can consist of minimum three, maximum nine cubes). These modules were the building blocks of the 3D labyrinth. Different colours used for the elements of the module family. Each module repeats at least two times during the creation of the labyrinth. It was mandatory to make a minimum of ten, which makes it easy for students during the trial phase.

Table 3. Contents of Exercise 2

Duration	Title	Keywords	Rules	Objectives	Materials
Three weeks	3D Labyrinth	Cube, Volume, Modularity, Shape parameters	**Production rules:** 1- New modules can be produced using minimum 3 and maximum 9 cubes. 2-At least 4 and at most 6 different modules can be designed. 3- Each module should be used at least 2 times. **Colouring Rule:** Different modules should be in different colours. **Neighbourhood Rule:** Modules can be neighbours with each other in certain directions. Neighbourhood rules are **Rotation Rule:** Modules can be combined by rotating from certain points. **Add / Subtract Rule:** New modules with a new join rule from modules derived.	- To design at least 4, at most 6 different modules by using 2x2x2 cm cubes -To design a 3D labyrinth using produced modules	1. 2x2x2 cm Styrofoam cubes 2. Acrylic paint

Evaluation of the second exercise was done according to the space relations, accuracy of the 2D expressions, care and quality of models, presentation sheets and technical drawings. Figure 3 shows final designs and drawings of student projects.

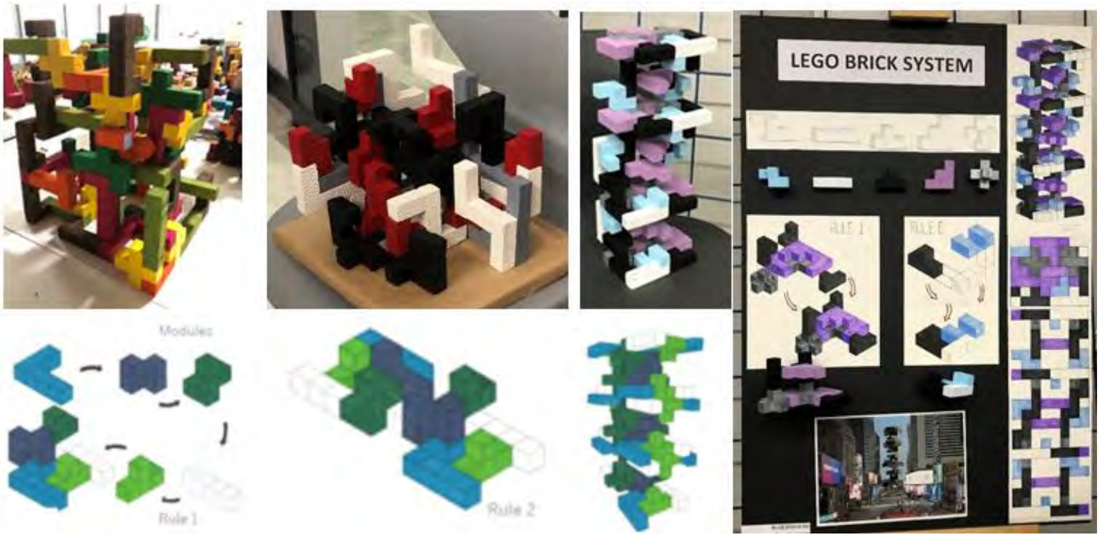


Figure 3. Student models and drawings

In this exercise a teaching method was devised on the basis of shape grammars. Teaching design using the "form generation" method provided students practical design experience. In addition, students practiced the manipulation of forms and volumes and spatial perception.

Exercise 3: Folding as a Form-Finding Design Process

To better understand the importance of ergonomics in design, the third exercise focuses on the concept of movement through the human body. The aim of this exercise is to design a cover for an arm, while using folding technique as a form-finding design process (Table 4). As Lebee (2015) states that the link between origami and mathematics is deep and therefore, in the last decades, origami has emerged as a new field of research. Many innovations merging mathematics, kinematic and structural properties of folding techniques are called Origamics (Stewart, 2007). Lebee (2015) mentions that, at the end of the 19th century, building and designing objects begin to be driven by the fabrication process and not only by formal questions. Even though mastering at folding techniques is time-consuming, the folding process is simple. Furthermore, it is a fast and easy way to teach structural design properties and material performances. During this exercise, to learn specific folding techniques, Jackson's (2011) book called *Folding Techniques for Designers-From Sheet to Form* and his "how to" videos are used by most of the students.

The most important challenges of this design task were as follows; students were allowed to use only one type of material (i.e. Kraft paper, 120-160 gr.), and they were allowed to use an interlocking system as an assembly method for connecting different parts of the cover. This means that using glue, staples, or sewing were not allowed. The natural Kraft paper had a natural brown colour, and any decoration or colouring were not permitted. However, the students could combine different folding techniques. Merging different folding techniques with cutting techniques or origami techniques were also allowed.

Briefly, during this exercise, the students measured their own arms and then based on the constraints and specifications related to human ergonomics, they designed an arm cover specifically for their arms by using craft paper as the material. The arm posture, the movement abilities of three joints (the shoulder, the elbow, and the wrist) were studied with diagrams. At the end, they designed a wearable arm cover prototype by using folding techniques as a form-finding design process.

Table 4. Contents of Exercise 3

Duration	Title	Keywords	Rules	Objectives	Materials
Three weeks	Wearable Arm Cover	Ergonomics, body, movement, flexibility, material performance	- Origami or folding techniques must be used to design the arm cover - Colouring is not allowed - Sewing, using staple and glue are not allowed - Adding/combining different folded surfaces are allowed - Connections can be made by clamping or similar techniques	- to design an arm cover that covers the parts from the wrist to the neck, - to design a cover based on the movement limitations of the three joints (shoulder, elbow, wrist)	Kraft paper (120-160 gr)

At the beginning of the exercise, the students studied human movements, Labanotation (Laban, n.d.), and they focused on three joints of an arm. They studied limitations and ergonomics of an arm. As can be seen in Figure 4, the students used different representation techniques such as diagrams and photographs for analysing human movements. Furthermore, they used different representation methods to describe design stages of the used folding techniques (Figure 5).

Figure 4. Top: Analysis of human movements (student drawings); Bottom: Analysis of arm movements (student projects)

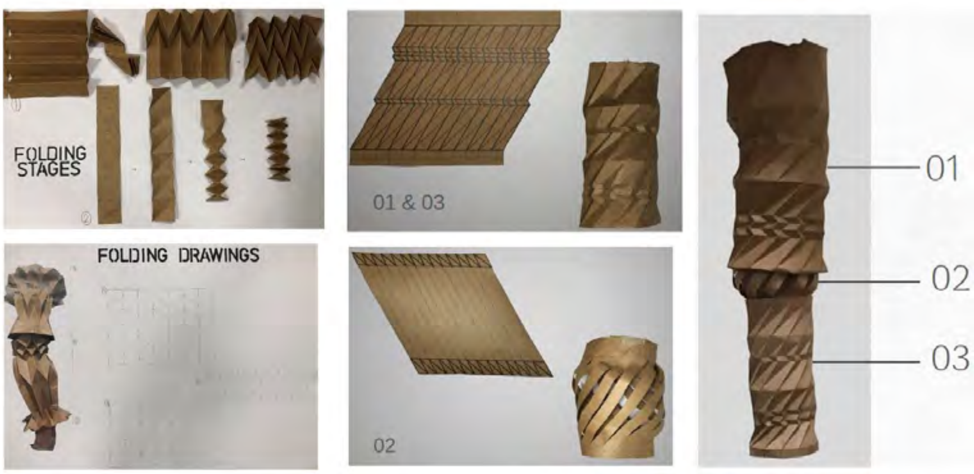


Figure 5. Design stages of a folding technique (student projects)

Today, the use of parametric design software such as Rhino's Grasshopper, eases the design process and improves the quality of the end products. However, the main aim of this design studio is teaching design principles by using parametric approach without the help of any design software. Even though the students do not use any software, they use algorithmic design thinking and systematic approach during developing their designs.

different parts were tested. It appeared that such a design task needs more time. However, since each exercise is based on similar computational design principles, students get familiar with parametric design thinking and they understand how to analyse and represent human movements, the importance of ergonomics, material durability as well as the importance of time management.

Figure 6. Wearable prototypes (student models)

Due to the time limitations of the exercise (three weeks), using folding as a form-finding design process was a challenging task. Analysing arm movements, experimenting different folding techniques, combining different folding techniques in order to accommodate specific requirements of different parts of their arms (such as using different techniques for joints, and resizing the folding technique based on the part of the arm), finding the best representation technique to explain their design process were the main challenges. During the final jury presentation, they wore the prototype and did certain movements asked by the jury members (Figure 6). By this way, the durability of the prototype, the solution used for connecting

Exercise 4: Topography of Sound

The aim of the fourth exercise is to study a physical environment and to investigate spatial perception in the built environment (Table 5). The main objective is to design an artificial topography using sounds of the city. First, the students are asked to record a video that should contain at least five different sounds. This 20-second video recording should be recorded at the same point and recorded without changing the angle and the position of the recorder. By this way, they could observe different sounds during the video recording. To accurately measure and analyse a sound, the difference between the types of sounds should be understood. Therefore, students separated

Table 5. Contents of Exercise 4

Duration	Title	Keywords	Rules	Objectives	Materials
Three weeks	Topography of sound	Sound level, noise, frequency, topography, space, time	- the 20-second video recording will be recorded at the same point and recorded without changing the angle and position - the recording sound should contain at least five different sounds	- to design an artificial topography using sounds of the city	Cardboard, acetate, metal plates, paper, wire, plastic or wooden plates, etc.

different sounds on their recordings based on the types and the origin of these sounds. For example, they separated natural (birds, sea waves, wind, human noise, animal, etc.) and unnatural sounds (vehicles, alarms, machinery, announcements, etc.). They also classified these sounds based on duration, such as continuous sound, intermittent sound, impulsive sound. Continuous sound can be caused by a machinery that keeps running without interruption (respiratory apparatus in a hospital, generator, or a highway noise). Intermittent sound can increase and decrease rapidly. This might be caused by a train passing or an ambulance. Impulsive sound can be defined as a sudden noise like a dog's barking, car brake or horn, or a child scream. The students studied spectrogram, the differences between outdoor and indoor sound levels, and they measured sound levels by different apps. Afterwards, they transformed the results of their analyses into an artificial topography. Some of the students used their sound graphs as a base for developing the topography, and some of them transformed sound level estimates into a topography. The student models of this exercise can be seen in Figure 7.

Figure 7. Student projects

Through this exercise, students developed a better understanding of the built environment and their surroundings, and acquired spatial skills related to urban planning, geography, and landscape design.

Conclusion

This paper explained the process, challenges, and opportunities of developing a curriculum based on parametric design principles in fine arts, design, and architecture undergraduate degree program. This curriculum was used on first year first semester architecture (N = 196), interior architecture (N = 184) and urban planning (N = 18) students. It was a challenge to design four different design exercises that aim different undergraduate programs. All exercises served different purposes; the main aim was to better understand spatial perception and develop critical design thinking through different scales such as human scale, building scale and urban scale. While doing so, computational approach was integrated into these exercises. The first-year design teaching and incorporating new knowledge, behaviours, and skills to students' learning experience are challenging tasks. The experiments gained from these four exercises showed that the method has improved students' intellectual and cognitive design skills and also such innovative ways of developing a design project can give studio teachers wider perspectives in architectural education.

To conclude, in this study, a non-computerized method to integrate parametric design thinking in early design studios is described. This method provides a systematic way to understand parametric thinking from an early stage in design education. Beyond tools and technology, educating students in a new process-driven way of thinking and exploration is needed to develop new skills to solve challenging design problems, collaborate effectively, and express ideas in new ways. Parametric design is a new tool for a more analytical type of thinking which develops the ability to analyse, synthesize and respond to design problems. We think that the use of our method has empowered students to be ready for the new era of architectural design. Therefore, we believe that sharing our experiences with broader international educators and academicians provide all of us with some clues for improving the first-year design education system.

References:

Betancourt, M. C., Quintero, L. M., & Cereceda, G. (2014). A Discussion on Algorithmic Thinking in Product Design Process. In DS 77: *Proceedings of the DESIGN 2014, 13th International Design Conference*, 1035-1042.

Chan, C. S. (2012). Phenomenology of rhythm in design. *Frontiers of Architectural Research*, 1(3), 253-258.

Denning, P. (2009). The profession of IT beyond computational thinking. *Communications of the ACM*, 52(6), 28-30. doi:10.1145/1516046.1516054.

Hacihasanoglu, O. (2019). Architectural Design Studio Culture, Journal of Design Studio, 1(1), 5-15.

Jackson, P. (2011). *Folding Techniques for Designers-From Sheet to Form*. Laurence King Publishing.

Koch, A., Schwennsen, K., Dutton, T.A., Smith, D. (2002). The Redesign of Studio Culture: A Report of the AIAS Studio Culture Task Force, Washington DC.

Laban, R. (n.d.) Labanotation (online). Available at: https://labaninstitute.org/about/laban-movement-analysis/ (accessed 04 July 2020). 2

Lebée, A. (2015). From folds to structures, a review. *International journal of space structures*, 30(2), 55-74.

Milovanovic, J., & Gero, J. (2020). Modeling design studio pedagogy: A mentored reflective practice. In Proceedings of the Design Society: DESIGN Conference (Vol. 1, pp. 1765-1774). Cambridge University Press.

Oh, Y., Ishizaki, S., Gross, M. D., & Do, E. Y. L. (2013). A theoretical framework of design critiquing in architecture studios. *Design Studies*, 34(3), 302-325.

Oxman, R. (2017). Thinking difference: Theories and models of parametric design thinking. Design Studies, 52, 4-39.

Purcell, A.T. and Gero, J.S. (1998). "Drawings and the design process", *Design Studies*, 19(4), 389-430.

Rowe, P. G. (1987). Design thinking. MIT Press.

Saulnier, C. R., Bagiati, A., & Brisson, J. G. (2016). A comparison of student design activity preferences before and after a design-based wilderness education experience. In *Proceedings of the 2016 ASEE Annual Conference & Exposition*.

Schön, D.A. (1985). *The Design Studio*, RIBA, London.

Stewart, I. (2007). Mathematics: some assembly needed. *Nature*, Vol. 448, No. 7152, pp. 419.

Stiny, G. (2006). *Shape: talking about seeing and doing*. MIT Press.

URL-1: https://www.medipol.edu.tr/akademik/fakulteler/guzel-sanatlar-fakultesi/bolumler/mimarlik/program-bilgileri/ders-detayi?DersBolumID=338602#DersProgramYeterlilikleri

URL-2: https://www.medipol.edu.tr/en/academics/undergraduate-schools/fine-arts-design-and-architecture/departments/architecture/program-information#programYeterliligi

Wing, J. M. (2010). Computational Thinking: What and Why?, *The Link - The Magazine of the Carnegie Mellon University*, School of Computer Science, 1-6.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, 49(3), 33-35.

Journal of
Design Studio
v:2 n:2 December 2020

Computational Design Thinking through Cellular Automata: Reflections from Design Studios

Pinar Calisir Adem
Yeditepe University, Department of Architecture, Istanbul, Turkey, (Corresponding author)
Gulen Cagdas
Istanbul Technical University, Department of Architecture, Istanbul, Turkey,

Received: October 26th 2020, Revised: November 7th 2020, Accepted: November 11th 2020
Refer: Calisir Adem, P., Cagdas, G.,, (2020), Computational Design Thinking through Cellular Automata: Reflections from Design Studios, Journal of Design Studio, V.2, N.2, pp 71-83,

P. Calisir Adem ORCID: 0000-0001-6139-6289, G. Cagdas ORCID: 0000-0001-8853-4207,
DOI: 10.46474/jds.816833 https://doi.org/10.46474/jds.816833

Abstract: The current technologies have created a shift from Computer Aided Design to Computational Design in architecture. Computational design allows inquiries into what can be implicit knowledge in traditional design thinking, enables the definition of the mechanisms of design process and formulations of design knowledge and representation, and defines generative and evaluative knowledge. The purpose of this study is to discuss how Cellular Automata can be utilized in design studios to develop computational design thinking, through the examination of Frazer's and Herr's studio works. After finding matching concepts and comparisons of Cellular Automata methods used in two design studios, the concept of 'computation' in Cellular Automaton studies and contributions of using this generative method in design studio will be discussed. In other words, this study will examine the content of Computational Design Thinking through Cellular Automata applications and their contributions to design education. As a result, since Cellular Automata methods are exploratory processes. They enhance seeing, reaching the whole from the parts, noticing the relationships and patterns between the parts and re-inventing them during and after the generative process. For these reasons, Cellular Automata have an important role in the development of computational design thinking in design studios with different concepts and setups.

Keywords: Cellular Automata, Computational Design Thinking, Architectural Design Studio.

1. Introduction

Technology is developing rapidly and "computational design" is becoming an important part of the architectural practice and education. Also, new modes of thinking and production methods based on computation are forming new agendas for the design studios. The computational design methods, unlike the conventional ones, can enable us to design with novel techniques and to look at the design process from different perspectives. As often stated, for the development of computational design thinking in architectural education, the use of computational design methods has been more important than the use of digital tools. In this context, the purpose of this study is to discuss how Cellular Automata, which is a generative design method, can contribute to the development of computational design thinking in design studios, based on the experiences of Frazer (1995) and Herr (2008), who have continued design studios for many years within this context.

The current technologies have created a shift from Computer Aided Design (CAD) to Computational Design in architecture. The relationship between architectural design and computation was a topic of research among designers (Antoni Gaudi, Frei Otto, Buckminister Fuller, Cedric Price), even before computers became so common. At the same time, computational design methods had been applying to design problems in terms of ideas and logic without using a computer. However in recent years, with the development of Information and Communication Technologies, computation has had significant effects on the perception and realization of architectural form, space and structure. These effects have led to improvements in the intended use of the digital tools. In this context, there are terminological and process-based distinctions between computational design methods and CAD. As Oxman stated, “while principles, theories and methods of CAD have been basically based on imitating paper-based design, the novel concepts of digital design models are re-introducing a different medium of conceptualization, replacing paper-based media” (Oxman, 2008, p. 106). Thus, computing and computerization (CAD) concepts are different from each other (Ahlquist & Menges, 2011; Terzidis, 2003). Computation increases the number and the content of information by revealing dependencies among data sets. On the other hand, computerization or computer automation compiles the sets of data and tries to process as much as data as possible. Thus, the differentiation between CAD and computational design methods arise from the algorithmic structure of the design action. While CAD aims to create an object, the computational design, which can also benefit from computer technologies, starts the process with properties of small parts and relationships between units of the design context. It is based on formation rules and reveals the information that generates the form as a dynamic system (Ahlquist & Menges, 2011).

The computational design thinking is formed depending on various developments in areas, such as system theory, cybernetics, morphogenesis, and biology (Ahlquist & Menges, 2011). It is based on a perception that enables designers to evaluate the purpose of design not through the final product, but through the generation process. In this manner, computational design methods are systems that produce forms using a set of stages (algorithms) that describes the formation process of form, space and structure with or without computer support. These stages contain processes ranging from the analysis and interpretation of design data, such as user, topography, climate, program; arranging the design stages and determining the formation rules; evaluating the resulting products in terms of various performance criteria, and materializing the optimum solution.

The computational design allows inquiries into what can be implicit knowledge in traditional design thinking by enabling the definition of the mechanisms of design processes. By doing so, it formulates and defines generative and evaluative design knowledge (Singh, 2012). On the other hand, the development of computational design leads emergence of a new domain of knowledge and a conceptual vocabulary. Thus, it can be stated that the computational design thinking causes a paradigm shift in design mediums, knowledge and theory, and models and methodologies. “The characteristics of topological form, the transformational evolution of spatial structure, non-hierarchical organization, complex, hyper-connective spatial conditions have become more prominent” with this paradigm shift in architecture. “Continuous, hierarchical, topological, materiality, structure and formation” are also very important concepts replacing with “discrete, intricate, typological, space, form and representation” (Oxman, 2008, p. 103). First, new modes of design thinking and designer-authored computational processes can enrich the individuality of design processes and support creativity and innovations in program, spatial qualities and materiality by breaking standard building typologies. They can help to define design based on a process rather than a final product and understand data and forces that shape design formation. Also, computational design processes can provide a different orientation to design discovery and creativity. Instead of a holistic, conventional problem definition that includes contextual, functional and typological programs, definitions of computational models, such as "animation", "parametric design" or “generative design”, can serve as a starting point for new modes of design exploration. Thus, it is very important to develop computational design thinking in design studios. Emergence, self-organization, complexity, parametric dependencies, seeing the design process as a system, feedback, evolution of forms and designer-authored formation rules are some basic concepts identifying with computational design thinking. In studios, conducting discussions and approaching the solution of design problems through these concepts can improve the computational design thinking.

In this context, the purpose of this paper is to discuss how Cellular Automata can be utilized in design studios to develop computational design thinking, through Frazer’s and Herr's studio works. Cellular Automata is a generative method which involves a pre-formalized formation process in which the final products will emerge. Since the user, program and context-related data can be included in the formation process and the designer gains a new position as a developer of the formation tool, the most comprehensive way that can enhance computational design thinking can be the generative design rather than the performance-base or parametric design. The Cellular Automata is chosen among the generative design methods, because, it is a method that expresses the complex creativity arising from simplicity in the formation process, and highly complex structures can arise with a very few elements and rules.

In this study, the studio works of Herr (2008) and Frazer (1995) will be examined and discussed within the scope of design purposes and concepts that they used. Herr and Frazer were chosen, because they tried to explore generative systems, particularly Cellular Automata, in a systematic series through workshops and studios. For each studio process, a conceptual map will be prepared to deeply understand specific concepts related to design studios, and two studios will be compared in terms of their Cellular Automata processes. After finding matching concepts and comparisons of Cellular Automaton methods used in two design studios, the concept of ‘computation’ in Cellular Automata studies and the contributions of using this generative method in design studios will be discussed. In other words, the content of Computational Design Thinking through Cellular Automata applications and its contribution to design education will elaborated. In this line, this paper will try to answer these research questions:

1. Is there a match between the concepts used in Cellular Automata studios and the concepts associated with computational design thinking in the literature?
2. What is the nature of computation in the process followed in Cellular Automata studios and how is this applied in architectural formation in design studios?
3. What are the contributions of Cellular Automata and what aspects of these models can be improved for enhancing Computational Design Thinking in design processes?

2-Generative Design Techniques

Computational design tries to solve design problems by defining specific steps, thanks to the algorithmic methods they use (Terzidis, 2003). Oxman (2008) divides computational design methods in 3 categories based on the process following by designers: the formation models, the performance models and the generative models. The formation models contain animation and parametric design approaches. The performance models suggest simulations for analysis, synthesis and generation of forms. Similarly, the generative models comprise formal methodologies consisting of rules and procedures to generate designs. Shape grammars, mathematical models, topological features, evolutionary algorithms (Frazer, 1995), mapping and morphism are algorithmic processes that reveal unpredictable, distinctive, formal behaviors and properties of space that can be used in architectural design. These algorithmic procedures lead to various generative design processes.

Design is a process in which the acquisition of knowledge and the production of forms evolve together. In a generative design process, the emergence of forms enables designers to look at the design problem from a new perspective and enriches the design process and design outcomes. Also, the generative design must be able to produce complexity, be based on the relationship with the environment, have the ability to fit the changing environment, and produce unpredictable, novel relationships or outcomes (McCormack et al., 2004). Generative design methods enable architects to explore a large design space. In addition, generative design systems are one of the main computational methods that can be used to enable automation in design (Gu, et al., 2010). There are 5 basic generative design algorithms frequently used in the literature: Shape Grammars, L-Systems, Genetic Algorithms, Cellular Automata and Agent-Based Systems. There are differences and similarities between these algorithms and different generative models are suitable for solving different design problems (Gu, et al., 2010).

Shape Grammar is used to produce a design language or a set. Shape grammar can be both a generative and a descriptive method. It can be used as a design tool to produce different design languages or as a formal analysis tool revealing the formation rules of a specific design. Shape grammars produce two and three dimensional compositions in terms of spatial arrangements.

L-System is a mathematical algorithm based on the recursive rewriting of a string with generation rules. The concept of a string is a symbolic expression of form in architecture. L-Systems create repetitive patterns. It can be used in an urban or architectural design while aim is to produce fractal-based forms.

Genetic Algorithms are inspired by evolutionary processes found in nature. They search for different solutions in the search space, using evolutionary methods to find optimized solutions based on a fitness function. Usually, it can be used for optimization in design.

Agent-Based Systems are often utilized for implementations in social or collective behaviours. Acts of agents are autonomous and independent, but they can also interact and communicate with each other to compete or collaborate, and collectively achieve specific goals. Local interactions of unsophisticated agents cause collective behaviours leading global patterns to emerge.

Cellular Automaton (pl. cellular automata, abbrev. CA) is context-sensitive based on its nature. Its generative process is controlled by the states of the neighbouring cells. Design constraints are implemented from bottom-up and the local behaviours of each cell affects the whole. As a result, the outcomes of Cellular Automata are often complex and difficult to predict. Although Cellular Automata depend on a finite set of elements and rules, an appropriate rule and initial configuration can create a setup that is perceived as unlimited. Thus, they enable emergent properties of the formation process and help designers to see and interpret new relations between cells. Since the cells can be represented by graphic symbols, the system allows abstraction in the design process. Because of the context-sensitive nature of Cellular Automaton, it allows many different factors to interact within the defined limits. Interaction makes the model suitable for systems focusing on the behavior of the elements. It provides editing after the generation process in terms of transformation of forms or representing cells with various functional forms. Also, emergent form can be the result of the desired functionality. As a result, for this study, Cellular Automaton is chosen for exploring computational design thinking in design studios due to its simple setup, abstract nature and rich set of results.

3-The Nature of Cellular Automata

The Cellular Automaton enables the cell population on a grid to be formed depending on certain rules based on their relationship with neighbouring cells in a consecutive time period. The method can be run by determining neighbouring typologies and different rules in one, two or three dimensional spaces. By establishing appropriate rules and an initial setting, the generative power of Cellular Automata can make possible to see all the potentials that may occur in the set of design results. Also, defining the appropriate rules can help manipulate the parameters affecting the design problem in terms of context or functionality. The Cellular Automaton is a generative design process, because the relations in the system are defined by the smallest units (cells) and affect the global form, reveal emerging behavior and unpredictable results. Associated cells come together depending on the formation rules over generations, to produce global shape. The ability of Cellular Automata to produce symbolic structures, the arrangement of their grids, cell formation rules and cell states in accordance with different contexts enable the methods to transform in accordance with the nature of the design problem. As a result, Cellular Automaton is shaped by using local knowledge, depending on the simple relationships of the cells and has the potential to produce complex forms.

The Cellular Automata were discovered by John von Neumann (1951) in the 1940's and developed by Stanislaw Ulam. Cellular Automaton is a mathematical method in which simulation models of complex structures can be formed as a result of simple structures following simple rules (Krawczyk, 2002). Because of its simplicity and complex productivity, the traditional Cellular Automata are used for the purpose of exploring and modelling many complex phenomena in nature. The method can be used to simulate complex formations, such as urban development and sprawl, fire and disease spread and traffic flow. The structure of simple computer programs can be reduced to visual and mathematical systems based on rules, and the processes in nature can be simulated by these mathematical models (Wolfram, 2002). Mathematical model based on computer technologies can make abstractions and simplify the relationship between parameters while looking at different kinds of complex systems in nature. In this context, Cellular Automaton has been applied in many disciplines due to its analysis of complexity based on its simple constructs. Wolfram (2002) states that no matter how simple the rules are, systems created by Cellular Automata cause a certain level of complexity and randomness. Fully repetitive patterns, repetitive-intertwined patterns, irregular-random structures, and finally, a complex structure that appears to be irregular in general with local patterns may occur in the global form of the Cellular Automata.

In sum, structures in nature that are perceived as complex and incomprehensible can actually be formed with the Cellular Automata with by following rules, and repetition of these rules over generations can create emergent properties. When we discuss the Cellular Automata within the scope of a design problem, it is necessary to proceed the design process by examining each factor/parameter/determinant and their relations revealing the design problem. If designer understands the nature of the design problem with the nature of Cellular Automata, associations can be build and context-sensitive nature of the model can be triggered. Five elements are needed to construct a simple Cellular Automata method. These elements are a grid/lattice, a neighbourhood, cell states, time and transition rules.

Grid/Lattice: In the Cellular Automata, each cell should be located on a specific space in the grid. The grid can be one, two or three-dimensional (Figure 1). Also, the grid or the lattice can consist of regular or irregular geometries (Figure 2).

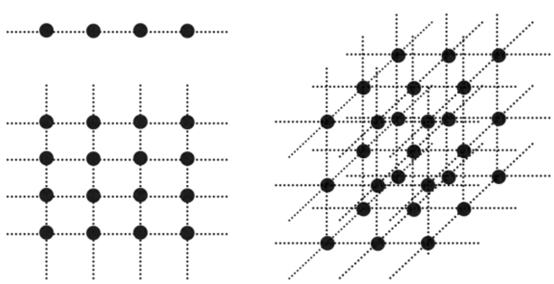


Figure 1: One, two and three-dimensional grids.

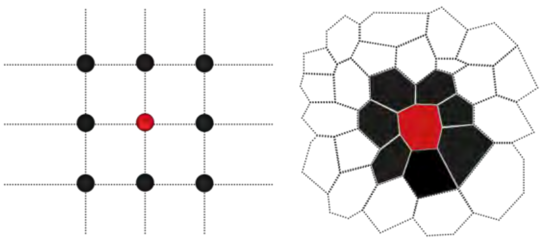


Figure 2: Regular and irregular two-dimensional grids.

Grids help designers locate neighbours by giving the location of each cell within the system and make cells aware of their neighbours.

Neighbourhood: The group of cells interacting with each other in the grid, constitutes the neighbourhood. The simplest one-dimensional automaton has a neighbourhood unit consisting of three cells, while the simplest two-dimensional automaton has a neighbourhood unit consisting of five cells (Figure 3).

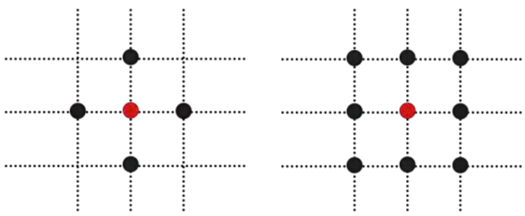


Figure 3: Left:Von Neuman neighbourhood. Right: Moore neighbourhood.

Cell States: Cell states are values, which the cells convey over consecutive time stages. These values are based on local interactions and information exchange with neighbours and may vary depending on transition rules. The cell state can be formed by a binary definition (on / off || 0/1 || live / dead), can be defined by symbolic colors, or expressed with numbers. Therefore, the Cellular Automata can also be seen as data systems that carry information about the configuration of cells (Coates et al, 1996).
Time: In the Cellular Automata, time is sequential and discrete. As time passes, the state of the cell is updated in each time unit and the system updates itself accordingly. During the generation process, each new neighbourhood unit is called "generation" in parallel with the time unit.

Transition Rules: In the Cellular Automata, the transition rules are determined by the designer. The rules, reflecting the system accurately, should depend on the neighbourhood relations and determine the new state of the cells in the next generation. Rules are applied to all cells in the system synchronously and provide general character of the system. One of the best known examples of Cellular Automata is "Game of Life". There are four basic rules in the Life simulation (Figure 4). Two of these rules determine the state of death, one of them determines the survival status and the other determines the birth status.

Death: If the living cell has less than two living neighbours at {t} moment, that cell dies from loneliness at {t + 1}.

Death: If the living cell has more than three living neighbours at {t} moment, that cell dies from overpopulation at {t + 1}.

Survival: If a living cell has two or three living neighbours at {t} moment, that cell will survive at {t + 1}.

Birth: If the dead cell has exactly three living neighbours at the moment of {t}, that cell becomes alive at {t + 1}, that is, it is born.

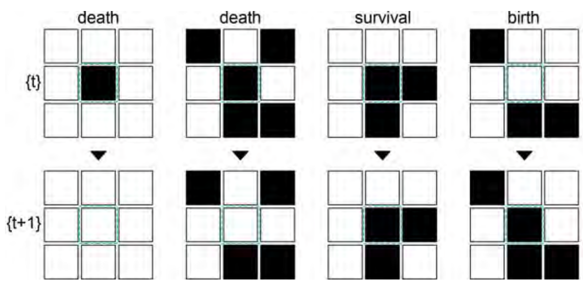


Figure 4: Game of Life rules.

In different Cellular Automata studies on urban and architectural scale, designers mostly divide the system into sub-parts, reveal and reconstruct the relationship between the parts and create repetitive formation rules in the design process.

In these studies, Cellular Automata are utilized as generative and analysis tools in different architectural contexts. In order to make the Cellular Automaton easier to produce the intended form in architectural scale, it is necessary to customize the transition rules, assign multiple and functional cell states, determine the rules for geometric transformations, and make quantitative and qualitative analyzes for the architectural problem, before the model is constructed. Due to the suitability of the method to the architectural design process and the ease of its editing, examples of applications are also encountered in design studios. In the next section, John Frazer's (1995) and Christiane M. Herr's (2008) studio experiences will be examined and discussed in terms of how Cellular Automata might be enhanced the computational design thinking in studios.

4-Cellular Automata in Design Studios

John Frazer's studio, Diploma Unit 11 in the Architectural Association (AA), continued from 1990 to 1995 to build experimental interactive models, generative and evolutionary systems, and explore architecture as an artificial way of life (Frazer, 2005). The produced architecture was accepted as a part of the natural system, exhibited as 'metabolism' acting like the mechanisms to which it was formed: in exchange with the environment, responsive to feedback and evolutionary in its own right

Image 1: "Universal Constructor",Unit 11, Gordon Pask and Julia Frazer, 1990 (Frazer, 1995).

(Ahlquist & Menges, 2011). One of the important Cellular Automata-based experiments of this group was the project called "Universal Constructor". The system was implemented as a Cellular Automata hardware system controlled by a main computer that also functions as a human-computer interface (Herr and Kvan, 2007).

Universal Constructor (Image 1) was made up of 3-dimensional identical cubes in an array. A cube shape was chosen because of its universality and potential for abstraction. Each cube had 8 LEDs to display 256 different cell states. Thus, 8-bit code could be used to match states of the cells with any form, structure or environmental determinants. Cubes covered 12*12*12 units in a volume called as "the logic space". Each cube had a defining state and also the ability to represent any other states. Messages could be transferred between cells by streaming data in a serial form by going one stack cell down and up. The array of the cells used as an input or output device. For an input device, the exact configuration, location and identifying code of every cell could be deduced by the controlling processor questioning each location and provoking for a possible neighbourhood above. For an output device, each cell could represent 256 messages with the 8 LEDs: one flashing light expressed "take me away" and two flashing lights expressed "add a cube on top". This 3-dimensional hardware Cellular Automaton was a tool for the explanation and demonstration of a radically new design process and it was understood as an expression of logic in space in architectural terms (Frazer, 1995). Various different experiments were conducted with this 3-dimensional hardware. One of these works was done by Stefan Seemüller in 1991 and called as "Evolving Sequence". In this experiment (Image 2), an evolutionary model also added to the system in order to test output results against the rule. In this model, the process started with definitions of the initial configuration of cubes, states and rules for generation and testing. Rules applied a series of loops in a chaotic string where each step in the evolutionary development was continuously read and tested against the rules, and at the end, emerging patterns appeared. Later, the system upgraded with 16-bit state patterns which produce a high level of complexity and unexpected, also logical forms.

Cellular Automata and the resulting form could be seen. One automaton controled the evolution of structure and the other controled the

Image 2: Evolving Sequence from the Universal Constructor by Stefan Seemüller, 1991 (From John Frazer, An Evolutionary Architecture, Architectural Association publications, Themes VII, copyright John Frazer and the Architectural Association 1995, p.46).

environment. The interaction between formations created flowing, intersecting surfaces as outputs. In addition, this study is an example of how abstract forms could be transformed into concrete forms during the form-finding processes.

In the below experiment (Image 3), self-organized cubes behaved like a 3-dimensional Cellular Automaton, at the same time, a positive and negative feedback loops existed between adjacent cells, causing interaction or in other words, flow of information. The interaction between cells relied on their comparison of the features of their growth, and their effort to duplicate successful behavior.

In the third experiment, which was called "Hierarchical Cellular Automata" (Image 4), two different Cellular Automata were merged to create 3-dimensional output. In this study, the coexistence of two different constructions of

Frazer (1995), produces a generative design model based on abstract expressions and computer-human interaction, without being tied to a real architectural space or an environment. These abstract expressions and rules can be utilized for exploration of architectural spaces, patterns, and contain concepts of computational design thinking, such as "rule, state, loop, hierarchy, feedback, interaction, development

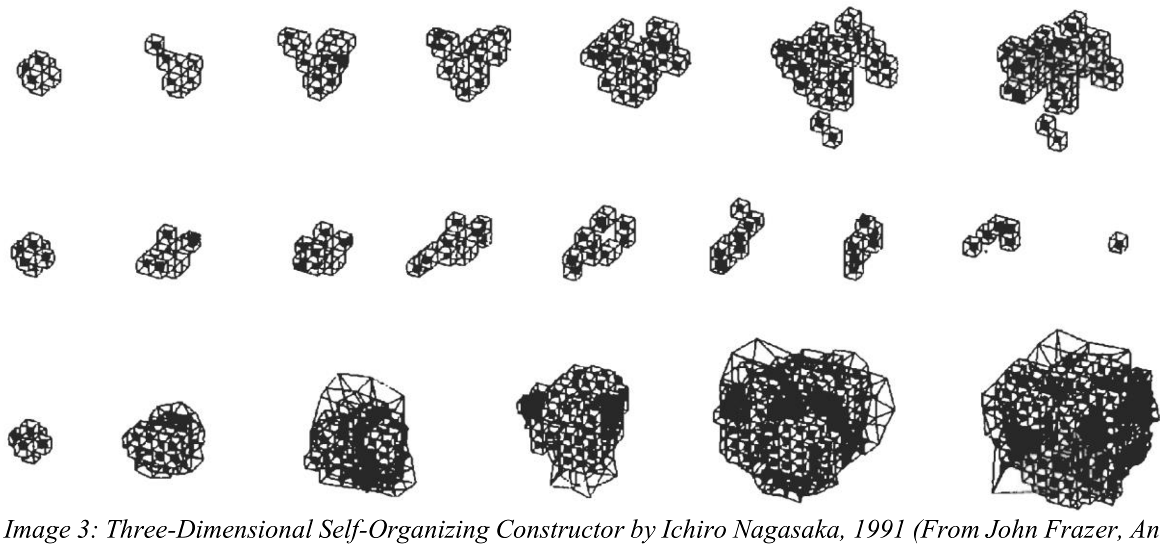


Image 3: Three-Dimensional Self-Organizing Constructor by Ichiro Nagasaka, 1991 (From John Frazer, An Evolutionary Architecture, Architectural Association publications, Themes VII, copyright John Frazer and the Architectural Association 1995. p. 50).

of form, complexity, self-organization" (Figure 5).

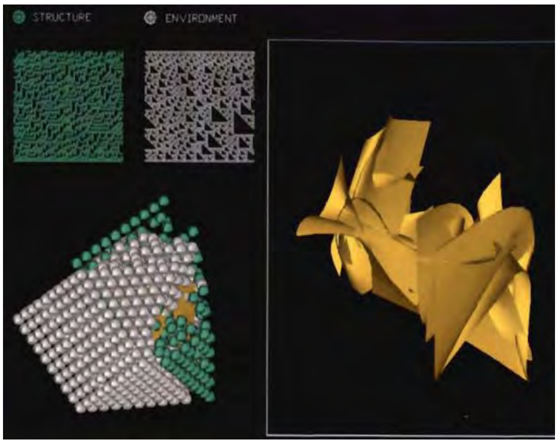


Image 4: Hierarchical Cellular Automata by Manit Rastogi, 1994 (From John Frazer, An Evolutionary Architecture, Architectural Association publications, Themes VII, copyright John Frazer and the Architectural Association 1995. p. 89).

Christiane M. Herr (2008) explores Cellular Automata as a design support in architectural design, based on series of studio experiments and workshops. Herr, focuses on how Cellular Automata can be adopted in the architectural design context, especially in the early conceptual design process. In this regard, Herr's studios differentiate from Frazer's ones. Frazer searches for a more general theory, while Herr concentrates initial steps of the architectural process, although her approach can be applied also in further steps in architectural design.

Herr, developed object-based extended Cellular Automata by improving cell and neighbourhood shapes and definitions in terms of architectural design process. Also, the context of the model had an actual program or an environment, and merged top-down and bottom-up dynamics. According to Schön (1983), in conceptual design processes, designers make use of design support to assist in the reflective conversation with the situation they are engaged in. For this reason, conventional conceptual design support usually provides representations in the form of sketches and models, which allow for different interpretations and visual discoveries. Used as exclusive, self-sufficient tools, Cellular Automata are unlikely to integrate well into the architectural design process, nor generate desirable outcomes. The extended design process model maintains the basic activities of framing, moving and reflecting or evaluation as characteristics of Schön's (1983) design process, and offers Cellular Automata-based generative processes as optional design moves. Additionally, such Cellular Automata-supported design moves provide nested evaluation loops as each element (Cellular Automata cell) is capable of automated

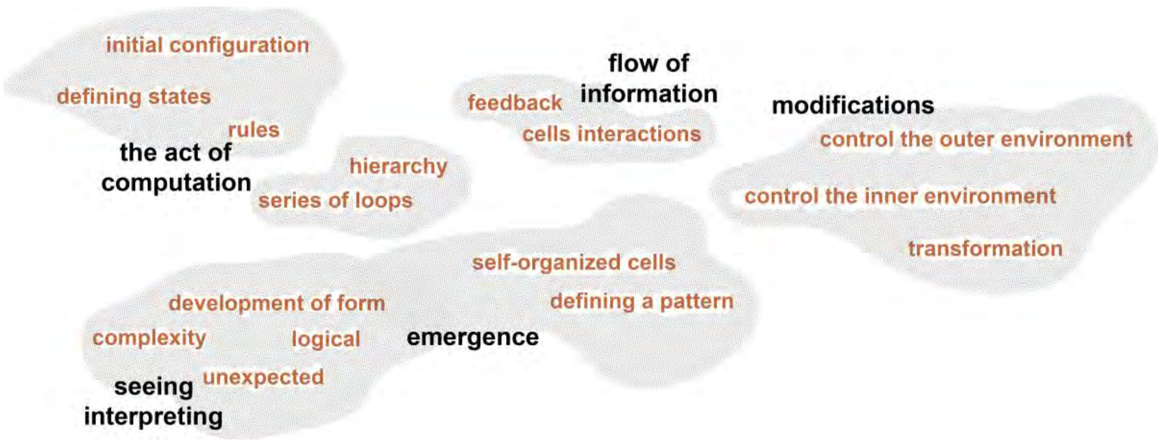


Figure 5: Conceptual map of Frazer's design studios: orange colors express specific concepts, black ones express generic concepts of computational design thinking.

evaluation of numerical constraints. While Cellular Automata are still employed as generative mechanisms with potentially surprising results, this process allows designers more immediate control in determining the direction of the design process. In this context, Herr (2008) created a Cellular Automata software. With executive studio experiments and enhanced software properties, Herr made Cellular Automata more appropriate for the designers' demands. In this process, while the first two experiments were the first trials of the software, the last experiments tried to respond to different demands in the architectural design process with more interesting transformations.

The earlier studio tests of Herr showed that students wanted to experiment with the Cellular Automata software without chasing bias/goal-directed results. In addition, the functions and rule compositions found too detailed and disruptive. Thus, for the Tofu Cubes and Soap Bubble studio (Image 5), conducted with Thomas Fisher in 2006, the level of generative automation of functions tried to increase with less required parameter settings. On the other hand, the increased automation and the generation of more complex and unexpected forms could provide richer design outcomes. In sum, the aim of this studio was to build a Cellular Automata software with few input, but more complex and unexpected outcomes based on the generative process. Also, in the studio two different processes were used. The first is the Tofu Automata Generator which worked as bottom up, and the second is the Soap Bubble Truss Co-Rationaliser which functioned as a top-down. In these processes, Herr (2008), added some functions performing to adapt results, such as multiplication, attraction, repellent, leveling, scaling or deleting. While the processes were designed in two different approaches in this study, it was revealed that the students used both generative systems in a bottom-up manner. Geometrical translations of forms and the inverted volumes based on parametric properties of shapes were some studies emerged at the end of the design process. In these works, fewer initial parameters created intricate and complex behaviours. Also,

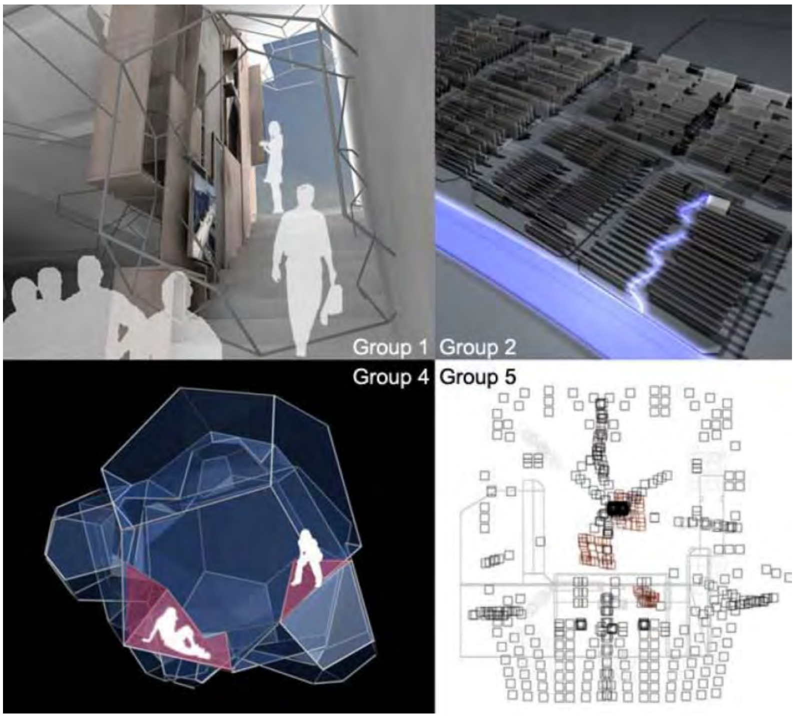


Image 5: Modified results from Tofu Cubes and Soap Bubble studio (Herr, 2008, p. 99).

the processes focused on configurations and relationships of elements rather than the 3-dimensional forms. The generative processes were used for the initial concepts and further modifications were applied.

The next experiment, called “KCRC Urban Automata”, was created for a specific urban design problem (Image 6). Therefore, multiple cell states were used to present functions of urban elements, such as living, working, recreation and landscape. The Cellular Automata generated the complex organization of urban elements based on rules defining the characteristics of urban space. The system, also permited manual interventions throughout the generative process. The results represented not the actual urban forms, but abstractions of urban models. Therefore, the system was open to further modifications for detailed urban arrangements.

based diagrammatic representations of design programs (Image 7). Thus, it can be also called as a generative model of “automated diagrams”. The model assisted thinking and reflections in terms of functional relationships of a design task. Automated diagrams were not limited to representing forms, but also allowed for various interpretations and mappings. To build a rule set for Algogram, the context and building program should be considered and functional relations should be revealed. By doing so, one could generate a rule set and proceed to the generative phase. Algogram could achieve to produce different types of spatial relations such as hybrid or intersected spaces. In addition, these spatial qualities also allowed ambiguity which could enhance the creativity of designers during the early design phases.

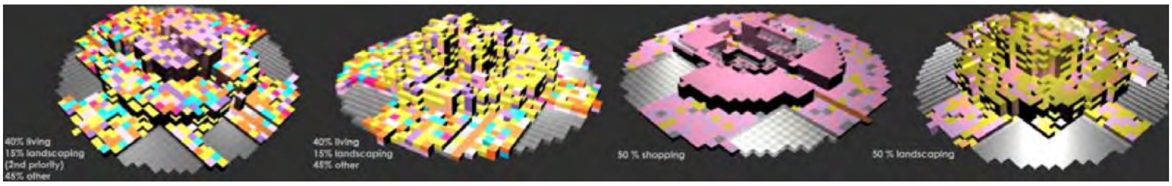


Image 6: Abstract outcomes of KCRC Urban Automata: different colors representing the density of various functions (Herr, 2008, p. 106).

“Algogram”, the last model from Herr (2008), was an implementation determined aspects of representation and interpretation as main research points. It provided a support during the conceptual design phase by producing rule-

Herr (2008), develops a generative model to be used in the early stages of design with abstract expressions, try to relate a real architectural space and environment with each other. In this process, the concepts of computational thinking, such as bottom-up process, context-

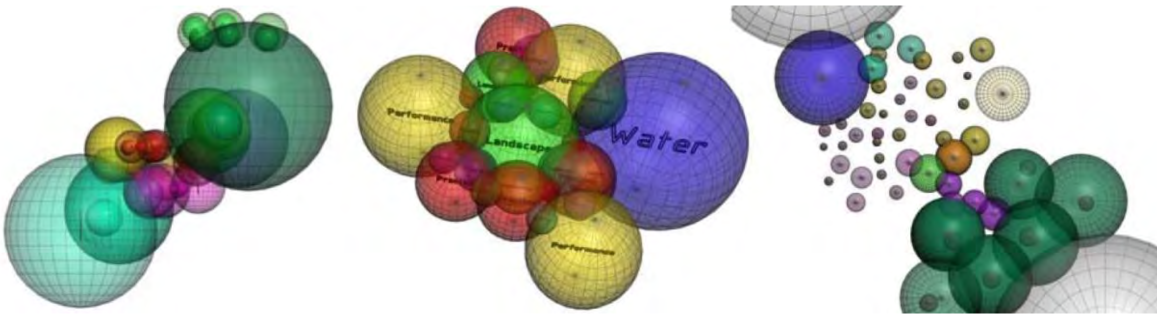


Image 7: Different diagrams generated by Algogram model (Herr, 2008, p. 115).

sensitive, if/then logic, ambiguity were mainly discussed (Figure 6).

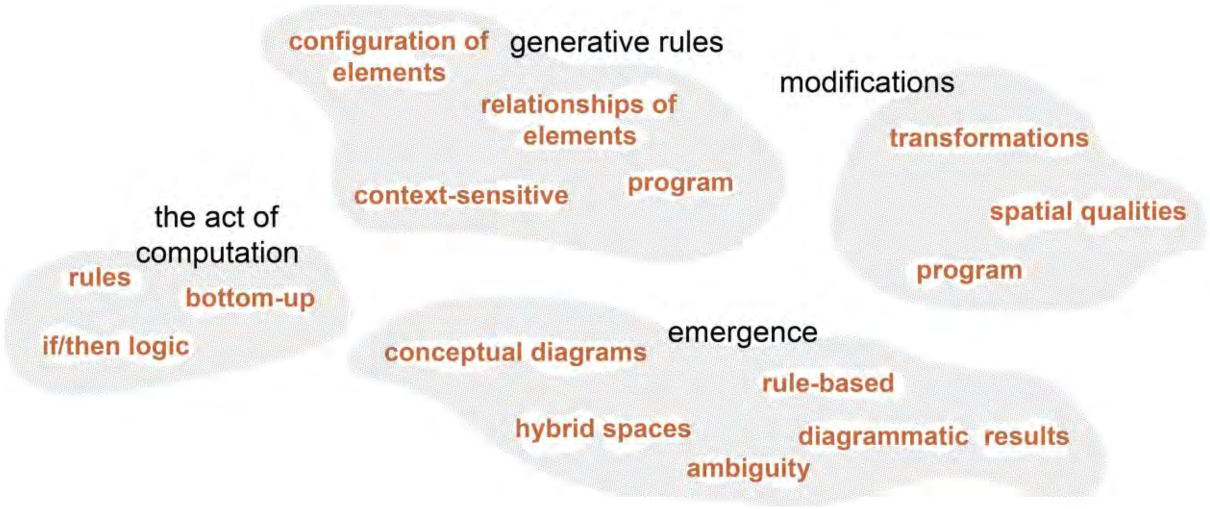


Figure 6: Conceptual map of Herr's design studios: orange colors express specific concepts, black ones express generic concepts of computational design thinking.

5-Discussion and Conclusion

Experiments in Frazer's and Herr's studios enhance Cellular Automata in two different ways. Frazer explores unusual formations and the potentials of computer-human interaction through the computational aspects of Cellular Automata. On the other hand, Herr has a more practical purpose and is trying to find a model of the Cellular Automata that can be utilized by designers in the early stages of design, by solving a program and context-related design problems with a conceptual diagrams. Although their aims are different, the two design studios actually follow similar processes. First of all, studios consider design as a system and evaluate it as a whole in terms of parameters, relations, rules, operations and final products (Sönmez & Ataş, 2016). The generative rules produced in these studios are constructed from abstract relations related to the program, form or context. Thus, the studios contribute to understanding of the basic concepts of computational design thinking in the context of architectural design. A system, emergence, parametric relations, morphological transformations, generated space, evolution of form, patterns, self-organization are frequently mentioned concepts and result products are discussed and evaluated through them. In both design studios, after understanding the nature of computation, post-operations or modifications, such as interpretation and manipulation have been applied, and the coherence of the resulting forms to the architectural program and the context can be discussed. Potentials and restrictive features of computation are discovered, and accordingly, the role of the designer in studios is changed from only a tool-maker into a designer of the post-operations.

In this study, first of all, the concept of computational design thinking and the generative systems in architecture were introduced and the conceptual background related to the subjects have been drawn. After, processes and concepts of Herr's and Frazer's Cellular Automata studios were examined in terms of Computational Design Thinking. Since Cellular Automata produce abstract results, they are very effective in understanding computational design thinking in the architectural design process. They enable the discussion of the computation-related concepts by producing abstract fictions. They increase the possibilities for the exploration of concepts such as emergence, ambiguity, seeing through resulting forms. As a result, since Cellular Automata are exploratory processes, they provide to see, to reach the whole from the parts, to notice the relationships and patterns between the parts and to re-invent them during and after the generative processes. For these reasons, Cellular Automaton has an important role in the development of computational design thinking in design studios with different concepts and setups.

References:

Ahlquist, S. & Menges, A. (2011). *Computational design thinking.* London: John Wiley and Sons.

Coates, P., & Healy, N., & Lamb, C. & Voon, W.L. (1996). The use of cellular automata to explore bottom up architectonic rules. *Eurographics Conference.* Imperial College of Science and Technology, London.

Frazer, J. (1995). *An evolutionary architecture*. Architectural Association publications, Themes VII.

Frazer, J. (2005). Computing without computers. *Architectural Design*, 75(2), 34-43.

Gu, N., & Singh, V., & Merrick, K. (2010). A framework to integrate generative design techniques for enhancing design automation. In Dave, B., & Li, A. L., & Park, H. J. (eds.), *New Frontiers: Proceedings of the 15th International Conference on Computer-Aided Architectural Design Research in Asia CAADRIA 2010*, 127-136. Association for Research in CAADRIA, Hong Kong.

Herr, C.M., & Kvan, T. (2007). Adapting cellular automata to support the architectural design process. *Automation in Construction*. Volume 16, Issue 1, 2007, 61-69.

Herr, C. (2008). From form generators to automated diagrams: using cellular automata to support architectural design. (PhD Thesis). Department of Architecture: The University of Hong Kong.

Krawczyk, R. J. (2002). Architectural interpretation of cellular automata. *International Conference On Generative Art.* Milan, Italy, December, 2002.

Oxman, R. (2008). Digital architecture as a challenge for design pedagogy: theory, knowledge, models and medium. *Design Studies*. Design Studies 29 (2008), Elsevier Ltd. 99-120.

Schön, D. A. (1983). *The reflective practitioner: how professionals think in action.* New York: Basic Books.

Singh, V. (2012). Towards an integrated generative design framework. *Design Studies*. Vol.33, No.2, March 2012, Elsevier Ltd. 185-207.

Sönmez, N. O., & Ataş, Z. (2016). An alternative design computing and education approach through the concept of computespace. *Yapı*, 419. (October 2016). 142- 146.

Terzidis, C. (2003). *Expressive form: a conceptual approach to computational design.* Taylor & Francis.

Von Neumann, J. (1951). The general and logical theory of automata. *Cerebral Mechanisms in Behavior: The Hixon Symposium.* New York: John Wiley&Sons.

Wolfram, S. (2002). *A new kind of science.* Champaign: Wolfram Media

Journal of
Design Studio
v:2 n:2 December 2020

Bridges as City Landmarks: A Critical Review on Iconic Structures

Ayca Arslan
Uşak University, Faculty of Architecture and Design, Uşak, Turkey

Received: September 21th 2020, Revised: November 9th 2020, Accepted: November 15th 2020
Refer: Arslan, A., (2020), Bridges as City Landmarks: A Critical Review on Iconic Structures, Journal of Design Studio, V.2, N.2, pp 85-99,

A. Arslan ORCID: 0000-0002-5262-1429
DOI: 10.46474/jds.798072 https://doi.org/10.46474/jds.798072

Abstract: This paper investigates bridges from 'landmark of cities' point of view under aesthetics theme. In fact, bridges gave many samples at history with high aesthetic qualities; constructed with diverse materials and vernacular traditional construction methods of the region and era they had been built. Bridges, however, known as engineering products, today it is expected from them to accommodate high aesthetic qualities as being perceptual productions of their environment. It is this 'construction and aesthetics' combination that makes them landmarks, which will be demonstrated in the paper by selected cases include both high structural and aesthetical qualities, transforms them to landmarks and icons of their city. On the other hand, by the development of new materials and construction styles, aesthetic consideration come forward by productions of sculptural steel construction bridges in cities. Basically paper consists of two parts, which first one is literature review that introduces aesthetic values in design, landmark features, classifications of iconic concept and 2nd part includes general mapping on bridges from past to present with different functional and constructional styles. In the article, aesthetics in design and landmark concept have been introduced strongly in order to understand the meaning of 'icon'. Thus especially the design content of Enzio Manzini have been introduced in the article with his work '21.th Century Values of Design' which he explains the importance of aesthetics in design. In addition, at this part, design elements as an architectural language formed by 'point, line, plane' and visual elements such as; 'shape, form, color and texture' have been introduced. In order to continue, design principles such as rhythm, balance, emphasis, scale & proportion, hierarchy have been introduced in the study to reach landmark concept. At second part approximately fifteen unique bridge design and construction have been investigated from all around world such as; Florence, Singapore, London, Sydney, San Francisco, France, Amsterdam, China, Australia and Turkey. All of these selected bridges accommodate iconic features uniquely and differently from each other which transform them to a landmark of their city or environment. The uniqueness of the bridges depends on superiority of some features such as; the length, the height, type, function, construction, material, form, referring the construction system design such as; helix, space frame, steel tensegrity, cable stayed steel swing bridge, single arch and hangers, pods steel high tech materials, steel, pylons and abutments, suspension bridge, steel through arch bridge, wave form made up of seven undulating curved steel, stone build, a three stage pointed arched stone bridge. As indicated, all construction systems are unique and in addition they show highly aesthetic criteria. Thus, when a unique structure meets with technology and/or high aesthetic qualities such as design principles and color, the structure of a building becomes an icon for its city. Then, at 3rd part, four iconic bridge cases have been investigated through their aesthetic and landmark values. At the end, important keys will be collected for aesthetically designed future bridge constructions. To sum up, in the article, it is aimed to reveal landmark concept in the cities over bridge cases which are very aesthetical and flexible structures by their forms, construction styles, materials and functional diversities.

Keywords: Landmarks, icons, aesthetics, innovation.

1. Introduction

This paper titled as 'Bridges as Landmarks', investigates bridge structures from past to present with an architectural aesthetical value. However, bridges are known as engineering products, it's the aesthetical value that comes forward by the urban spatiality they create. The aim of the paper is to indicate the importance of aesthetic values in bridge design especially from urban spatiality features and landmark

criteria. Study makes a wide investigation on selected iconic bridge cases from past to present such as; Sinan's Büyük Çekmece Bridge in Turkey, Golden Gate Bridge in U.S, Millau Viaduct in France and Zaragoza bridge in Spain. Cases have been selected due to their iconic features which make them landmarks in their environment.
As the part of literature review, general mapping on bridges have been achieved around the world within a search through superiority features such as ; too long, too high, too aesthetic &artistic, too multi-functional and/or too high-tech by construction techniques which compromise the limitation of the 15 sample case selections. On the other hand, bridges have been investigated under two themes; structural and functional variations of bridge structures from past to present. Firstly; structural superiority and diversity introduces bridges with different construction styles such as; stone-made, steel, cable-stayed, steel space frame structures. These structural analyses revealed how technology and architecture have an important role on changing bridge designs. Then, with second theme as functional diversity, bridges have been investigated and classified from past to present through their functions such as; rail-road bridges, pedestrian & bike bridges, and lastly as a superiority feature; bridges as buildings with enclosed spaces such as shops, exhibition areas where one can both travel in the museum and cross the river.

Problem Statement & Field study

Problem: When analyzed from past to recent day, it is found that bridges include diverse aesthetic qualities not only being functional structures, but also the creation of urban spatial imagination which transforms them landmarks inside the city.

"In this respect; study tries to find answers to the question; *"1. For to be a landmark, can aesthetic values of a bridge come forward than structural value?"*

Field Study: 4 bridge constructions that include iconic architecture features: Büyük Çekmece Bridge, Golden-Gate Bridge, Milla Viaduct, and Zaragoza Bridge have been analyzed deeply by parameters that are determined by 15 sample case analyses.

Aims & objectives: The aim of the paper is to reveal and demonstrate the importance of aesthetic values on bridge designs which transform them landmarks in urban spatiality.

Methodology: The study includes both quantitative and qualitative research methods. a comprehensive literature review introduces; theoretical review about aesthetic values in design, landmark concept for iconic values in design and basic design principles for artistic values. By making a general mapping on bridges from past to present, super adjectives have been determined such as; too high, too long, too aesthetic, too functional (multi-functional) and too technological by construction methods, which transforms a simple bridge structure to a landmark and 15 unique bridge designs have been selected for sample analyses to determine features in design to be an 'icon' that have been used at basic case analyses. Deep case analyses have been achieved on selected 4 bridges, by parameters that have been determined both at first and second parts. which create high quality landmark criteria. Lastly at fourth part, conclusions have been given with important keys for bridge designs, aesthetic values and landmark criteria for to give a light for future studies on bridge designs (Table 1.).

Table 1. Methodology of the study

1.LITERATURE REVIEW	SAMPLE CASE ANALYSES	BASIC CASE ANALYSES
1)Aesthetic values in design 2)Landmark concept 3)Basic design elements and principles as artistic values	15 landmark bridge analyses to determine parameters for landmark and icon criteria	4 iconic bridge analyses by parameters that are determined by 15 sample case analyses

2. Literature Review and General Mapping

2.1. Aesthetic Values, Landmark Criteria and Principles of Design

This part introduces literature review as three part theoretical architectural investigations on; aesthetic values, landmark criteria and design principles and elements that have been used for analyzing cases by aesthetic urban spatiality.

2.1.1 Aesthetic Values of Design:

Design has been defined by different theorists till now. There are some descriptions for word 'design' which comes from old days. For example, Booker (1964) describes design like 'Simulating what we want to make before we make it as many times as may be necessary to feel confident in the final result.' And at fine arts, design is the creative period that covers the study of sketches and plans for a project. As Enzio Manzini indicates; 'design will have to re-examine the very basis of its culture and he puts particular emphasis on the significance of the role of values in designing' (Inns T, 2007: 306).

In addition, Manzini asserts; 'the need for an aesthetic to be based upon a value system, and emphasizes the important role that an aesthetic of sustainability would play in the transition to a new economic and social order' (Inns T, 2007: 307).

As Enzio Manzini in the book 'Designing for the 21.th Centuries-Values of Design', indicated that (2010); 'Every era has its own ethics and aesthetics. Aesthetics represents the way in which a historical period and the values it contains 'take form'. During the first part of the century, design played a decisive role in giving form to modernity. During the 1980's, the better or worse, design was the protagonist of an aestheticization of things: an aestheticization which, on the whole, has proven incapable of countering the more generalized aesthetic decay for the world. Today, the perspective of sustainable society has not yet 'taken form' and an aesthetic of sustainability have yet to be born' (Inns T, 2007).

The theme of aesthetics must be considered seriously: as it become commonplace to view the aesthetic dimension as secondary; an extra to be added when the rest has been resolved, a luxury for those who have everything. In reality aesthetics is connected to ethics in the sense that no true, profound aesthetic renewal can occur without being based on a value system (Buchanan R., Doordan D., Margolin V., 2010).

2.1.2. Landmark Value analyses

"Do quantitative and qualitative characteristics of size, innovation, beauty, location and surrounding, simplicity, complexity, historical traces, longevity make a bridge iconic?"

As the subject of the paper; 'Bridges as Landmarks', it's better to start by meaning of icon; An icon is an image as defined by Oxford English Dictionary (2011), it can be a statue, a figure, representation or a portrait. A representation of some sacred personage honored with a warship or regarded as secret (Inns T, 2007).

Through C.W. Morris's definitions of icon, the basic aspect of an icon is 'aesthetic' and an aesthetic sign is defined as an iconic sign (an image) whose design datum is a value. Iconic, in generally refers to events, people and /or objects that are famous for those within the fields in question (notably popular culture, fashion and sport) and often also for the public at large and have special symbolic/aesthetic significance attached to them and the key factors of iconic are such as; unique design, concept or symbolic values of design construction made it iconic. In addition, as Charles Jencks indicated; 'The new type of architecture has emerged in the last decade: the iconic landmark building, which challenges the traditional architectural monument. In the past, public buildings expressed shared meaning through well-known conventions. Today those conventions are superseded by commercial forces and the quest for instant fame. Public architecture is now required to be an amazing piece of surreal sculpture as well as something that appeals to a diverse audience-at once provocative and practical yet without the context that religion and ideology once provided' (Jencks C,2000). Here, Jencks emphasizes how iconic buildings became landmarks especially at last decades and compromises with past as traditional monumental landmarks such as Eiffel Tower which is also landmark too. Today by the help of changing technology iconic landmark buildings have been created such as; Gehry's Guggenheim Museum at Bilbao. Each year many tourists visit Bilbao to see landmark as museum, which demonstrates the power of landmarks in a city. Of course Bilbao effect has precedents, but the Eiffel Tower was built for no compelling purpose except to be an icon, later it came to symbolize Paris (Jencks C,2000).

2.1.3. Design Principles:

In architectural language**,** basic design principles that are formed by; 'point, line, plane' and visual elements such as; 'shape, form, color and texture' are commonly used during creating visual compositions. Visual language composes of these elements and their relationships. Conceptual elements become visual elements when they take form, size, color and texture. On the other hand, when these conceptual elements have been organized by design principles, artistic compositions are determined. This part introduces some basic design principles such as; rhythm, balance, scale & proportion and hierarchy. (Kaymakcan M, 2006)

a. Rhythm Principle: A unifying movement characterized by a patterned repetition or alteration of formal elements or motifs in the same or modified form. (Ching,1996)

Figure.1.Sidney Opera House, John Utzon, 1957-1973(source: https://www.archdaily.com/65218/ad-classics-sydney-opera-house)

b. Symmetry: The balanced distribution and arrangement of equivalent forms and spaces on opposite sides of a dividing line or plane, or about a center or axis (Ching,1996) (Fig.2).

Figure.2. Maria Botta, San Francisco Museum of Modern Art, (source: https://www.dezeen.com/2015/08/10/postmodernism-architecture-sfmoma-san-francisco-museum-of-modern-art-mario-botta-snohetta-craig-dykers-extension/)

c. Scale & Proportion Principle: While proportion pertains to an ordered set of mathematical relationships among the dimensions of a form or a space, scale refers to how we perceive or judge the size of something in relation to something else. In detailing with the issue of scale, therefore, we are always comparing one thing to another (Ching,1996: 162).

d. Hierarchy Principle: The principle of hierarchy implies that in most if not all architectural compositions, real differences exist among their forms and spaces. These differences reflect the degree of importance of these forms and spaces, as well as the functional, formal and symbolic roles they play in the organization. For a form to be articulated as being important or significant to an organization, it mıst be made uniquely visible. This emphasis can be achieved by endowing a form or shape with;

- exceptional size
- a unique style
- a strategic location (Ching, 1996:338) (Fig.3).

Figure 3: Centre Pompidou as a sample for hierarchy with a huge size (https://www.arkitektuel.com/centre-pompidou/)

2.2. Analyzing values:
(1) Formal design of building/bridge, (2) Unique style of building/bridge, (3) Technology usage in building / bridge design, (4) Sustainability issues (if exist) Icons are famous not simply for being famous, as in the case for various forms of celebrity, but famous for possessing specific symbolic/aesthetic qualities, qualities that are the subject of considerable debate within the specialist fields and, increasingly, with the recent rise of the blogosphere, debate to which the general public actively contributes (Jencks C, 2000).

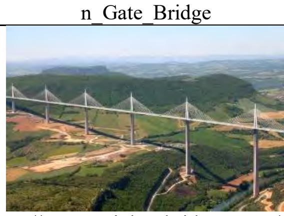
When we look through architectural view, for a building/bridge to be an iconic, it must consist of a variety of integrated features such as; 'unique design, large scale, high level, spectacular representation and a specific message signify by the building'. (Jencks C,2000) And, iconicity in architecture is also defined as fame or a special symbolic/aesthetic significance that is contributed with buildings, places and sometimes architects them. An iconic design can be separated into two through their inspiration points, it can have a relationship with culture of nation or it can have a unique design in global era with consisting different type of features like technology & material usage or sustainability (Jencks C,2000).

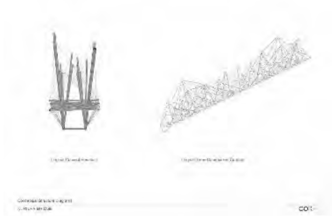
2.3. General Mapping on Iconic Bridges from Past to Present
Through sample case analyses its determined that all 15 bridges have iconic design criteria by being too long, too high, too innovative and too aesthetic with a unique form double curve generally. The most common feature is the form and aesthetic perception that they create in the city, by a curved deck (FOOTBRIDGE MEDIACITY UK), steel tensegrity structure (KURILPA BRIDGE), diamond shape (CLYDE ARCH BRIDGE), double helix form, formal resemblance to anaconda (PYTHON BRIDGE), unique wave form (HENDERSON WAVE BRIDGE). Secondly, sample case analyses determine innovative and unique technological features such as; being too long, too high with extraordinary dimensions such as Millia Viaduct bridge by being the tallest bridge between Paris and Barcelona, or Phyton bridge by being the longest foot bridge and Golden Gate bridge by being the longest suspension bridge in the world. Thirdly, sample case analyses also determine spatial features such as; multi-functional usages in addition to linkage such as ; Ponte Vecchio bridge in Florence with

housing units indicating a distinctive façade design with colourful windows & balconies and Zaragoza pavilion bridge which is both museum and bridge (Table 2.).

Table.2. *General mapping on iconic bridges from past to present identifying iconic features. (bridges are also classified into two parts; 'structural and functional' in the table through their including closed-spaces for other functions)*

	Name of the Bridge	**Architect& date&city**	**Type of the bridge**	**Landmark property**	**Iconic features**	**Structure**	**Principles**	**Visual perception**
1.	Büyükçekmece bridge. (structural)	Mimar sinan, 1567-68, Istanbul.	Pedestrian and vehicle bridge.	Huge&long: Crosses sea and lake.	Unique form, Large scale.	A three-stage pointed arched stone bridge.	Rythm, Scale& Proportıon, Hıearchy, Symetry	 Https://Kantaratlas.Blogspot.Com/2014/12/Buyukcekmece-Bridge.Html
2	Ponte vecchio bridge. (functional)	Taddeo gaddinri di fioravante, 1345, Floransa	Pedestrian bridge-multifunctional (stores+bridge).	City center iconic.	Bridge Façade design, Multi-functional usage.	Stone build.	Rythm, Scale& Proportıon, symetry	 Https://Tr.Wikipedia.Org/Wiki/Ponte_Vecchio
3	Henderson wave bridge-Functional. (structural)	Singapore, 2008.ura	Pedestrian Public spaces with sittings.	Connects two hills of mount faber and telok blangah hill.	-highest pedestrian bridge. -unique wave-form.	Wave form made up of seven undulating curved steel "ribs".	Rythm, Scale&proportıon, Hıearchy	 Https://En.Wikiarquitectura.Com/Building/Henderson-Wave-Bridge/
4	London tower bridge. (structural)	River thames, 1894, by john wolfe barry and horace jones.	The bascule bridges-brickwork in a feudal style of arch..	The landmark its place in history of the river thames.	The piers of the tower bridge are different from an ordinary bridge. 1982- the glass walkway.	Stone towers and cable stayed.	Scale&proportıon, Hıearchy, Symetry	 **Https://En.Wikipedia.Org/Wiki/Tower_Bridge**
5	Sydney harbour bridge. (structural)	John bradfield, march 19th 1932,sydney.	Rail-road, bicycle and pedestrian-traffic.	Iconic, Port jackson (sydney harbor)	Large scale, Longest.	Steel Through arch bridge.	Scale&proportıon, Hıearchy	 **Https://Www.Ice.Org.Uk/What-Is-Civil-Engineering/What-Do-Civil-Engineers-Do/Sydney-Harbour-Bridge**

6	Golden Gate bridge. (structural)	1937, strauss, san francisco.	Rail-road, bicycle and pedestrian traffic.	Between san francisco bay and the pacific ocean.	Longest suspension bridge in the world. Art nouve elements Color usage.	Steel, A suspensio n bridge.	Scale&prop ortıon, Hıearchy	 Https://En.Wikipedia.Org/Wiki/Golden_Gate_Bridge
7	Millia viaduct bridge. (structural)	Foster&partners 1996.	Highway rail-road bridge Innovative Contemporary.	Valey of the river tarn	The tallest bridge in the world between paris and barcelona	Pylons and abutments	Rythm, Scale&prop ortıon, Hıearchy	 Http://Www.Highestbridges.Com/Wiki/Index.Php%3Ftitle%3dmillau_Viadut
8	Python bridge. (structural)	West 8 design, Amsterdam 1998	Pedestrian bridge- innovative	Spans the canal of sporenbu rg-borneo island.	Longest foot bridge. -formal resemblence: Anaconda -innovative	Steel.	Rythm, Scale&prop ortıon, Hıearchy	 Https://En.Wikipedia.Org/Wiki/Python_Bridge
9	Helix bridge. (structural)	Cox group pte ltd (australia) and arup- 24 april 2004 - singapore .	Pedestrian bridge- innovative &high-tech.	Crosses singapore river.	Unique style: the world's first "double-helix" -unique form	Frittered -glass and perforate dstainless steel	Rythm, Scale&prop ortıon,	 Https://Www.Archdaily.Com/185400/Helix-Bridge-Cox-Architecture-With-Architect
10	Hangzhou bay bridge. (structural)	14 june 2007,china,	Highway rail-road bridge Innovative	Connects the municipa lities of jiaxing and ningbo in zhejiang province.	Large scale: longest trans-oceanic bridges in the world. 22 miles long.	Cable stayed bridge	Rythm, Hıearchy	 **Https://En.Wikipedia.Org/Wiki/Hangzhou_Bay_Bridge**
11	Zaragoza pavillon bridge- (functional)	Zaha hadid, Zaragoza spain,2008	Pedestrian bridge Multifunctional: Pavillon bridge	Enclosed space spanning the river ebro to the zaragoza expo 2008	Unusual typology: a union of two building typologies	4 pods – steel-high tech materials	Rythm, Scale&prop ortıon, Hıearchy	 **Https://Www.Dezeen.Com/2008/06/16/Zaragoza-Bridge-Pavilion-By-Zaha-Hadid/**

12	Borough high street bridge. (functional)	Jestico+ Whiles London	Pedestrian bridge-tube bridge	Located in a conservation area and the busy borough market	The iconic feature bridge is 70m long, 9m high in the centre	Steel-bridge is 70m long, 9m high in the centre	Scale&proportıon, Hıearchy	 **Https://Structurae.Net/En/Structures/Borough-High-Street-Bridge**
13	Clyde arch bridge. (structural)	Glasgow, uk Gillespies architect, 2006	Road bridge, Rapid transit tram system and four lanes of traffic.	Crosses the river cydle in glasgow, for access to pacific quay area	The diamond shaped arch section is a unique.	96 m.span single arch rib and hangers	Rythm, Scale&proportıon, Hıearchy	 **Https://Structurae.Net/En/Structures/Clyde-Arc**
14	The footbridge mediacity uk-(structural)	Wilkinson eyre architects,2012	Pedestrian	Spans the manchester ship canal	Unique by the deck is a curved both in plan and elevation	Asymmetric cable-stayed steel swing bridge	Rythm, Scale&proportıon, Hıearchy	 **Https://Structurae.Net/En/Structures/Media-City-Footbridge**
15	Kurilpa bridge, australia (structural)	Payner architects, brisbane, 2009	Pedestrian and cycle	Crosses brisbahe river	Form of public space-Unique structure	Steel tensegrity Structure	Rythm, Scale&proportıon, Hıearchy	  Https://Www.Archdaily.Com/186214/Kurilpa-Bridge-Cox-Rayner-Architects-With-Arup
	Name of the Bridge	**Architect& date&city**	**Type of the bridge**	**Landmark property**	**Iconic features**	**Structure**	**Principles**	**Visual perception**

3. Revealing Bridges Landmark Features with Two Themes: Structural Diversity & Functional Diversity

This part investigates selected bridges through their spatial properties and classifies into two; a) structural diversity which introduces bridges with innovative construction techniques that create **sculptural structures** such as; stone, suspended steel or cable-stayed steel construction and b) functional diversity introduces multi-functional bridges with additional functions such as museum bridge that create **building bridges**.

3.1. Structural Diversity: Büyükçekmece Bridge & Golden Gate Bridge & MillauViaduct

3.1.1. Sinan's Büyükçekmece bridge

Sinan, who is one the most talented master architect of the period, had produced some cluster of bridges and aqueducts in addition to other projects which can be seen as architectural superstructures of its own period.

Design of the bridge: Sinan had constructed Büyükçekmece Bridge within a concept of interlinked four bridges consisting series of spans and lanchet arches that covers a total length of 635 meters. The bridge has had to be a bit long due to its place which forms a landmark concept between the lake and the sea. Master architect Sinan solved the length problem by developing a repetitive structural model concept with integrated aesthetic values such as; totatly four interlinked bridges that transfer the major stresses with the equilateral triangular members which support the platforms horizantally. (Fig.4) In order to distribute the weight and avoid overloading, Sinan had designed large number of arches to each span. (Necipoğlu G,2005) In addition, Sözen explained the structure of stone made bridge as; 'By building slenderer piers, expanding the span of the arches, raising the road level of the bridge and replacing the triangular cross-section of the structure, architect created the stability essential to its long survival' (Necipoğlu G, 2005).

Turgut Cansever, on the other hand, describes the bridge as a structure between the sea and the lake, surrounding the lake and inside the core of the soft topography, interconnection of low heighted four peaks. The bridge which landmarks its environment with its calm sharp, geometrical lines and forms, resembles like the white sparkling waves of Marmara Sea (Cansever, 2005).

Figure.4. Views from Büyükçekmece bridge, (Necipoğlu G,2005)

A. Aesthetic&Artistic analyses of the bridge: This part includes principle analyses of the bridge design

a. Rhythm principle: Reveals between spans, arches and four bridges. At bridge, a mathematical repetition of same elements and forms can be seen. The continuity of architectural elements such as lancet arches and slender spans with different sizes, creates an aesthetic rhythm. (Fig.5)

b. Color, texture, light principle of the bridge: The texture and color of stone material create a unique harmony and unity with its time and environment.

c. Proportion & Order & From Principle: Proportions of each peak and arches in-between create a human-scale form.

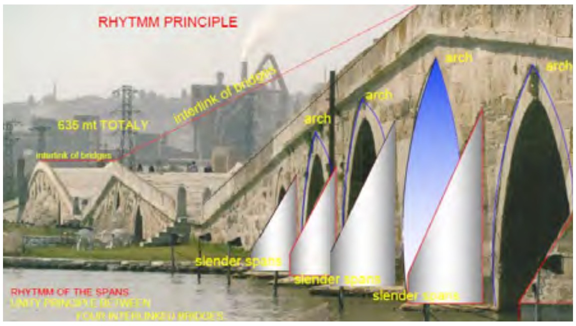


Figure.5. Rhythm principle analyses of the bridge. Rhythm, between interlinked bridges, arches and spans and how they create an architectural aesthetics value. (Necipoğlu G,2005)

d. Hierarchy by organization of rythmic arcitectural elements; by placing two same size units both side of a smaller unit, variety appears by the use of architectural instruments such as, arches, slender, spans. and so on. Emphasis principle is very visible by the peaks designed from beginning to the end like waves.

B. Landmark Value analyses

a. Formal design of Büyükçekmece Bridge: The Bridge resembles big waves within more geometric shapes like triangles which indicate the formal design approach of the architect. In addition, bridge resembles the mountains behind formally and gets in harmony with them by an urban spatial imagination.

b. Unique style of the bridge: The Bridge's unique style comes from its form and long distance it crosses with making peaks for three times.

c. Technology usage: Through the construction date of bridge, there weren't existing technological devices. It is a traditional designed bridge with vernacular materials such as stone usage, latchet arches and slender spans.

d. Sustainability issues: The Bridge consists of sustainable elements such as vernacular materials and construction methods which keep it standing till today friendly with its environment.

3.1.2. Golden Gate Steel Suspension Bridge

The Golden Gate Bridge was used to be known as longest suspension bridge in the world till 1964 with a main span which is 1300 meters. Now its famous span length has been passed by ten different bridges over the world by the help of developing technology. Golden Gate Bridge is now the second longest bridge in the United States after Verrazano-Narrow Bridge in New York. Today Golden Gate length from abutment to abutment is totally 2.337 meters. The height analyses of the bridge is also excellent such as; the highest water average is 67 meters and while the two towers at each side reaches a height of 227 meter above water which ensures the suspension design of the bridge. They were the tallest in the world till 1998 when at Denmark and Japan higher were designed. (Fig.6)
(http://goldengate.org/exhibits)

Figure.6. San Francisco with two bridges (Western section of the Bay Bridge in the left background),Coit Tower (in background to the left of North tower),and Fort Mason (on the San Francisco waterfront in the background behind the North tower) from Marin. (source:http://goldengate.org/exhibits)

Design of the bridge: At first stages of the bridge design, Strauss was working for the overall design and construction project of the bridge but then due to the requirements for more experienced constructions such as; cable-suspension systems, it's decided to come over a final scheme with both architect and engineer corporation work. So Leon Moisseiff, who had experienced on suspension design with New York's Manhattan Bridge work, had been chosen for structure designer of the Golden Gate Bridge.

Steel usage & protection: The Bridge's main body/roadway is hung by two cables from each tower symmetrically and is fixed in concrete at each end where cables reach land. Each cable is made of 27.572 strands of wire. There are 80,000 miles (130,000 km) of wire in the main cables.

Aesthetics: Irwing Morrow was responsible from the aesthetics values of the bridge as an architect and especially he used color at bridge for perception. Morrow choose an orange vermillion color, called international orange because it fits with natural surrounding and environment on one side and on the other side it makes the bridge perception visible in foggy atmospheres.(http://goldengate.org/exhibits)

A. Aesthetic Analyses of Golden Gate Bridge

Rhythm principle; can be easily found on the iconic bridge firstly at repetition of cables and secondly at the lights of the bridge that are placed on both sides and main cables. (Fig.7)

Texture and color; by its orange color bridge really creates a harmony with its natural environment which is known as a foggy place. (Fig.7)

Figure.7. Aesthetic analyses of Golden GateBridge(source:http://goldengate.org/exhibits)

Hierarchy by sizes: Bridge crosses huge length 1280 meters and the towers highest in the world 227meters

***B. Landmark Feautures**:* Golden Gate bridge is a landmark in the city San Fransicso by including iconic features such as first longest suspension bridge in the world with a railroad span of 2.337 meters long connecting San Francisco Bay and Pacific Ocean. Although it's a big structure, the bridge is in a harmony with its environment like a sunset with its orange colour, its visibility in the fog and its thick and tall towers with art deco elements , looks like futuristic skyscrapers of both sides, like gates entering SanFransico one side, and the Marin gate on the other side.

3.1.3. MILLAU VIADUCT, FRANCE 1993 / cable-stayed steel bridge

Millau Viaduct Bridge constructed in France, between 1993-2004 is the longest high way bridge by 2.48 kilometers, from Paris to Barcelona, crossing the Tarn River. The bridge is an infrastructure which successfully achieves to articulate the challenge of spanning the 2.48 kilometers form one plateau to the tower in the most economical and aesthetic manner. The iconic bridge is located in southern France forms a link between A75 auto route from

Clermont Ferrand to Beziers across the Massif Central. (Fig.8) (www.fosterandpartners.com)

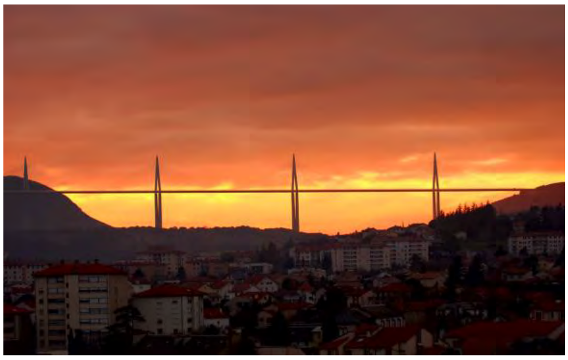


Figure.8.Millau Viaduct, France, 1993-2004) (www.fosterandpartners.com)

Design: The master structure has a cable-stayed steel construction solution, very delicate, transparent in materials and owns optimum span between the columns. The bridge is iconic by several records that it consists such as the highest pylons in the world, the highest road bridge deck in Europe, and it is the second super ceded, tallest, steel structure in France after Eiffel tower. (Fig.9-10) (www.fosterandpartners.com)

B.Landmark features: Millau Viaduct is an iconic viaduct by its superoir and aesthetic

Figure.11.Aesthetic analyses of the viaduct

features such as the highest raodway bridge deck in Europe today, second tallest steel transparent struture in France after Eiffel tower. Bridge creates an excellent aesthetic silhoutte from a topografic and environmental point of view.

3.2. Functional Diversity of Bridges

3.2.1. Zaha Hadid's Zaragoza Bridge Pavillon:'Space-Frame Steel Structure' pods

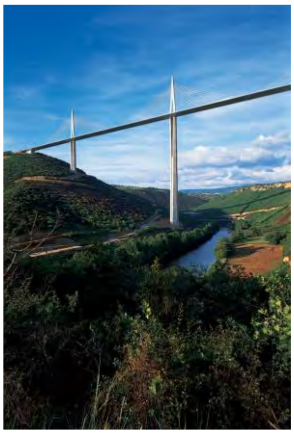


Figure 9. Environmental view of the bridge, (www.fosterandpartners.com)

Figure 10. Transparent elements of the bridge.

***A.Aesthetic Analyses of Millau Viaduct*:** In the bridge design; repetition, rhythm, form and proportion design principles can be found.
Hierarchy by sizes: the huge length of the bridge and height creates a strong perception in the area.

Description of the bridge: Zaragoza Bridge is a pavillon bridge with an iconic concept, placed at Zaragoza Spain, constructed between 2005-2008 with a size of 6.415 m2. The Pavillon Bridge is a multi-functional and mix use, pedestrian bridge including both exhibition spaces and shops, crosses the Ebro River.

Firstly, the bridge pavilion is very unique and distinct from other bridges by its' structural design which is a steel space frame structure that acts like trusses on one hand and transfer all the pedestrian load to the floor. It's a space frame structure-bridge that creates different spatiality at each pods, four in the number totally. Each of the pods act as both interior spaces for exhibitions and it's space frame steel structures that carry the bridge. As being a landmark in the city, Pavilion Bridge has a diamond shape section and constructed and extruded around a curved path. (http://www.zaha-hadid.com/design/zaragoza-bridge-pavilion/)

Materials: At surface design, shark scales system is fascinating both for visual appearance and for performance. In addition, this pattern can easily wrap around complex curvatures with a simple system of rectilinear ridges. The exterior or outer skin of the pavilion is divided into two elements; the lower deck is made of structural metal plates, and the higher level consists of a cladding system of a glass-reinforced concrete (GRC) panels in various shades form white to black. (Fig.12-13) (http://www.zaha-hadid.com/design/zaragoza-bridge-pavilion/)

Construction Description: The foundation piles of the bridge Pavillon are the deepest ever constructed in Spain with 68.5 meters. Almost 62.500 steel structure elements have been prefabricated in nine metal-fabrication workshops and subsequently assembled on site.

Aesthetic values: Repetition of pods creates a rhythmic sense and by using diverse sizes at pods variety principle appears. Bridge suits with a harmony by its environmental scale and height, and has a texture value by the innovative materials that used both at interiors and exteriors. And Landmark values appear by unique construction method called; 'space frame' system at steel bridge Pavilion.

4. Conclusions

In the paper, it's aimed to demonstrate the aesthetic values of bridges which transforms them first icons then landmarks of their cities. With the help of general mapping on bridges, firstly, diverse functional usages of bridges have been revealed such as; pedestrian, bike-path, rail-road, tram, and even multi-functional building-bridges like pavilion integrated with exhibition spaces and shops in it. Than secondly, structural diversities have been analyzed and revealed such as; steel, cable-stayed, space-frame and stone, indicating the innovative construction styles of bridges that create sculptural forms. For deep case analyses, the study is limited with four important bridge analyses which all have iconic and landmark features.

A building and/or structure can be an icon by its design or its designer/architect can be an icon too, and all four cases in the paper are icons also their designers are icons too. This is the first common feature of all selected bridges that makes them landmarks. Architect Sinan,

Figure.12. Exteriors views of the bridge-pavillon, *Figure.13.Interior views of the bridge-pavillon*
(http://www.zaha-hadid.com/design/zaragoza-bridge-pavilion/)

Norman Foster, and Zaha Hadid; all of them are icon too and even known as star architects today. And their designs create landmarks in the city; Büyükçekmece Bridge, Golden Gate Bridge, Millau Viaduct, Zaragoza Bridge, and all of them have iconic features; Büyükçekmece Bridge by its huge length, its place crossing between the sea and lake, its' material harmony and its' geometric wave formal approach.

Secondly Golden Gate bridge, by its very long span which is the first in the world, cable-stayed steel construction with its orange color steel towers and by unique form which is delicate and aesthetics of its proportions. Thirdly, Millau Viaduct, by its height which is unique, passes over the town, with its high-tech steel constructions and material usages like transparent façade instruments. And lastly, Zaragoza Bridge, with its unique construction style, space frame steel construction, with its innovative material usage, multifunctional spaces as being both pedestrian bridge and exhibition center too (building-bridge), and its unique form creates a landmark theme. These are all iconic features that transform these bridges to landmarks of their region and city. To sum up, in the paper it's aimed to reveal the landmark features of bridges with some selected themes such as; by high-tech steel construction styles, innovative material usages, aesthetic formal approaches, multi-functional usage features and by their architects whom are icons too.

References:

Buchanan R., Doordan D., Margolin V.(2010), The Designed World:Images, Objects, Environments', Hirst J, 'Values in Design: 'Existenzminimum, Maximum Quality and Optimal Balance, Berg, Oxford, NewYork, pg.306

Cansever T. (2005), Mimar Sinan, Albaraka Türk Yayınları: 24, Kültür Kitapları: 2, ISBN:975-00582-0-8 (pages 267-273)

Ching, F. (1996); Architecture: Form, Space and Order, John Wiley and Sons.

Morris, C.W., (1939), Esthetics and the Theory of Signs, Journal of Unified Science , VIII p.131

Morris, C.W., (1948), The Open Self , New York, p.55.

Morris C.W. (1946), Signs, Languages and Behavior, New York, p.195.

Jencks, C., (2000), Iconic Building, Rizzoli International Publications.

Inns, T., (2007). Designing for the 21th Century-Interdisciplinary Question and Insights, 'Spatial Imagination in Design, Gower Publishing, England

Kaymakcan, M., (2006).'The Basic Design Elements and Principles Education and Applications at Graduate Degree Art Education', Master's Thesis, Dokuz Eylul University, Education Sciences Instıtute,Fine Arts Education Department.

Necipoğlu, G. (2005). The Age of Sinan Architectural Culture in the Ottoman Empire, Reaktion Books. (Sinan: Architect of Ages' (the Republic of Turkey, Ministry of Culture),Text by: Metin Sözen, Photographed by Sami Güner, Coordinator Mehmet Özel, (pages 218-225)

References of Pictures

http://goldengate.org/exhibits/exhibitarea1c.php
http://www.zaha-hadid.com/design/zaragoza-bridge-pavilion/
http://www.fosterandpartners.com
https://kantaratlas.blogspot.com/2014/12/buyukcekmece-bridge.html
https://tr.wikipedia.org/wiki/Ponte_Vecchio
https://en.wikiarquitectura.com/building/henderson-wave-bridge/
https://en.wikipedia.org/wiki/Tower_Bridge
https://www.ice.org.uk/what-is-civil-engineering/what-do-civil-engineers-do/sydney-harbour-bridge

https://en.wikipedia.org/wiki/Golden_Gate_Bridge
http://www.highestbridges.com/wiki/index.php%3Ftitle%3DMillau_Viadut
https://en.wikipedia.org/wiki/Python_Bridge
https://www.archdaily.com/185400/helix-bridge-cox-architecture-with-architect
https://en.wikipedia.org/wiki/Hangzhou_Bay_Bridge
https://www.dezeen.com/2008/06/16/zaragoza-bridge-pavilion-by-zaha-hadid/
https://structurae.net/en/structures/borough-high-street-bridge
https://structurae.net/en/structures/clyde-arc
https://structurae.net/en/structures/media-city-footbridge
https://www.archdaily.com/186214/kurilpa-bridge-cox-rayner-architects-with-arup

Journal of
Design Studio
v:2 n:2 December 2020

The Threshold of Abstraction in Beginning Design Pedagogy

Stephen Temple
Department of Architecture, University of Texas at San Antonio, San Antonio, USA,

Received: November 4th 2020, Accepted: November 14th 2020
Refer: Temple, S., (2020), The Threshold of Abstraction in Beginning Design Pedagogy, Journal of Design Studio, V.2, N.2, pp 101-110,

ORCID: 0000-0002-0926-1165
DOI: 10.46474/jds.820784 https://doi.org/10.46474/jds.820784

Abstract: By immediately being asked to work abstractly, beginning design students are investigating architecture through a pedagogy taken-for-granted by its instructors. To abstract something is to draw it out of the concrete, and unless a student is looking for this displacement, they will become disconcerted, struggle, and become lost to the design process. Abstract operations of design, when presented out of step with student self-development, can mislead and distort experience. This essay defines a student's encounter with abstraction as a threshold concept within the transformative journey of design student self-development. Writings about abstraction in artistic production by Sigfried Gidieon and Rudolph Arnheim define abstraction and provide a basis for critique of abstraction as a threshold concept in beginning design pedagogy. Challenges caused by abstraction for both pedagogy and beginning design students are investigated. Arnhem's definition of abstraction as relations between part and whole implies a pedagogical approach for learning design that positions encounters with abstraction as a transformative threshold, suggesting that a gradual introduction of abstraction can build connections through embodied experience rather than disassociations. A series of architectural design exercises will be demonstrated that are structured, as result of this study, to gradually introduce abstract operations in design through a progressively transforming sequence over the first six weeks of beginning design studio. Delivered as analogous to architecture, each successive exercise initiates an abstract design operation as an individual design choice, enabling students to learn to see part in terms of whole, toward a working, conceptual understanding of abstraction in design.

Keywords: Beginning Design Pedagogy; Abstraction in Design; Threshold Concepts of Learning; Design Learning Theory; Transformative Learning; Architectural design.

1.Introduction

Almost all beginning design exercises investigate architecture through a pedagogy taken-for-granted by its instructors, by immediately asking the student to work abstractly. The beginning design student is not only not ready for abstraction, they do not understand abstraction's mechanisms of transformation, nor how abstractions become active within a design processes they are only just starting to comprehend. To abstract something is to draw it out of the concrete, and unless a student is looking for this displacement, they will become disconcerted, struggle, and become lost to the design process. Abstract operations of design process, when presented out of step with student self-development, can mislead and distort experience, interfere with the transformative learning necessary to design education, and ultimately malign the meaning of the designed environment.

This essay will define and explore the act of abstraction as a threshold concept within the transformative journey of design student self-development, first by defining abstraction through the writings of Sigfried Gidieon and Rudolph Arnheim. Also examined will be assumptions about abstraction as a threshold concept in beginning design pedagogy, as well as the associated challenges caused by abstraction for both pedagogy and beginning design students. In particular, Rudolph Arnhem's definition of abstraction as a relationship between part and whole suggests a pedagogical approach for learning design that positions abstraction as transformative of learning. A duly considered pedagogical introduction of abstraction can build connections through embodied experience to a deeper understanding of abstraction in design processes. A series of initial design exercises will be demonstrated that model design processes in such a progressively transforming sequence over the first six weeks of beginning design studio. Delivered as discreet analogies of the architectural environment, each successive exercise necessitates initiation of an abstract operation of transformation as an individual design choice, enabling each student to learn to see part in terms of whole, toward building a conceptual understanding of abstraction in design processes.

Abstraction as a Threshold Concept in Learning Design

Learning design involves a developmental transformation of the learner, especially with respect to the frequently confounding elements encountered in learning design. For beginning design students to make informed decisions on design exercises requires development of an awareness of the source and context of their knowledge, as well as their values and feelings, within a context that enables testing and critical reflection of the validity of these assumptions.

"Transformative learning refers to the process by which we transform our taken for granted frames of reference (meaning perspectives, habits of mind, mind-sets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action. Transformative learning involves participation in constructive discourse to use the experience of others to assess reasons justifying these assumptions, and making an action based on the resulting insight." [Mezirow 2000, 7-8]

The necessity for these transformations in the beginning design student is evident in consideration of frequent student reliance on pre-conceptions in early design exercises. As Mezirow states, transformative learning occurs when students become critically aware of their own tacit assumptions amid those of others when assessing their relevance. [Mezirow 2000] Transformative learning in design thinking involves an acknowledgement that pre-conceptions must metamorphoze in order to become usefully relevant. This kind of transformation in the learner can be characterized as an encounter with a threshold concept. As explicated by Michael Tovey,

"The threshold concept theory posits the idea that within disciplines there are conceptual gateways or portals, which – due to their troublesome nature – can make it difficult for students to progress. This notion of a threshold concept is seen as distinct from 'core concepts' – or building blocks – within disciplines, as it engages with the notion of transformation. Grasping, experiencing and understanding a threshold concept will irrevocably transform a student's understanding, and this transformation can relate to the particular subject at hand, and or be extrapolated beyond the academy." [Tovey 2016, 10-11]

There are many such threshold concepts encountered as students learn to design in their initial design studios. A little recognized threshold concept in design learning is the confrontation with abstraction in the form of drawing, modeling, and design operations, especially when creative and/or conceptual design thinking is initially called for.

The Threshold of Abstraction in Design Learning

Architectural designers imagine the world by use of design activities using drawings, models, and diagrams as instruments of production and communication but also as a means of anticipating how we experientially situate ourselves in the world through engagement of body, mind, and imagination. Architectural design utilizes of these kinds of representations, as abstractions of the form and construction of buildings, and simultaneously to imaginatively visualize spatial and social experience. [Sweeting 2011]

The term, 'abstraction' as used in this essay does not a refer to an aesthetically abstract appearance but is instead concerned with processes of abstraction. Some definitions of abstraction will be explored as a means of describing its effect in design. Abstracting is a progressive transformation away from any concrete actuality drawn out of the concrete world as a continuum from the particular and sensorial to the general and even symbolic. [Seabury 1991] Sigfried Giedion defined abstraction as an active mechanism of transformation of physical reality in which there is a "distillation of the essential elements from an intangible multiplicity of forms." [Giedion 1962, 10] Giedion defines the act of abstracting as "withdrawal" from the particulars of an object in order to pick up its general essence out of the vast abundance of inputs available within perceptual attention. The act of abstracting also isolates one aspect of an object from all other aspects of the object in order to separate part from whole, this for the purposes of perceiving significance in relations *between parts* instead of subsuming them unto a greater whole. The complexity of particulars and relations is resolved for Giedion through the main tenant of Gestalt psychology - the whole is greater than the sum of its parts. Giedion finds that the concrete perception of a thing comes when "the parts are derived from the whole, which alone determines its character." [Giedion 1962, 14] Giedion's primary interest is in abstraction in art forms for the role it plays in which the everyday appearance of the subject is transformed by abstraction into symbolic essences. Abstraction thus occurs as a simplifying and distilling concentration of form within transparency, simultaneity, and movement. These effects, if abstractly withdrawn far enough from the actual, recognizes a signification of universals as "magical symbols" in which abstraction can become transcendent. [Giedion 1962, 24] Giedion's concern for abstraction is to describe the use of abstraction in the analysis of artistic production within a historical, anthropological, archeological context and does not refer to the means of production or the concerns of the producing artist. [Giedion 1962]

A later contemporary, Rudolph Arnheim, describes the act of abstraction as a removal, "since the verb *abstrahere* means to actively draw something away from somewhere and passively to be drawn away from something." [Arnheim 1969, 153] Arnheim articulates abstraction as an act of generalization, developing in abstraction a generative conceptual order, as "an act of restructuring through the discovery of a more comprehensive whole." [Arnheim 1969, 187] Arnheim views representation in acts of artistic production as an active and instrumental restructuring of the processes of abstraction in perception:

"Percepts are generalities from the outset, and it is by the gradual differentiation of those early perceptual concepts that thinking proceeds toward refinement. However, the mind is just as much in need of reverse operation. In active thinking, notably in that of the artist...wisdom progresses constantly by moving from the more particular to the more general." [Arnheim, 1969, 186]

Arnheim views representation and engagement in design as part of the same cognitive activities. However, students new to design thinking are unaccustomed to separating part from whole, or concentrating a distilled (abstract) view of experience, especially as an act of conceptualization. A more instrumental definition utilizing relations between part and whole is when abstraction is used as a technique to reduce the complexity of a problem by removing irrelevant properties while retaining the important ones necessary to still be able address a given problem. [Ponson 2010] A primary agent of transformation bound into design processes, abstraction becomes active as a reduction, simplification, and in the language of design, conceptualization. Information is lost in abstraction in the interest of conceptualization. To use abstraction as a transformative device within design, a designer must come to recognize its distancing effect from both physical reality and actual experience, and thereby the meaning of engagement in living experience, or as characterized by Juhani Pallasmaa, "the silent understanding that lies hidden in the human existential condition and our specific embodied mode of being," [Palassmaa 2009, 22]

Abstraction as a Threshold Learning Experience

Abstraction has continued to be a fundamental issue in design pedagogy due to traditions from Bauhaus and art-school pedagogies and curricular bias toward satisfying needs of more complex designing later in a curriculum. Learning to use abstraction as an instrument of design is also one of the most important threshold encounters in early design learning, encountered as students first engage abstract operations within iterative processes of design. Most students enter into design programs with a limited critical view of their experience in the world and only a vague, uninspected comprehension of abstract processes that bring about that world. Beginning design students are instead engaged in seeing the world through symbolic appearances rather than how things really are. The observer of appearances sees only wholes as a relationship to categories of prior experience as the thing known, instead of the characteristics of the thing itself. Perceiving the world becomes valued as part of symbolic reordering of the world as a personal, subjective venture. (Vesey 1976) A designer does not just manipulate the appearances of the designed world for purposes of symbolic engagement but is responsible for all the constituent qualities of material things that in the end are the subject of experience. Learning abstracting as a part of design thinking is disruptive and frequently becomes an ordeal for new students as they encounter abstraction's distancing from the real. This experience often leads to the undoing of personal meaning in experience. As students become untethered from their ontological anchorings, many become unable to realize the substance of first design experiences.

Abstracting from the actual content of both architecture and experience is potentially an advantage in mature design activities but it presents great difficulties to learning in beginning design pedagogy. However, beginning design pedagogy takes for granted that the abstracting of issues like 'form' from the wholeness of architecture is not natural to everyday experience, when in fact it is raising an encounter with the threshold of abstraction. While abstraction has the potential to enable the dissolution of preconceptions about architecture, abstraction instead confounds those prior conceptions that might otherwise be drawn out of the experience of the world, leaving only ungrounded abstractions in its place.

In student experience of design pedagogies, issues like 'form' often become an abstraction in-itself, leaving an impression that architecture should look and act abstractly. The 'form' of architecture does not operate in experience separate from myriad other aspects of the surroundings that influence the constitution of experience. Architectural design pedagogies that overly stress abstract process place abstraction out of the developmental context of a student's movement through a design curriculum, devaluing experience with an impression that abstraction, not the building itself, is the substance of design. If abstraction is presented without connection to its origins, students can be led to the idea that architectural activity is principally only a mental operation of thought. With little development of heuristic mechanisms to help them design, or any measure of the awareness of the difference between representation, appearances, and reality, beginning design students have trouble navigating cognitively from concrete to abstract thinking to begin to construct operational design structures to manage the abstract components of design processes. Instead, when recognized as a threshold learning experience, encounters with abstraction in beginning design learning experiences can provide an opportunity to reveal abstract transformative operations as a reduced aspect of architecture that can be clearly grasped, experienced, and understood.

A Series of Design exercises that Engage the Threshold of Abstraction

The role of the threshold of abstraction in design student development is commonly overlooked or assumed in design pedagogy and curriculum, often in favor of disciplinary traditions or uninspected faculty preferences for their own beginning design experiences. Without a pedagogy presenting a clear understanding of abstraction and its operations in design processes, students are left on their own to 'get it' or figure it out for themselves later in the curriculum. To the contrary, it is an obligation of beginning design pedagogy to place students into such 'troublesome' design situations where threshold issues like abstraction can be encountered, explored, and comprehended as transformations of learning. Beginning studio exercises that stage encounters with threshold concepts offer comprehension of abstraction and transformation of preconceived notions of design in the context of critical discourse of the work of others. However, the encounter with the threshold of abstraction cannot be realized within a single design exercise. Just as abstraction is drawn from reality in stages of transformation, grasping the operations of abstraction on design learning best occurs in slow, deliberate transformations of the seeming concreteness of everyday experience in which students are comfortable.

In realizing a more gradual engagement with abstraction, the initial six-week project was structured into a progressive sequence of exercises drawn out of the architectural environment but are not representational. Differing yet concise abstract operations transform each preceding iteration to progressively engage greater degrees of issues like geometry, volume, space, mass, frame, and panel. Each successive stage necessitates design choices made by each student to comprehend and initiate each abstract operation of transformation, as a means of developing a personal stake in that stage and in the role of abstract operations through the entire process. In applying each abstract operation in relation to previous iterations, students learn to see part in terms of whole, while also learning not to be deterministic about the next steps. Making design decisions always with respect to a previously transformed iteration enables a conceptual understanding of the abstracted nature of architectural form.

The exercises are hands-on design learning experiences, engagement that necessitates execution in direct resolution of idea/concept and material. In hands-on efforts, flaws in making are clearly exposed, often as a direct critique of a concept materialized through design thinking and also when compared to other students solutions. As stated by Robert McCarter, hands-on design exercises operate to, "bind together thinking and making, engaged and embodied in the action of building." [McCarter, in McKay-Lyons, 2008] Hands-on exercises place the student directly into the role of designer, with process and result of decision-making bound up in thinking and making, and in comparative project review.

Exercise 1 - First in the sequence of exercises happens on the first day of the initial design studio course. Given a three-foot piece of tie-wire and a rock, students are told to make an 'orderly support for the rock.' Using no tools other than the hand, the rock must be one 'fist' from the table surface. (Figure 1) Critique of this project is focused on motives for design decisions, play, conceptualization, and workmanship. The second aspect of the project is to transform the concept of the project by using paper, with no glue, instead of wire. It is made clear in project review that material transformation is an abstract operation. [Temple 2009]

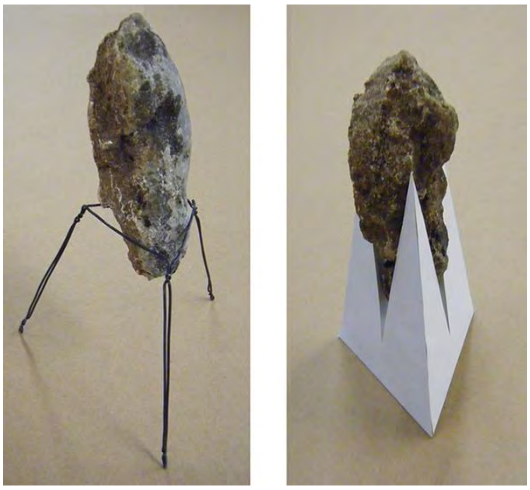


Figure 1. Ex. 1 – Place for a Rock.

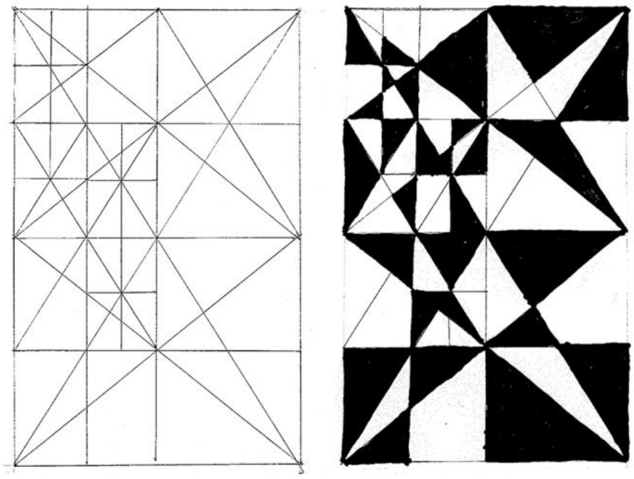


Figure 2. Ex 2 – 3D to 2D transformation

Exercise 2 - Students are asked to make a drawing of the paper place for a rock exercise as the first step in the next transformation. Most have limited drawing skills and draw a portrait of the project (not shown). The "Bull Profile Series" (1973 not shown) by artist Roy Lichtenstein is an example of abstract transformation from a drawing of only a figure to the figure abstracted into the geometry of the rectangular drawing field. The final stage of this transformation asks students to make choices in darkening every other geometric space to produce a black and white value drawing. Review points out that this project is analogous to analyzing a site and using geometric regulation in developing plans and elevations.

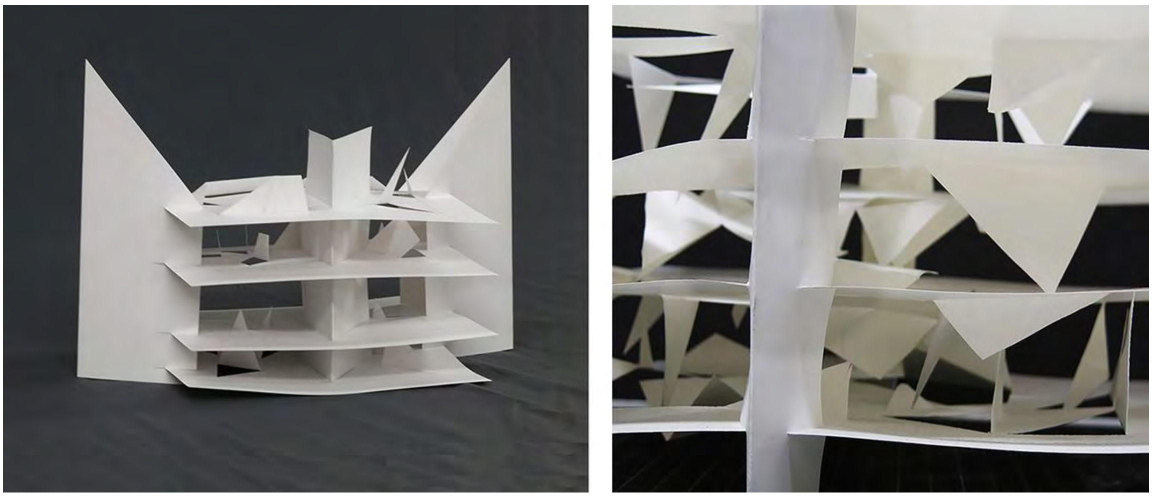


Figure 3. Ex. 3 – Spatial assembly using stacked, cut-out geometric patterns and view of interior space

Exercise 3 – The 2 dimensional geometric transformations represented in the geometry of the value drawing are first cut-and-folded into a relief regulated by the geometries. Four cut-and folded-layers are stacked and separating supports are designed regulated by the extension of internal geometries. Students hold the constructions up to their eyes and use their cameras to photograph and film the interior spaces. A lecture compares the resultant construct to existing buildings like the Herzog & de Mueron Miami parking garage.

Exercise 4 & 5 - The second sequence of exercises begins by abstractly developing a portion of the geometries of the value drawing by stacking geometrically derived layers into a 3-diimensional solid, which becomes an example of the relations between mass and space in architecture. The second abstract operation is a material transformation using wooden sticks to capture the space of the solid form. (Figure 4) Wood construction provokes understanding of workmanship and joinery as significant to architectural form. A lecture follows showing steel frames and other buildings using these components.

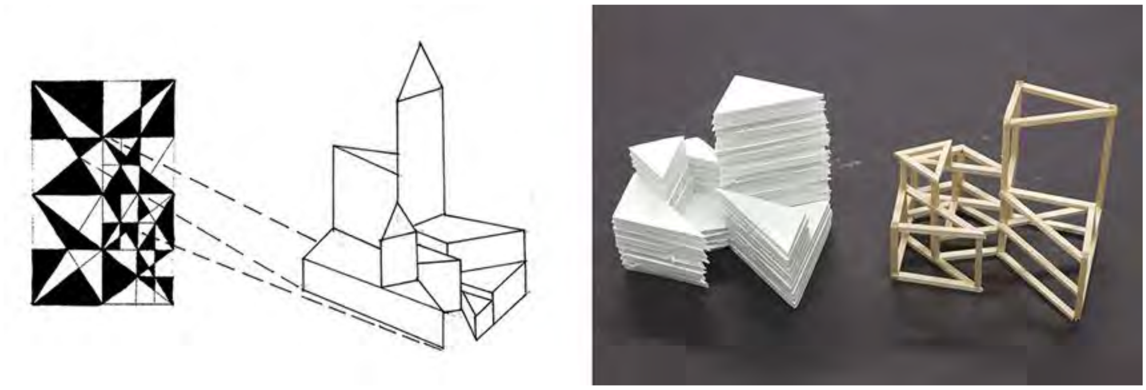


Figure 4. Ex 4 & 5. Transform into layered solid, followed by material transform (in wood)

Final Exercise: Preliminary - The beginning of the final sequence of exercises requires pouring two plaster blocks in a volume of 2” x 3” x 2” high, regulated by rectangular and diagonal lines on a 1” module. The two different plaster bocks are then placed in alternate arrangements to observe formal and spatial variations by constructing tacit spaces around and between them due to formal variants in the blocks. In review, these various arrangements present an analogy to the manner in which building masses construct spaces. All plaster forms are arranged into streets and city blocks to develop relations to scale.

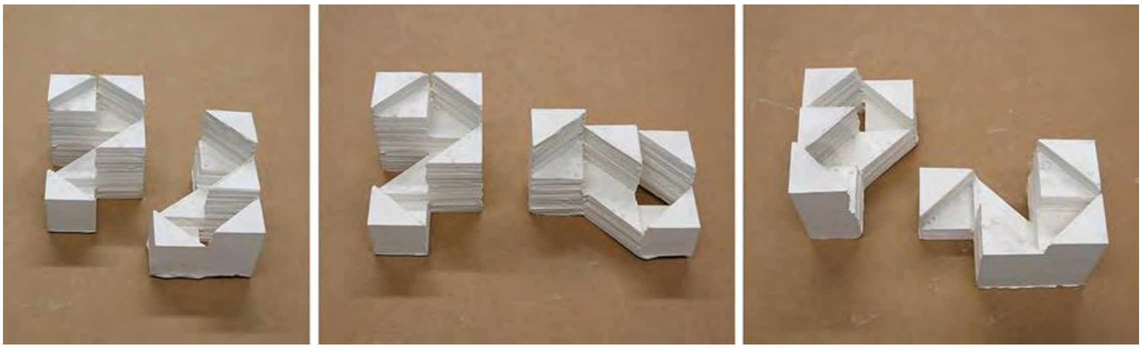


Figure 5. 2” x 3” x 2” high plaster blocks in three alternate spatial arrangements

Figure 6. System of mass, frame, and space. Left – blocks frame added. Right – blocks at eye-level with frame and panels added

Final Exercise – Exercise parameters ask for design of a 'system of mass, frame and space,' by adding wooden frames to amplify the spatial development of the entire form as implied by the arrangement of the plaster blocks (Figure 6). Another transformation asks students to add panels to the system to emphasize and transform the spatial nature of the plaster and wood construction. Students clearly recognize that these components act systematically like mass, and frame, and panel systems in building design. Students are required to photograph the final construction both as an object and as at a simulated eye-level scale. This photographic process transforms the construction from an abstract object into an experientially scaled conceptualization of a building. A final lecture compares the resultant constructions to existing architectural designs.

Discussion and Implications of The Threshold of Abstraction

Students recognized the progressive abstract transformation in realizing their final work was derived from the exercise of the first day. This recognition acknowledges that the iterative, developmental process of creative design thinking in the entire sequence was analogous to design, especially regarding the transformative nature of abstract operations amid their own transformation as designers. Despite direct representation not being part of the exercises, students worked readily with abstracted geometric regulation, illusions of depth and layering, mass, space, and frame as 'stand-ins' for components of actual architecture. Because the exercises in form were framed as analogous to architecture, student design decision-making about these issues occurred without interference from issues raised in the fullness of architectural experience. Critical to student navigation of the threshold of abstraction was a realization they can switch back and forth between perceptions of the object as thing and scaled model. As a hands-on construct analogous to the way that architecture acts in full-scale, the applied knowledge in making these exercises was readily absorbed as a conceptual design foundation.

Working with form distilled abstractly from architecture asks the beginning design student to work abstractly with little understanding that form is being used as a pedagogical artifact of architecture. Abstractions stand for other things, ideas, or perceptions, and as such, can create distance that reduces experience only to thought, far from the fullness of experience. A primary difficulty in learning to design happens when abstraction is taken as *different from* reality, rather than its *connection to* reality. An idea that interaction with architectural design happens abstractly, mentally, with little association with the actual concrete reality of architecture in experience leads to design thinking that disassociates architectural design decision making from responsibility toward the fine-grained complexity of experiential, socioicultural, environmental, and material forces.

Abstraction is a central issue of beginning architectural education because coming to terms with abstraction is an early demand of learning design, with the intention that students learn new modes of abstract representation as instruments of design process, to see the world through abstraction, to think through abstraction, and use it to communicate an imagined architecture. [Sweeting 2011] Beginning design pedagogy must recognize the challenges beginning design students experience in coming to terms with how abstraction becomes operational as a threshold concept of learning. Because most students enter beginning design education unfamiliar with abstraction and with ineffective abilities to think or work abstractly, beginning designers need to be gradually drawn toward abstraction in a period of acclimation, in opposition to the way abstraction draws away from actuality, to retain its essential groundedness in the real. As a threshold concept, learning is transformed by comprehension that abstracting the world opens up new interpretations, possibilities, and range of content. However, it also conflicts with each student's previously known, comfortable, yet uninspected way of seeing the world that, instead of giving clarity, tends to be experienced as an unwarranted initiation of confusion.

Curriculum design is often thought of as an orderly presentation of core disciplinary concepts, within an increasing complexity from foundation to discipline-specific levels correlated with movement through sequences of courses. Threshold concepts however, are distinct from 'core concepts' of a discipline, as threshold concepts engage with transformations of learning while disciplinary concepts do not necessarily do so. Beginning students are novice learners who grow into advanced novices at the second level, but are in no way thought to be developing expertise. [Perry 1998] Developmental learning theories suggest that initial experiences in a college curriculum that are direct and experiential in nature are most consistent with student learning maturity level. [Perry 1999] However, encountering abstraction too early in a student's development can prioritize abstraction outside of readiness to work in this manner. At the beginning of a design curriculum, curricular concern for student development must be much greater than the conveyance of disciplinary concepts because of the need for learning experiences that transform student development. The sequence of exercises presented in this essay serves as a threshold for the recognition of processes, abstract operations, and the opening of ideas that transform student learning, making beginning design students more receptive to and mindful of their own design inquiries.

Realization of intellectual boundaries and recognition of new potentials is part of the educational process inherent in discovering the operative nature of abstraction in design. Within the educational structure, limitation to the abstraction of an issue like form can seem a well-reasoned, strategic pedagogical reduction to just the amount of content with which a beginning design student can grapple. However, first design experiences must present abstraction in a manner that enables students to both accept its abstract distance from actuality and to learn to think by way of its artifice while hindering misplaced notions that abstraction in-itself can result in complete architectural proposals. The basic value of beginning design pedagogy as a foundation of a design curriculum is not to teach students what or how to think, rather it is in teaching them to value thinking through creative processes and that this thinking must become disciplined and spring from an enabled sense of self-development.

References

Arnheim, R. (1969). *Visual Thinking*. Berkeley CA: University of California Press.

Giedeon, S. (1962). *The Eternal Present: 1. The Beginnings of Art, 2. The Beginnings of Architecture.* New York: Bollingen Foundation.

Hoare. Carol (Ed). (2006) *Handbook of Adult Development and Learning*. Oxford, UK and New York: Oxford University Press.

Land, Ray, and Cousin, Glynis, Meyer, Jan H.F. Davies, Peter. (2006) "Implications of Threshold Concepts for Course Design and Evaluation." in *Overcoming Barriers to Student Understanding: Threshold Concepts and Troublesome Knowledge.* By Meyer, Jan H.F. and Land, Ray (Eds), London and New York: Routledge, 2006.

Lawson, Bryan. (2019) *The Design Student's Journey: Understanding How Designer's Think.* New York and London: Routledge.

McCarter, Robert, (2008) quoted in McKay-Lyons, "Ghost: Building an Architectural Vision" Princeton Architectural Press, 193.

Meyer, Jan H.F, and Land, Ray, and Baillie, Caroline (Eds) (2010) *Threshold Concepts and Transformational Learning.* Rotterdam, Netherlands: Sense Publishers.

Mezirow, Jack. (2000) *Learning as Transformation: Critical Perspectives on a Theory in Progress.* San Francisco, CA: Josey-Bass: A Wiley Company.

Osmond, Jane and Turner, A. The Threshold Concept Journey in Design: from Identification to Application. in Jan H.F. Meyer and Ray Land and Caroline Baillie (Eds). *Threshold Concepts and Transformational Learning* (pp: 347-364). Rotterdam: Sense Publishers.

Perry, W.G. Jr. (1998) *Forms of Intellectual and Ethical Development in the College Years: A Scheme.* New York: Jossey-Bass.

Ponson, Marc and Taylor, Mathew E Taylor and Tuyls, Karl. (2010) "Abstraction and Generalization in Reinforcement Learning: A Summary and Framework," in *Adaptive Agents and Multi-Agent Systems IV, LNAI,* Springer-Verlag, 1-33.

Seabury, Marcia Bundy. (1991) Critical Thinking via the Abstraction Ladder. *The English Journal Vol 80 No. 2.* National Council of the Teachers of English, 44-99.

Sweeting, B. (2011). Conversing with Drawings and Buildings: from Abstract to Actual. *Kybernetes Vol 40 No 7/8*, 1159-1165.

Temple, Stephen. (2009) Initializing the Discipline of Design in the First Project(s). *Proceedings of the National Conference on the Beginning Design Student,* Louisiana State University, Baton Rouge LA: College of Art and Design, 207-214.

Tovey, Michael, and Osmond, Jane. (2014) Design Pedagogy and the Threshold of Uncertainty. *International Conference of Engineering and Product Design Education.* The Netherlands: University of Twente.

Tovey, Michael (Ed.) (2016) *Design Pedagogy: Developments in Art and Design Education.* London and New York: Routledge.

Vesey, Vesey, Godfrey N.A. 1965. "Seeing and Seeing As." In Perceiving, Sensing, and Knowing edited by R. J. Swartz, 68–84. Berkeley CA: University of California Press.

Journal of
Design Studio
v:2 n:2 December 2020

The Concept of Limits in Architecture as an Instructional Tool for Design Education

Aysenur Hilal Iavarone
Istanbul Kultur University, Faculty of Architecture, Department of Architecture, Istanbul, Turkey (Corresponding author)
Emel Birer
Istanbul Kultur University, Faculty of Architecture, Department of Architecture, Istanbul, Turkey

Received: October 21th 2020, Revised: November 26th 2020, Accepted: November 29th 2020
Refer: Iavarone, A. H., Birer, E., (2020), The Concept of Limits in Architecture as an Instructional Tool for Design Education, Journal of Design Studio, V.2, N.2, pp 111-130,

A.H. Iavarone ORCID: 0000-0001-9838-8098, E. Birer ORCID: 0000-0003-0152-3690,
DOI: 10.46474/jds.814390 https://doi.org/10.46474/jds.814390

Abstract: The paper aims to re-thinking limits in architecture through an educational approach. A study on the concept of limits in architecture provides an understanding of architecture's sensitivity, responsibility, and bindingness. To investigate the effect of limits on design, the paper has conducted a discussion of a design studio experience as a case study. As a method in the study, an architectural design studio where students are asked to produce architectural solutions by giving physical legal, and social limits has been established. In the architectural design studio scenario, Garipce Village, a fisher village located on the border of Istanbul and a first-degree protection area by the Bosphorus zoning laws, was given as a design problem to second-year architecture students. The design solutions that the students brought to the limits of the village both exemplified how architectural design sought an answer to the limits and demonstrated how to approach rural areas. The limits of conservation areas, the social implications of the conservation sites, and the physical limitations of the village compose a limitation set for the design problem of the rural area. The outputs of the design studio are discussed in the context of architectural solutions for limits. The results revealed how questioning the concept of "limit" transformed students' learning experiences in the design studio. It has been observed that the act of designing with limits improves students' awareness, strengthens the relationships established with the context, and incorporates the social dimensions of architectural design into the design.

Keywords: Architectural Design Studio; Architecture in Conservation Areas; Rural Architecture; Limits in Architecture.

1. Introduction

Limits are the fundamental problem that the designer frequently encounters in questioning the perception of design and concern all design processes from space to urban scale. The design limit is also a determinant of architectural design. Design studios, where the limits of architectural design are discussed and solutions are developed in this context, are educational areas that focus on the solutions of the problems shaped by the limits.

In architecture, the concept of limits refers to many restrictions in architectural design. The design is ordinarily limited by physical borders, local zoning permits, natural and historical conservation site regulations, construction rules etc. The limits in architecture sometimes appear as material choices, structural system difficulties or economic limitations. The user of the design is a limit as wells as the nature of the site. Indeed, as John Locke (1689) said “Where there is no law, there is no freedom". A common spur in any creative process is a limitation, of any kind: formal, functional, constructive, etc.

In this context, the concept of limit as a reality in creative processes and a driving force for design has always been an instructive element in the nature of architecture. From this point of view, the limits of design turn into paradigms to be solved in architectural design education. In the context of this conceptual framework, the theoretical background of the study is considered and associates the concept of limit in three contexts: the concept of limit in design; limit concept in architectural design; The possibilities of limits as an instructional element in an architectural design studio.

The paper opens a discussion in the context of architectural design studio over architectural design limits. In a scenario where the concept of limit in architecture is placed at the center of the architectural design problem, it is investigated how limits can turn into an instructive element in the design. After discussing how limits shape architectural thought and how they guide creative processes from a theoretical framework, this article aims to reveal the educational aspect of limits in design education over the limits of a village in Istanbul through the architectural studio. In this article, we discuss “the concept of limits” in architecture as a learning support tool in design thinking. In the scope of this article the limits are considered as instructional tool elements of architectural design. The designer is surrounding by the limits in the real world during the creative process of thinking, and thus he/she cannot be in the position of a creator without the limitations of the nature of the design. This awareness not only affects the designer's ethical values such as worldview, environmental awareness, and social approach but also shapes the formal and phenomenological existence of design. Therefore, it is an obligation for design education to conceptualize the system of limitations on design for students of design. This understanding brought us to consider the concept of architectural design in the architectural design education curriculum.

2. Theoretical Background

2.1. The concept of limits in architecture

In order to investigate the didactic effects of limits mentioned above, it is necessary to define the limit in a conceptual context. First of all, to define the importance and possible instructional features of the limit concept in architectural education, it is necessary to focus on the concept of limits from the design and architectural perspective first. Therefore, the concept of limit, which establishes the conceptual background of the study, constitutes the theoretical background under three main headings for this research. These headings are "limits in design", "limits in architectural design", and at last, conceptualizing the limits as an educational tool in the architectural design studio.

Limit is located in the intellectual and operant background of design creation with adjectives such as determinant, guide and developer of design. It has been tested in creative fields that certain limitations trigger the creative process of design. There are cases easily extrapolated to the world of architecture, such as Oulipo in literature. This group utilized mathematics and grammar to combine a series of limitations, initially random, that served to trigger the writing of the books. The book "Exercices de style", by Raymond Queneau (1947), one of the authors of the Oulipo Group, reveals how limitations trigger creative thinking. Oulipo related mathematics and grammar to combine a series of limitations, initially random, that served to trigger the writing of the book. Queneau described the same story in 99 different ways, by using different Oulipian techniques in "Exercices de style" and created an advance formal constraint for text. The reproduction of a single story by restricting it to different narrative forms sets an example of how creative production can multiply with predetermined limits.

Every being exists and differs with its limits. There are limits in everything we observe in nature; There are boundaries of assets from micro scale to macro scale (Mumcu Ucar and Ozsoy, 2006). In addition, the concept of limits can have non-physical meanings. The existence of non-physical limits can be understood through relational context. The term “limit” cannot be positioned outside a relational structure (Dincer & Aydınlı, 2016).

Substantially, if there is a limit between x and y, x stands as the reason of y`s becoming. The concept of limit, with its physical and relational meanings, can also refer to the elements and relations in the production and theoretical background of the structural environment. "The border provides the possibility of combining many different aspects of architectural action and space and works to emphasize the connection of space with people from all sides. The border is more than a two-dimensional line." (Mumcu Ucar & Ozsoy, 2006, p. 12, translated by authors).

The concept of limits also appears as physical boundaries in architectural design thinking. Since there are boundaries in every element of nature, human beings first saw, used, and learned by natural boundaries. The possibilities of the boundaries, arranged by humans, provides the design inspirations (Mumcu Ucar & Ozsoy, 2006). The physical limits, the boundaries, determined by the expansions of the boundaries exist at all levels of the environment. Thus, openings that present spatial structures, such as windows, walls, thresholds, transitions, are designed. The physical concept of limits can also be related to the physical difficulty of the architecture which is directly related to the structural system design. Since the limits of the laws of physics are directly related to the carrier limit of the material, they have historically been seen as the main factor affecting design. For instance, the fact that the dome form, arising from the limitations of the carrier system technologies, has shaped architecture for hundreds of years.

Another approach brought to the topic is that the transformation of architecture, as Savasır (2008) suggests, is redefining the limits of discipline. Savasır (2008) explains how avant-garde formations during the 1960s have re-conceptualized the limits in architecture by changing, folding, multi-layering, cutting out, and transform the architecture is that is known. It can be argued that the architectural styles emerged from the instinct to change the limits, as Savasır (2008) described the idea of reconsidering the limits in architecture, which he defines through the example of avant-garde style. “Cross-limits” as an attitude in architecture appears in Stephanie Riker's reading of Bernard Tschumi. Riker (2013) interprets Tschumi's innovative and extraordinary approach as building with the intention of redefining the concept of architecture and transcending the limitations imposed by society. Tschumi explores how drawing upon exterior concepts will breach the limits of architecture. As seen in his definition of architecture, limits are challenges, and yet, the limitation of architecture continuously challenged by Tschumi.

Architecture is mentioned with limits since it is also not independent of laws and regulations in construction practice. In terms of construction restriction and site area regulations, architecture, as the design process and as the construction practice, is limited by the local regulations, zoning laws, and legal restrictions. In other words, architecture is based on the concept of construction limitations and laws. The architectural practice, which is limited by many factors such as earthquake regulations, fire regulations, elevator regulations, parking regulations, zoning law, urban planning, cannot exist with new spatial formations, especially in places declared as protected natural and historical site areas. Although site area restrictions are significant for protection from possible undesirable settlements, there are negative consequences that site areas face such as losing the social and economic standards and come to the brink of extinction. Therefore, the consequences of the regulation also can be considered as another sort of limitation.

As can be seen, the concept of limit in architecture theory and practice makes transitions between meanings and has different meanings within different relationalities. What is certain is that the architectural design process, the knowledge of making, and the built environment cannot be thought of without borders. On the other hand, the concept of limits and design has a dynamic relationship that triggers creative thinking.

2.2. "Limits" as a Tool in Architecture Design Studio

As seen in the study of the concept of limit in architecture, architecture is not independent of borders, but the limits of architecture exist as a kind of driving force that causes the development and learning of architecture. It can even be said that in the examples existing in the literature these limits are "challenges" that lead to design thinking.

Feigenberg (1991) suggested that architectural education should focus on the enhancement of their ability to think critically and to learn how to learn. With a similar approach, the concept of "limits in architecture", which restricts, controls, directs and develops architectural design, is seen as a part of the critical thinking structure of architectural education. These approaches have encouraged us to research by placing the limits in architecture within a realistic scenario in architectural design studio training.

As Ockman (2012) has stated, architecture school is where the architecture in all its disciplinary and professionally cognates, is where collectively constituted. Based on this perspective, we suggest that the architecture design education is responsible for introducing the limits and responsibilities of design to candidate architects. Within the architecture school, architectural design studios are areas of discussion and production where this responsibility is assumed intensely. According to the outputs of Uluoglu's (1990) work, the design studio is the most important area in the architectural education program. For this reason, the architecture design studio is generally given the lead role in architecture education and it is considered as the core of the architecture school curriculum (Lawson and Dors, 2013). Fatouros (2002) describes the design studio as a discussion area where people come together to ask each other questions, think together, and develop various relationships. Senturer (1994) defines the design studio similarly; a place where knowledge and skills are tried to be given to the participants. Therefore, these are the environments where the limits of architectural design are transferred to the designer candidate with the established design problem in the context of legal, structural, physical and social limits.

In addition to this major impact on architectural education, the design studio is also responsible to create awareness about urban context, current constriction regulations, and future architecture scenarios. Most importantly, as Feigenberg (1991) stated that architectural education does not focus on students' retention of facts and formulas, but rather on the enhancement of their ability to think critically and to learn how to learn. For this reason, the design studio should be an environment where the limits of architectural design are critically discussed as well as they are described and introduced to the students.

The nature of design is a process that involves phases of analytical understanding, critical thinking, and creative decision making (Salama, 2005), and it is taught to students in the design studio with the design problems given to develop these capabilities. Yucel and Aydınlı (2015) note that the architectural education is also an education that aims to increase the level of awareness, therefore, their social and environmental sensitivity, to gain critical thinking skills, and to train intellectual professionals. As it is descripted, the design education is "The issue of creating an environment for discovering, integrating, sharing and applying the lifelong knowledge to nurture the learning habit and mind structure" (Yucel and Aydınlı, 2015, p.18, translated by the author). Therefore, the ability of the individual to understand, internalize knowledge and skills should be evaluated under the responsibility of design education. In contemporary architectural education, this design learning takes place in design studios where students encounter design problems, find solutions by experimenting, and learn to learn.

The nature of architecture design studio is based on students' experience on a given design problem. Because of this nature of the studio, the design-related skills, and fundamental inclinations that are acquired in these studios influence the future designing actions of the students (Kararmaz & Ciravoglu, 2017). As Shaffer (2003) suggests, three basic components of the design studio, "how a student's progress is judged, what kinds of behaviors are rewarded and, what the discipline values and/or rewards", are carefully chosen during the organization of design studio. Therefore, the main expected behavioral changes of the students are organized according to the given design problems and approaches. This awareness suggests that the design problem given in the design studio will change the approaches the student will develop in the future.

Figure 1 shows that based on literature, studies that reveal the role and values of the architectural design studio in architectural education, this study focuses on the concept of architectural limits included in the architectural design process, through the architectural design studio. In line with this focus, limits, which constitute an input for the architectural design problem, are considered as an instructional tool of the architectural design process (Fig. 1). For this purpose, the following chapters explain the architectural design studio that has been designed where the concept of limits forms the design problem. The basic principle of the designed studio is to consider more than one architectural limit simultaneously within the

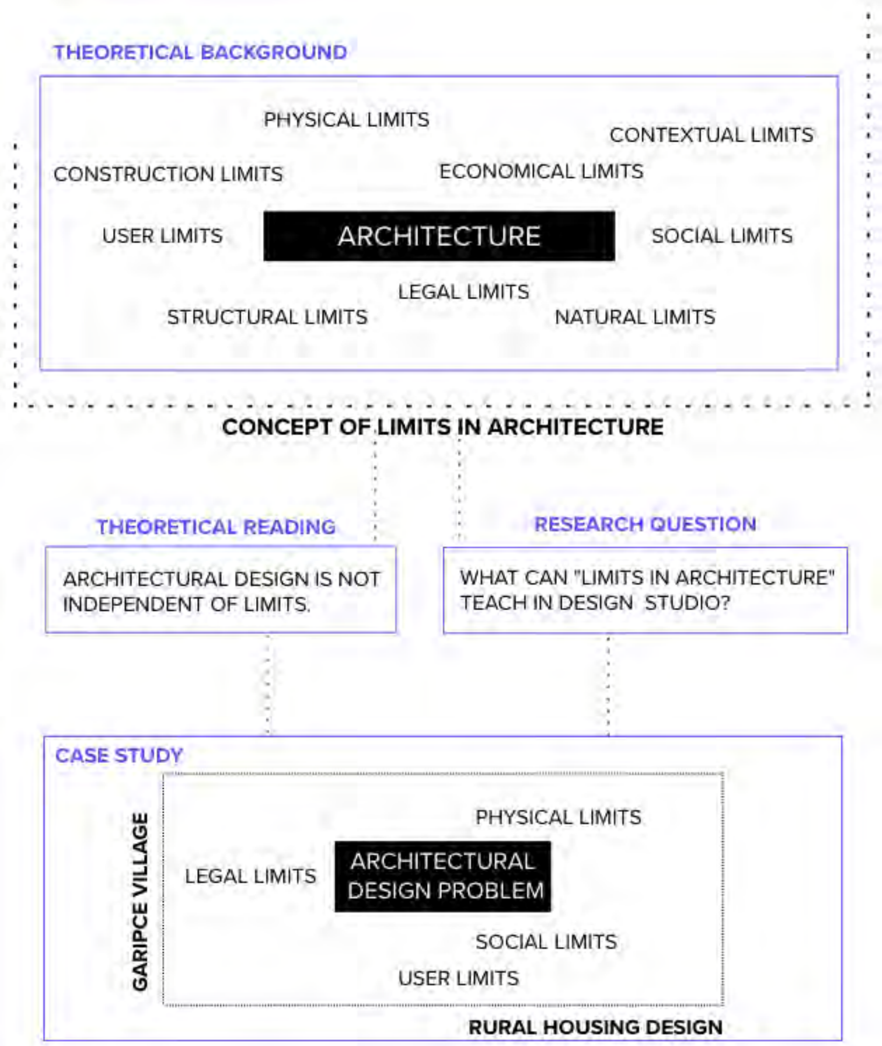


Figure 1. Transferring the concept of the limits of architectural design to the case study.

design problem and use them as instructional tools of design.

3. Method

Within the scope of this study, it is aimed to test the above-mentioned approach with an architectural design studio setup where the limits of architecture are discussed and considered as a design element. Although architecture design studio is based on solving a design problem and creating an idea for the design of a building, it is also an environment to develop an attitude toward the built environment. For this reason, it is considered the right place to conceptualize the limits of architecture and discuss the idea of limits as an instructional tool. With this motivation, in order to understand the limits of architecture and how it can be used as a tool in architecture education profoundly, presenting studio experiments would be explanatory.

Architectural Design III course, which is the third term project in the curriculum of the Istanbul Kultur University Architecture Department, is a residential design project. In this context, giving the subject of "limits in architectural design" as a design problem, as an approach that restricts the residential design and at the same time narrows the existing design criteria, determines the main framework of the studio. For this purpose, the context of the design studio has been determined as Garipce Village, a small fishing village located in the north of Istanbul. Garipce Village is located near the Bosphorus so that as the conservation area, it is limited in many ways. In addition to conservation laws, the physical and social limitations of the village dominate the housing design problems. This area, with the architectural and experiential features it displays both for limits and in terms of rural architecture, offers a laboratory environment to designers. In this way, it is aimed to create an experimental environment that includes the limits of the design in the basic instructional mechanism of the studio has been set up by limiting the housing design through context, needs, legal obligations, and users.

The method of the research, which aims to reveal the instructive aspect of the concept of border in architectural design education, consists of three main parts: Determining the area that will constitute the context for the residential design of the Architectural Design III course with its limits; determining the limits of the field and asking the students to suggest solutions; Evaluation of design proposals and studio process. The case study created from the architectural design studio and the design

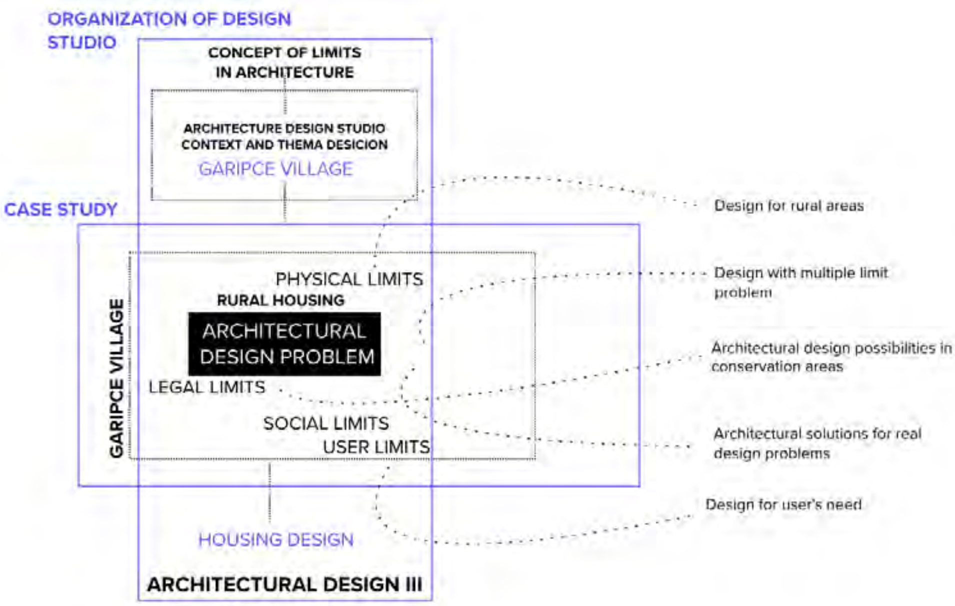


Figure 2. The setup of the architectural design studio that created the case study.

problems it contains are summarized below (Fig. 2).
The case study created from the architectural design studio contains instructive aspects within the limits of the design problem. These instructional parameters are can be categorized as the design for rural areas, design with multiple limit problem, architectural design possibilities in conservation areas, architectural solutions for real design problems, and design for user's need (Fig 2). The characteristics of Garipce Village, which is thought to provide a laboratory environment in order to read the architectural design problem over the concept of limits, are discussed in the next section. In the following sections, the architectural design studio process and the result products are discussed.

4. A Case Study: Learning from The Limits of Garipce Village

4.1. A village with limits

Garipce is a fishing village located on the Bosphorus coastline and between Rumelikavagı and Rumelifeneri Village. In mythology, it is known to be the village where the cursed King Phineas lived. It is estimated that Garipce was named after "Gyropolis" which means "City of Vultures" because it had a stony and rocky beach in ancient times and the eagles and vultures nested in its high cliffs. Another belief is that Garipce got its name after Karibian. The word "Carib" means, "close, close to place and time, close to noble" in Ottoman Turkish. Historical artifacts belonging to the Byzantine and Ottoman periods can be found in Garipce. The Hungarian origin French architect Baron François de Tott built Garipce Castle (Fig 1), which is located in Cape of Garipce in Sultan III Mustafa (1557-1574) period (Tekeli ed. 1994). Another historic artifact is the watchtower on the highest hill of the village; however, it is unknown when or by whom it was built. In addition, there are traces of baths, churches, and semi-solid fortress walls in the Buyuk Liman area. There was a shipyard in Great Harbor during the Ottoman period (Karadag, 2003). There are no remains related to the shipyard today. Depending on its inscription the fountain is understood to be built by Hasan Pasha in 1199 for the shipyard. Soguksu Fountain and Haci Suyu Fountain are among the other historical monuments in this region. Apart from these, The Topcuoglu Mansion next to the harbor and some buildings belonging to Cınar and Coskun families are also historical monuments. In addition to these buildings, there are several stone houses.

Despite all this historical background and limited living space, the village has been affected by some recent developments. The Third Bridge (Figure 3) on the Bosphorus connects both sides through the village of Garipce on the European side and Poyrazkoy on the Anatolian side. Debates on The Third Bridge have been ongoing for a long time on the agenda of the country. The highway and bridge passing through the last forested lands on the European side will significantly change Garipce, one of the last genuine fishing villages in Istanbul soon. Garipce Village faces a dilemma that although currently, no construction activity has taken place currently

Figure 3. Garipce Castell and The Third Bridge (Source: Authors).

due to the conservation laws, its needs have increased gradually. The surrounding areas turned into a more valuable area with the construction of The Third Bridge, threaten the village on the one side, but also respond to the internal needs of the village on the other side, creating a tense area. Since the area is a natural conservation area and protected by the conservation law, new houses cannot be built in Garipce. However, the village is in danger of possible conservation law changes shortly, as its value keeps increasing.

Figure 4. Garipçe Village's location, at the foot of the Third Bridge, as an important strategic location (Source: Google Earth)

Due to the lack of zoning and construction permits in Garipce, the village is continuously emigrating. According to the last census, its population is 420 people. It is the smallest residential area of Sariyer with this population. However, while there were 17 houses in Garipce in the 1900s, this number increased to 65 after the 1970s. Today, this number has reached 105 (URL-1). In the following chapter, the Bosphorus conservation law and its implications will be framed in order to describe the base of the limitations of the village.

4.2. Challenges of the limits: conservation and its consequence

With a 2500 years old historical heritage in geography where two continents meet, Istanbul has a privileged position in the world. In addition to this unique set of features, Istanbul has many natural and cultural values such as the Historical Peninsula, Golden Horn, and Bosphorus. This area has been declared as a conservation site since the 1970s and was tried to be protected under a special status. However, the city has been becoming the center of attraction of the economic investments and the country's population, especially in the second half of the last century; therefore, these heritage sites are under the pressure of change and transformation.

The power and the responsibilities of urban planning in Turkey are divided between the central and local governments, depending on the scale of the planning and goal settings. The central government, which is more regulator and supervisor in planning, also assumes responsibilities in high-level planning. The power and the responsibilities for spatial planning are left to the local governments; however, in the areas of unique quality and protection, the central government again determines and guides the legislation and its operation. Also, there are also differences in legal regulations according to the nature of the planning area and multiple structures in the distribution of authority and responsibility in planning. While the practices for zoning and urbanization are carried out with the Zoning Law and regulations numbered 3194, there are separate legal regulations for select areas such as tourism areas, the Bosphorus coast, national parks, forests, and so on. The roles of local governments in planning mostly focus on the preparation of local physical plans. Local administrations have the opportunity to prepare their own regulations for the implementation of the plans, with the approval of the Ministry of Public Works and Settlement (Unal, 2003). In Turkey, the protection of cultural and natural heritage is under the responsibility of the State, depending on the Constitution. For this reason, all kinds of regulations regarding protection should be made under the leadership and supervision of the central government. The state fulfills its duty through the Ministry of Culture and Tourism under the Law No. 2863 on the Protection of Cultural and Natural Assets, and the regulations issued accordingly. The Supreme Council for the Protection of Cultural and Natural Assets, working under the Ministry, guides the conservation policy with its policy decisions and determines the basic conservation criteria for the protected areas and structures (Zeren, 1991).

"Conservation Development Plan" is a tool that developed for subjecting and managing urban, archaeological, and natural sites to be planned in accordance with the principles of conservation. It was first defined in the KTVK (Turkish: Kultur ve Tabiat Varlıklarını Koruma Kanunu) Law No. 2863 and was developed in 2004 with some amendments made with the law numbered 5226. Along with the announcement of the conservation area and the registration decision, the "Transition Period Building Conditions", which should be developed depending on the degree of the registered area, is also a practice introduced by this law. It is envisaged that these conditions will be produced depending on the unique identity of each region. Due to an act of protection to take place in a region, declared as a conservation area, it is not the only and sufficient condition

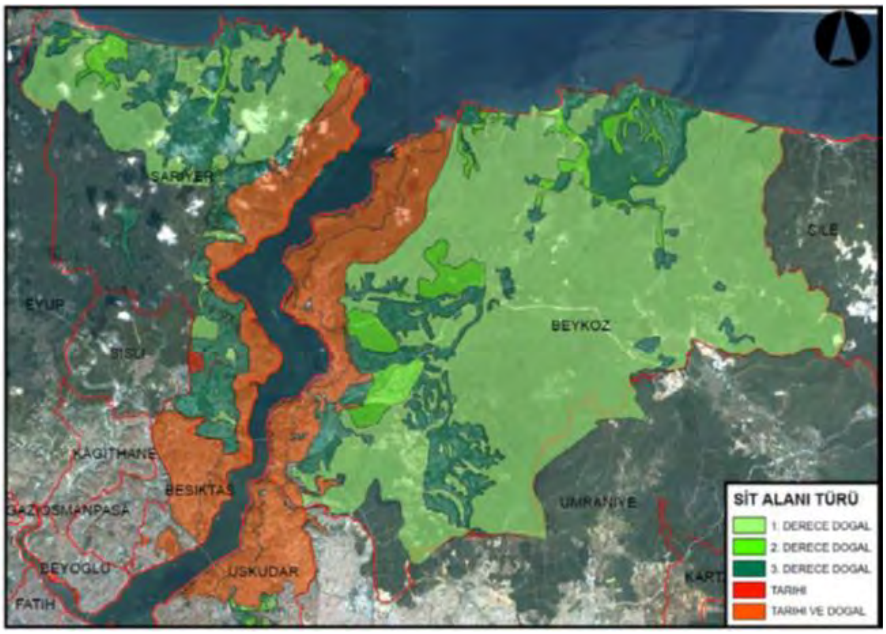


Figure 5. The spatial distribution of the conservation sites in Beşiktaş, Beykoz, Sarıyer, Üsküdar districts. (Source: Dinccer, Enlil and Evren, 2009)

to "plan" that area or its surroundings. As a result of the fact that the plan decisions are not developed as "protection-oriented" plans, the region is under the risk of overlapping. The fact that the conservation areas are structured with the plan, the decisions against the basic urbanism principles even containing decisions that are contrary to the basic conservation principles of "conservation development plans" in some cases, constitutes even greater risks. Investment decisions (such as making road routes, declaring the area as a trade and tourism area) contrary to upper-scale plan decisions that contain holistic decisions in a conservation area, emerges as another risk group.

Local administrations are responsible for the preparation and implementation of protection plans within the system that concerns conservation areas. However, within the scope of the plan implementation, projects, and practices for registered buildings and the conservation boards must approve structures in their protected areas. Based on these observations, it is possible to say that the authority and the responsibility distribution in urban planning and conservation areas have a multiple and complex structure on the legal framework in Turkey (Zeren & Gulersoy a.o., 2001). The Real Estate Antiquities and Monuments Supreme Board (Turkish: Gayrimenkul Eski Eserler ve Anıtlar Ycksek Kurulu, GEEAYK), established in 1951, has determined and announced a total of 11 conservation sites in Istanbul within the scope of the Antiquities Law of 1971. When these historically important conservation areas are examined, it is seen that the first declared site was "Bosphorus Natural and Historical Sites" covering the districts of Besiktas, Uskudar, Beykoz and Sariyer in 1974. These mixed site areas with different site areas are 13.581 hectares in Istanbul. The most significant part of these sites (79%) consists of 11 "natural and historical sites". Bosphorus prediction and back view, which is registered as a natural and historical protected area and spread over a wide area, is one of these areas (Fig. 5. Dincer, Enlil and Evren, 2009).

From this framework of conservation laws, we can suggest that rural areas with conservation laws face the "risks and limits", specifically in Turkey due to the distribution of control mechanisms. Based on the Garipce example, it is seen that in the processes of determining, documenting, and announcing the conservation areas, the following priorities are required for the plan and implementation conditions required for the protection of these areas in the context of the risk: Restructuring of the planning committee on the axis of protection, prioritizing contemporary practices in structuring the protection institution, transferring scientific knowledge into practice correctly and spreading the planning culture to large sections of society. Apart from that, the development of comprehensive programs against the results of the social, cultural, and economic risks will also be the priority issue. These risks can be classified into three parts; risks arising from the fact that the culture of conservation is not widespread, risks arising from insufficient public resources for protection, risks arising from low-income levels of the society. In addition to that due to the Third Bridge, Garipce has faced the danger of being zoned, even though it is a protected rural site. This situation shows that the site laws, which emerged as a limit in architecture, may undergo sudden changes.

As a result of all the legal restrictions mentioned above, it is possible to talk about the restrictions in the physical and social fabric of the village. The legal constraints caused by the conservation law, together with the physical conditions of the village, constitute physical limitations (Fig. 6). On the one hand, while the village preserves its physical texture, on the other hand, the insufficient physical facilities caused by this situation cause the villagers to leave the village. As a result of this situation, the villagers cannot accommodate their growing population and they give migration. Consequences such as the presence of an elderly population, the forced to leave the village of the young people of the village, and the difficult economic conditions stem from this situation.

Figure 6. Examples of architectural texture created by physical limits (Source: Authors).

The main action that establishes the relation of the village with Istanbul is the fish restaurants (Fig. 7) serving Istanbul residents at the weekend. While these restaurants cover the entire seaside of the village, they create social space restrictions for the villagers. In this respect, the traces of physical and social restrictions can be mentioned in the daily life of the village.

Along with the limits arising from the protection laws, the physical, economic, and other social limits which are the results of being a conservation site contain significant information on the architectural requirements of this rural area. Therefore, it is possible to

Figure 7. Lack of social space of locals of Garipce Village is an example of social limitations. (Figure on the left: Url-2, Figure on the right Url-3).

mention three basic limits that limit the design in Garipce Village: Physical Limits, legal limits and social limits (Fig. 8).

One of the fundamental aims of the Architectural Design III course is to stimulate architectural students' awareness of the context

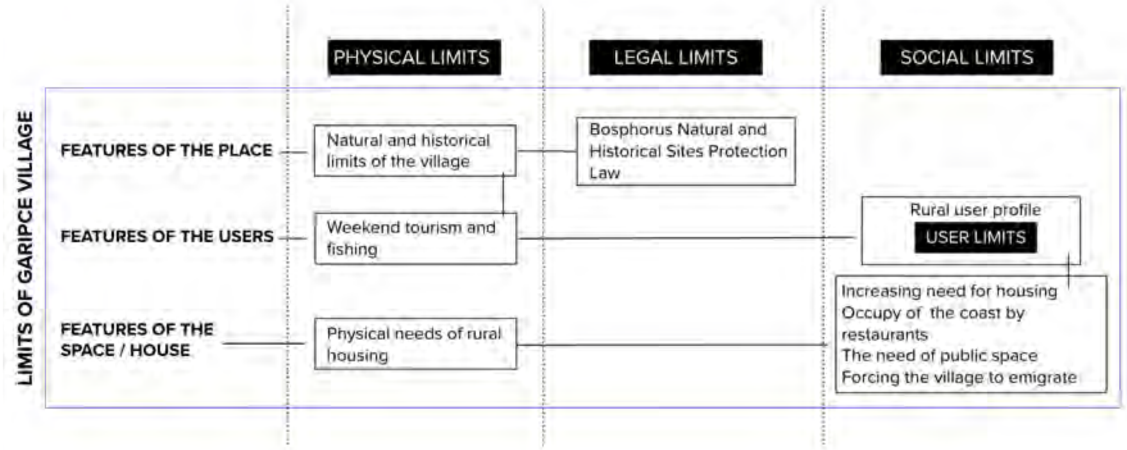


Figure 8. The main limits of Garipce Village

With the features mentioned above, the Garipce is like an architectural laboratory in terms of its limits. Within the scope of the presented architectural design studio, listed limits in Figure 8, are investigated and answered in each student project. The next chapter is focused on the instructional role of the limits in the design studio.

4.3. The Studio: City in the Village, Village in the City

Architectural Design Studio III course, which is in the curriculum of Istanbul Kultur University Architecture Department 3rd semester in the 2019-2020 fall period, is titled “City in Village, Village in City: Garipce”. The main design topic of the Architectural Design Studio III course is a single house project with additional practice. Therefore, it is expected from the students to understand the urban context, user profile, legal and social limitation, then to solve a single housing project for this purpose and develop a design idea in between. In this context, the students not only expected to produce single house projects for the daily needs of rural life but also consider the village limits as a design input.

and the impact of the built environment. At that point, the legal restrictions constitute the biggest limitation of the study. At the beginning of the studio, students were informed about the concept of limits in architectural design, as well as the current conservation site area regulations and possible future scenarios due to the fact that construction of Yavuz Sultan Selim Bridge. Although Garipce is involved in the conservation law, as well as the rest of the Bosphorus coast, it is still in danger of reconstruction as a result of the bridge since it creates new construction motivations for the site. Since these constraints cannot change, their assets were accepted and included in the design problem of the project, but the intervention was not expected. During the studio work, it was stated that Garipce Village was not expected to be a solution to legal restrictions because it is located in a protected area. On the other hand, students were expected to define the limits caused by legal restrictions and offer solutions with housing design. Thus, students have developed a design proposal in these limits; they have exanimated and conceptualize the limitations of interventions in such areas.

Figure 9. An example of Garipce's limits maps.

4.4. Determination of the Limitations

During the design studio, the students have provided strategies to overcome the limits of architecture in terms of post-conservation law in rural areas. After the preliminary information about the project area in terms of regulations and limitations and a field trip, the students have completed the urban analysis process and developed first concept ideas. In this process, we as instructors have led the projects as it is discussed, in terms of limits of the village. The students have generated the analysis by following three main steps: the determination of the limits, the determination of users, and the determination of urban voids in Garipce.

The first urban analysis period includes the process of designing urban maps to understand and evaluate the limits of Garipce. Along with limitations of conservation areas, social implications, and physical limitations of the village, which are determined earlier and expected to answer during the design studio, the students create Garipce Village’s mind maps to determine the main limits, challenges, and scenarios that may arise. The cognitive and experiential mapping process has guided the students in the context of assimilating and embodying the realities of the village. Although, each map considers relatively different limits, with the overlap of all cognitive maps the main limits of Garipce have been exposed and they all have searched the main three limitations. Figure 9 is an example of Garipce's limits map which considers the main limitations along with conservation area, social implications, and physical limits.

After re-mapping Garipce Village with its limits, the students have worked on user scenarios for the village. As it is mentioned above, the construction regulations and conservation laws create social limitations for such places in the village's everyday life. To detect this situation, during the analysis process, the students have visited the town hall of Garipce and report the current social structure. As a result of this research process, it has been revealed that the majority of the village population consists of the elderly. According to the interviews with the village residents and the village headman, it was obtained that the young generation in the village did suffer from the lack of housing and it was determined that the most dynamic need of the village was housing for the future generations. The young generation also affected by the lack of social facilities, job opportunities, or education facilities. Therefore, it was determined that the protection of the village with the conservation law, actually caused social problems to the villagers, in terms of family life and social structure. In addition to these implications, it is possible to suggest that the villagers consisted of a relatively closed community. The fact that the villagers have a closed attitude towards new settlers coming from outside strengthens this discourse. On the other hand, they express their concern that the younger generations cannot be accommodated in their villages; nevertheless, they do not want the village's profile to change with possible conservation law changes neither. Under all these conditions, it was concluded that it would be more accurate to determine some user profiles that can meet the requirements of the village or develop alternative scenarios for the existing users in the village. The realistic approach for user profiles is also considered as one of the design parameters arising from the limits of the village.

The third analysis step is to identify suitable areas for residential projects. In this step, students were expected to identify the urban voids in the existing residential areas of the village or mark the structures that are not worthy of protection and that cannot be used. According to this analysis, residential areas that can be designed in Garipce are covered in three groups: Existing unstructured residential area, Existing residential area, Existing built but unused residential areas.

Under the existing conservation law, the fact that no new housing can be built in the village and the rule about in case of a housing demolishment, only building with public function can be constructed, constitutes important limitations for the determination of housing sites. These limitations that affect the process of determining the areas are in line with the determined limits of the village. User profiles determined for housing projects also affected the type and location of the housing area. Throughout the study, the students were reminded of the necessity of preserving the existing urban texture and developing the design with the least possible intervention. As a result, the three-step analysis process is thought to nurture students in terms of exploring the village's limitations and facts worth protecting. The students who argued that the protection would not only be with construction prohibitions and the concept of protection could not be independent of the daily functioning of life started the design processes by drawing the boundaries of intervention to the village.

4.5. Design within and for limits
The students who evolved an attitude towards the village during the analysis process developed projects consisting of housing and side functions that overcome the restrictions created by the conservation law and may have positive effects on the daily life of the village. 12 students have attended the Architectural Design Studio III course. The students have developed successful housing design projects with given approaches. The design proposals that these students developed during the course have analyzed according to their user and land chooses.

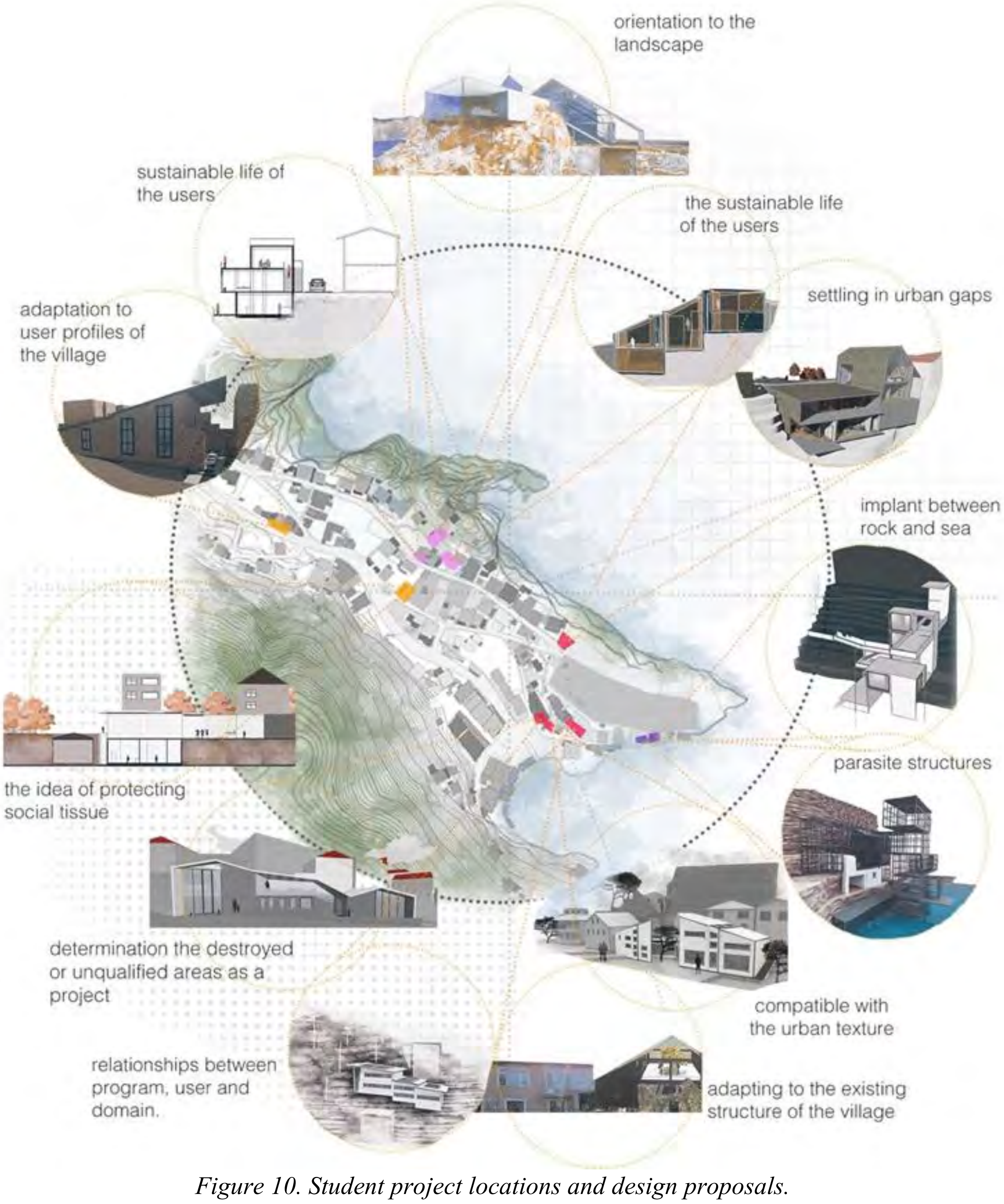


Figure 10. Student project locations and design proposals.

The projects of the students (Fig. 10) have evaluated according to their design strategies. These strategies are classified into two titles: Users and locations. The user profile and the location decisions show that how the students have developed new designs without damaging the village texture and how they have responded to the limits of the conservation laws. As can be seen from Figure 7, all of the student projects are located in urban spaces or areas of demolished / unused buildings. No student has intervened in the green areas of the village; all preferred to settle in the housing stock. Three projects that have scenarios with doctors and teachers settled in the village and projects with additional public functions such as education were located on the road that determined the main entrance line of the village.

The three of the projects inspired by real users living in the village have been considered together with sales and production units. It is seen that these projects with such user profiles are settled around Garipce Castle. In this approach, a visual relationship has been established with the castle, and physical contacts have been avoided. The two projects were placed in a way to establish a direct relationship between the sea and the castle. Both of the residence's places on the cliff on the sub-level of Garipce Castle. One of them belongs to the ornithologist and one to the fisherman. These uses, which require special relations with the sea and vista points, preferred to be the most symbolic place in the village; however, they touched the area using light structures. In the remaining three projects, there is an approach to the sea in the north to establish relations with other residences of the village. In these projects located on rocky cliffs, the phenomenon of privacy comes to the fore. These projects, which are a part of the silhouette of the village because they are in the residential settlements, follow the silhouette of the village with their roof forms. In addition to the formal approach, the dialogues they establish with the residences in the neighboring parcels are parallel to the general settlement decisions of the village. Therefore, it can be suggested that the silhouette of the village is preserved even in areas where the intervention in the village is most visible.

As can be understood from these evaluations, user profiles have been selected from the village-fed or village-owned profiles, and projects have been developed in this axis. While responding to the limits of the village, it is seen that student projects that prefer to be invisible within the texture are also developed. In general, projects with profiles dominated by public functions are located close to the entrance of the village, and projects in which the housing function comes to the fore are located in the north. The projects with functions for those visiting the village have been gathered around the castle. All these settlement decisions have helped identify residential areas that will answer the village's needs if the conservation law changes or repeals.

It was determined as a prerequisite for the designs developed in the studio to meet the basic limits of the previously stated village. When 12 design projects (Fig. 11) are examined, the immediate answers given to these limits stand out.

Figure 11. Students' design solutions presentations for the limits of the village.

As seen in Figure 12, we can briefly categorize the design solutions of students as follows:

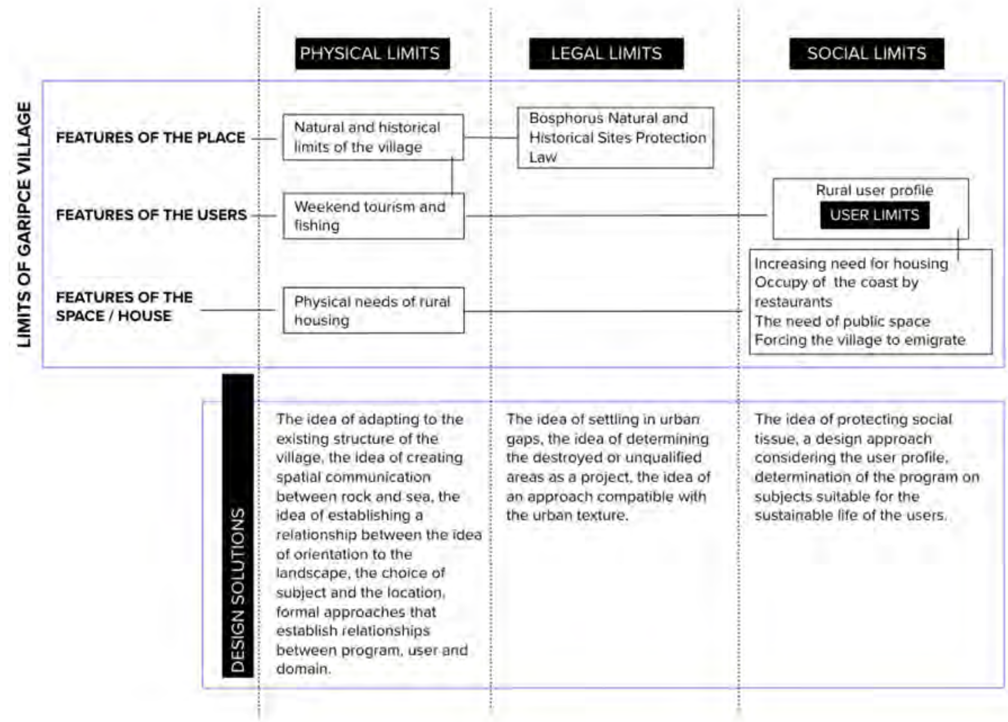


Figure 12. Students' design solutions ideas for the limits of the village.

Consequently, the evaluation shows that the students have used the limitation of the rural context and theoretical background of conservation law's limitation to provide projects that have less intervention as possible (Fig. 12). It has been observed that the students often have difficulties in the process of design, in terms of these limitation and user profiles of the site. On the other hand, these limitations have a major effect on design strategies, which also help students to finalize the concept ideas. At the end of the term, it is clearly seen in students' projects that have advanced the awareness of the conservation areas and had been developed with approaches that center the village life.

5. Conclusion

This article focuses on the concept of limit and its possible role in design education through realistic design scenarios of rural architecture in Garipce. The design problem of second-year architecture students, the housing designs, is asked to respond to the limits of Garipce, starting from the analysis process to the final design decisions. With the developed design approaches, the concept of limit has been discussed through alternative solutions for architectural intervention that are proposed to the conservation areas that are in danger of extinction due to the recent interventions.

In this study, conservation laws and the concept of "limits" that appears because of the laws had been reconsidered based on Garipce Village through the architecture design studio. Thus, the main idea of designing with the limits is to understand that the architectural design is exist only with and in limits. On the other side, as it is aimed, it was seen that certain limitations help designers to have creative solutions for each design problem. In this case study, we have seen that students tried to find responses to each limitation that they discovered, whether it was social, physical, or legal (conservation laws).

The architectural design studio's experimental environment helps the reframing the problems caused by conservation laws, such as social and environmental dysfunctions. With the result, the students have developed cognition about protection and construction relationships. In addition to this cognitive perspective, they have developed a project that responses to the daily needs in realistic scenarios to solve the limits. These design strategies that have created through limits of the village gives an opportunity to re-think in case of dramatic changes in the conservation laws, how can we design housing for villagers.

As seen in this case study, it has been observed that reading the design problem in an architectural design studio over the limits of architecture has an instructive role in terms of the approaches developed by the student. To summarize briefly, the implications of the experience of including architectural limits in the studio training strategy can be listed as follows:

- Incorporating limits as a concept into the architectural design studio enabled the discussion of design possibilities for conservation site areas.
- The concept of architectural limits supported students to develop a design approach by deepening their context reading.
- The act of designing housing "despite the limits" and "in response to the limits" has become a means of conveying the responsibilities and limitations of architectural design to the student.

The concept of "limit" transforms students' learning experiences in the design studio, in terms of context readings and developing an awareness of architectural design's effect on daily life. The experience of designing within multiple constraints such as the limits of working in the rural area, the limits of living in the conservation zone, the possibilities of architecture in the conservation zone, and the responsibility of architectural design to the environment, motivates the students and prepares them for real design scenarios. Based on these results, reading "the limits of the architectural design" as an instructional tool in architectural design studios can be transformed into a design studio model proposal. In this way, the responsibilities and awareness of architectural design can be transferred to students through real scenarios starting from an early stage. By placing different conceptual limits in the architectural design problem, these teaching models can be reproduced.

Acknowledgements
We would like to express our thanks to Emre Karaman, Tugay Ünver, Yusuf Ruhat Köse, Betül Doğan, Nisanur İmadoğlu, Naile Ertaş, Duygu Kandağ, Hüseyin Aslan, Tuğba Kurt, Erol Dinçer, Eda Sayan, Şeyda Arıcı for their efforts in the project that were carried out within the scope of the course Architectural Design III in Istanbul Kultur University Architecture Department.

References:
Dinçer, D., & Aydınlı, S. (2016). Blurring Limits in Architecture. Tasarım+Kuram, 48-60.

Dinçer, İ., Enlil, Z., Evren, Y., (2009). İstanbul'da Koruma Alanlarının Değerlendirilmesi, Megaron, YTÜ Mim.Fak.e-Dergisi, Cilt 3, sayı 3, 310-324.

Fatouros, D., (2002), Who cares? Towards a Common European Higher Architectural Education Area, Ed. Spiridonidis, C.&Voyatzaki, M., pp. 31–35, Greece.

Feigenberg, A., (1991). "Learning to Teach and Teaching to Learn". Voices in Architectural Education, s. 265-278, Eds. Dutton, T., Bergin & Garvey, New York.

İlhan, T. ed. (1994). Dünden Bugüne İstanbul Ansiklopedisi Cilt II. İstanbul: Tarih Vakfı Yurt Yayınları.

Karadag, R. E., (2003). Rumelifeneri Kalesi Restorasyon Projesi. İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi.

Kararmaz, Ö., Ciravoğlu. A. (2017). Erken Dönem Mimari Tasarım Stüdyolarına Deneyim Tabanlı Yaklaşımların Bütünleştirilmesi Üzerine Bir Araştırma. Megaron Dergisi 12 (3), 409.

Lawson, B., Dorst, K. (2013). Design Expertise. Routledge

Locke, J., (1689). Two Treatises of Government. Awnsham Churchill: UK.

Mumcu Uçar, Ö. ve Özsoy, A., (2006). "Sınır Kavramına Mekânsal Bir Yaklaşım: Bahçelievler Örneği", İtüdergisi/A Mimarlık, Planlama, Tasarım, Cilt:5, Sayı:2, Kısım:1.

Ockman, J., 2012. Architecture School: Three Centuries of Educating Architects in North America. Cambridge, Massachussetts: The MIT Press.

Queneau, R., (1947). Exercices de Style: Edition Gallimard, Collection Folio.

Queneau, R., (1998). Exercises in Style, Trans by. Barbara Wright: John Calder Publishers, London.

Queneau, R., (2003). Biçem Alıştırmaları, Trans.by: Armağan Ekici, İstanbul: Sel Yayıncılık.

Riker, S., (2013). "Overcoming Limits", Volume 21 - 2013. 8. https://preserve.lehigh.edu/cas-lehighreview-vol-21/8

Salama, A., (1995). New Trends in Architectural Education: Designing the Design Studio. United States of America: Tailored Text & Unlimited Potential Publishing.

Savaşır, G., (2008). "Re-thinking the Limits of Architecture through the Avant-garde Formations during the 1960s: Projections and Receptions in the Context of Turkey", Yayımlanmamış Doktora Tezi, Orta Doğu Teknik Üniversitesi, Ankara.

Şentürer, A., (1994), "Mimari Tasarım, Stüdyo Eğitimi Bu Kadar Rastlantısal mı Olmalı?", Tasarım 43, İstanbul.

Shaffer, D. W., (2003). Portrait of the Oxford Design Studio: An ethnography of design pedagogy (WCER Working Paper No. 2003–11). Madison, WI: University of Wisconsin Madison, Wisconsin Center for Educational Research.

Uluoğlu, B., (1990), Mimari Tasarım Eğitimi: Tasarım Bilgisi Bağlamında Stüdyo Eleştirileri, Doktora Tezi, İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.

Ünal, Y., (2003). Türk Şehir Planlama Hukuku. Ankara: Yetkin Yayınları.

Url-1 www.envanter.gov.tr (Last visit: 19.10.2020)

Url-2 https://www.tripadvisor.com.tr/Restaurant_Review-g293974-d3383562-Reviews-Garipce_Aydin_Balik-Istanbul.html (Last visit: 19.10.2020)

Url-3 https://tayfurlab.com/2016/07/07/garipcekoyu/ (Last visit: 19.10.2020)

Yücel, S., and Aydınlı, S., (2015). 'Mimarın Eğitimi' Üzerine Spekülatif Bir Deneme, Erciyes Üniversitesi Fen Bilimleri Enstitüsü Dergisi, Sayı:31(1) s. 17-2.

Zeren-Gülersoy, N., Tezer, A., Yiğiter, R., (2001). Zeyrek a Study in Conservation. İstanbul: Cenkler Matbaası, İ.T.Ü. Mimarlık Fakültesi.

Zeren, N., (1991). Koruma Amaçlı İmar Planı Yapım ve Uygulama Sorunları. İstanbul: İ.T.Ü. Çevre ve Şehircilik Uygulama-Araştırma Merkezi, Proje No: 71/20.

Journal of
Design Studio
v:2 n:2 December 2020

A Mobile Design Environment for Building Form Generation

Mehmet Emin Bayraktar
Istanbul Technical University, Department of Informatics, Architectural Design Computing Program, Istanbul, Turkey (Corresponding author)
Gulen Cagdas
Istanbul Technical University, Faculty of Architecture, Department of Architecture, Istanbul, Turkey

Received: November 16th 2020, Revised: November 29th 2020, Accepted: December 1st 2020
Refer: Bayraktar, M. E., Cagdas, G., (2020), A Mobile Design Environment for Building Form Generation, Journal of Design Studio, V.2, N.2, pp 131-142,

M. E. Bayraktar ORCID: 0000-0003-4441-7425, G. Cagdas ORCID: 0000-0001-8853-4207,
DOI: 10.46474/jds.826659 https://doi.org/10.46474/jds.826659

Abstract: Computer technology has affected architectural studies as well as other professions. Architectural tools are used in every stage of the design and their primary goals are transferring and sharing the ideas of the architects' mind. Nevertheless, in the early design phase, digital design tools remain ineffective in terms of idea development. Current design software and modeling tools are insufficient for the architect to quickly share ideas and generate alternative suggestions for fast sketching and modeling.

In this paper, a mobile design application is developed. It aims to support open-ended design thinking and to be fast and effective in terms of improving ideas. It is based on augmented reality and it works on mobile phones. In order to evaluate the application, a set of images consisting of tall buildings are shown to users. Then they are asked to model a similar form of their own. At the end, results are assessed with a questionnaire. Using the obtained data, the effectiveness of the digital mobile tool in the early design stage is discussed.

Keywords: Digital architectural design tools, Early Design, Augmented reality, Mobile environment, Tall buildings.

1. Introduction

Various tools are used in the architectural design process. The main purpose of architectural design tools is to prepare an environment for developing architects' idea, transferring to other media, and communicating with stakeholders through drawings and visual models. The effects of technological changes in the field of computer aided architectural design are observed strongly. In the past, producing, modifying, sharing, and displaying models were the main intention of using the tools. Today, issues such as designing in digital environment, multi-user interaction and online collaboration, augmented reality, generative systems, and the use of artificial intelligence affect the design process. Computer aided approaches are advancing in a parallel manner with the software and hardware improvements. It is unthinkable that this transformation will not influence the design habits of architects.

These are the research questions prepared in this context;
1- How effective are the existing digital media used in the development and representation of initial ideas in the preliminary design phase when making sketch, diagrams and working models?
2- How can productivity be supported in the

early design by utilizing digital environment?

3- Can mobile digital environment help rapid generation of design alternatives and does that influence productivity?
4- Can alternatives be developed by establishing a relationship between mobile, digital, and physical work environments? Can they transform into prototypes quickly?
5- How does augmented reality support the design environment?

The motivation of this research comes with a suggestion to a problem. In the early stages of design with the help of information technologies, the architect can benefit from alternative mass creation on a mobile device, without depending on computer hardware. From this point on, an augmented reality based mobile application for idea creation environment has been developed and tested with users. The content of the study is limited with high-rise building design topic since form creation problem is encountered predominantly in this type of projects.

There should be no restrictions with the use of tools while developing ideas, especially at the early design stage. Since tools have influence on shaping ideas, it may not be possible to reach satisfying solutions due to the architect's inexperience with the tool or because of the limitations of the tool itself. In order to remove these constraints, an application is created to increase productivity in the form creating activities. If this new environment is used at a stage where thoughts are mostly uncertain and not well defined, it can contribute to diversify and ultimately refine design solutions by generating quicker alternatives to choose among them. The objectives of the research using the potential of augmented reality can be summarized as follows:

1- Providing the opportunity to test mass alternatives with surrounding structures and topography on the project site using the potential of augmented reality,
2- Developing a mobile digital environment similar to modeling experience as if the user works on a physical model,
3- Transferring the final product physically or virtually to other media.

The research consists of three stages, the literature review for the application, the development of the mobile media application, and the evaluation and interpretation of user tests.

2. Digital environment in architectural design

Since the 1950s, with the digitization and processing of information, research on digital design has been increasing. Sketchpad application, which is considered as a cornerstone in the field of computer aided design, is an important study because it defines a 3D virtual geometry with vectors, presents a real time manipulation of models and reflects changes that made within a block to the whole drawing which we still use today as primary concepts in our computer aided design tools (Sutherland, 1964). However, the most important claim of Sketchpad program is to demonstrate that a communication environment based on ideas can be established in computer environment with its input and output. Since this study, CAD software has been developing continuously and now they are used by the architects, especially with the widespread use of personal computers. In addition, there are improvements shaping design and production in architecture and construction, such as building information modeling (BIM) systems. Many breakthroughs such as parametric design, decision support mechanisms, generative systems, artificial intelligence support, pedestrian simulations and research like these have paved the way for new thinking methods in the field of architecture (Koutamanis, 2003; Bayazit, 2004). Considering all these advances, it can be said that; computer technology has caused a paradigm shift in architectural design thinking. Today, it is possible to continue this progress even further with innovative approaches.

The aim of design thinking, which is the subject of these achievements in the field of architectural design is basically the same. According to Akin (1978), the cognitive part of the design has inputs and outputs and a common mechanism is established by using the notes, models, sketches and similar supporting elements with the other available information of the designer. Also the tools used in early design, such as sketches, are not just output of ideas, but they provide the opportunity to transform ideas and create new ones (Goldschmidt, 1991; Twersky, 1997; Smith, 2012). According to Ackerman (2002) drawings emerged as a communication tool and they are created according to their purpose. In addition, all the tools we use directly has an impact on the design approach and event on the final product itself (Füssler, 2008).

2.1. Augmented Reality in Design

Augmented reality (AR) is a mixed environment created by projecting virtual objects or information onto real world video stream. Digital additions are synchronized with the help of a computer and the user perceives these two environments at the same time. Thus, the potential of the virtual world can be used without getting away from the physical environment. The AR experience can be enriched not only by using image but also by additions such as sound, smell, and touch. According to Milgram et al. (1995) augmented reality is a subgroup of mixed reality. They define mixed reality with a reality – virtuality line as in Figure 1. The amount of reality decreases as you go to virtuality from real environment and decreases the other way around.

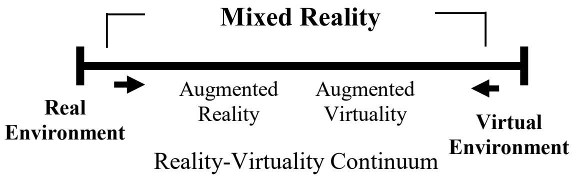


Figure 1. Mixed reality use on the reality-virtuality line (Milgram et al, 1995).

In the past, pioneer works of augmented reality needed to use special, expensive equipment such as custom headsets (Caudell & Mizell, 1992; Azuma et al; 2001). Due to these limitations, AR technology did not reach to everyone. Nowadays, with the help of mobile devices and tablets more people can have the access to AR systems. Thus, the application areas have expanded and different usage scenarios have emerged (Dimitris, 2017). In the same manner, interest in the field of AR in education has increased substantially compared to previous years (Chen et al, 2017). In architectural design, it is possible to come across studies made for different problems of different scales (Kerr & Lawson, 2020; Birt et al, 2017; Arashpour, & Aranda-Mena, 2017).

Another important subject is whether the information placed on the real environment is interactive or not. In the past, displaying information in a virtual setting was the main purpose, but today the approach of manipulating digital content and creating new objects has opened new doors for AR. It makes a difference to work on content in the virtual space than only displaying it. (Figure 2, 3).

Figure 2: Present day streets and buildings are shown with their history in an augmented reality application (URL-1, 2020).

Figure 3: The object is placed on the image and it follows moving objects to change its position to create a hybrid environment (URL-2, 2020)

2.2. Representation Models and Techniques of Forms in Digital Environment

In architecture, besides producing solutions, it is also important to choose one of them that meets the desired conditions. Various software using representation, visual evaluation and geometric modeling techniques are used for this purpose. These techniques, which provide the geometric definition of the architectural form, have followed a progress from the technique of expression with lines to surface, mass and object models based on database. Mitchell (1990) describes these representations both as data structures and architect's interpretation of geometrical shapes and volumes. They can generally be examined in three groups (Figure 4).

- Wireframe model: In this technique, design product is represented with only its edges.
- Surface model: 3D objects defined with wireframe technique are filled as surfaces.
- Solid / Void model: Objects are visualized with basic geometric volumes.

Pixel, voxel, vector and nurbs techniques are used while defining geometric models:

- Pixels: A pixel defines a pair of coordinates in a two-dimensional coordinate system and it is written by (x, y, PR) notation.
- Voxels: Voxel is the expression of the pixel definition according to three-dimensional coordinate system and it is written as (x, y, z, PR). In these techniques, PR refers to unit properties.
- Links: Combining neighboring coordinate points creates links.
- Vector: This definition technique is based on the generalization of links, in other words, the combination of any pair of coordinates that are not adjacent to each other. Two-dimensional definition is written as (x, y, x1, y1) notation, three-dimensional definition is written as (x, y, z, x1, y1, z1) notation.
- Nurbs: Non-Uniform Rational B-Splines is shortened as nurbs. It is one of the mathematical expression methods of 3 dimensional curves. It is used to express geometric shapes such as cones, spheres, or cylinders. These forms have known mathematical equations that express them.

Geometrical models of complex shapes can be constructed on the computer with form algebra operations or boolean operations (combination, intersection, subtraction) applied to the shapes defined by these techniques. Also, "move, replace, change scale, copy, mirror, rotate, cut, stretch, subtract" operations are used to produce forms in the design process. In this article, wireframe modeling and vectors are used for 3D sketching, and solid modeling and voxels are used for mass modeling.

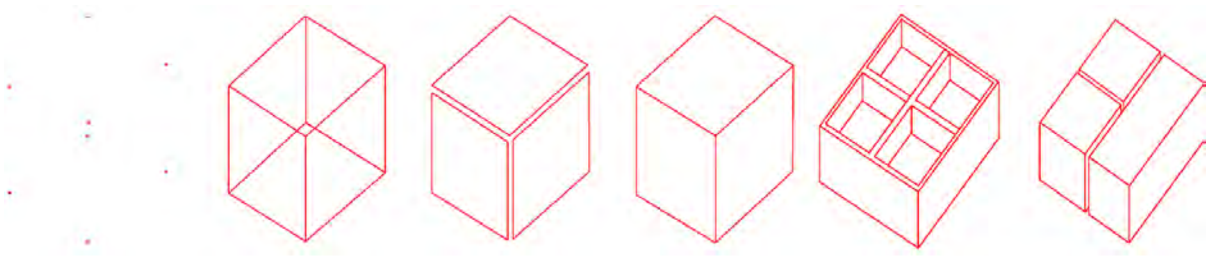


Figure 4. Model types (Mitchell, 1990).

3. Mobile Design Environment and Its Interface

The early working phase in architectural design is a continuous process in which ideas are produced, interpreted, changed and fundamental design decisions are made. Making such a task more efficient means affecting the quality and time variables related to the architectural activity. Therefore, in the scope of this study, a mobile design application has been developed to increase the efficiency of the design process. By using this digital environment, early design activities can be supported with easily accessible devices such as mobile phones and tablets that people can carry with them at any time.

The goal is to develop an application similar to physical model environment productivity in order to test mass alternatives with surrounding structures and topography in the project area in the first stage of architectural design.

Unity 3D game engine software is used to create the model. Unity 3D works with object-oriented C# programming language support. Codes written in this language are assigned to objects in the scene, they can be edited with any code editing software. Many improvements can be added to the software as extension libraries. As of now, it is possible to publish and run the developed applications on 27 different platforms. Although it has a game-oriented style, its support for mobile devices and augmented reality makes it a suitable development environment for this research (Url-3). Google ArCore plugin was used for AR infrastructure (Url-4). In this way, a markerless AR system can be set up. In free hand design activities and quick studies, it is important for the tool to be easily accessible at all times.

3.1. Workflow of the Application

The activities carried out in the application are divided into two main groups as "Object Modeling" and "Sketch actions". Accordingly, solid object creating actions mimic real-world modeling activities. Sketch actions get inspiration from the idea of drawing lines with a pencil on a 3-dimensional plane. Solid model and voxel techniques define units of a volume and vectorial lines are used in the sketch method.

Each user chooses their own starting scenario for form generation. For their project, users can work with the existing environment. Scale relationship can be better established when a real object is taken as reference. For example, a site model with surrounding buildings is created first. Then the form creation study in AR environment can be carried out with the nearby physical elements. This way user defines a scale for the object worked on. Secondly, design can be studied in a completely empty virtual space. This helps with the quickest form production approach because object size is not referenced to any object. Also, it can be adjusted at the end of the study. After this part, the mobile device is held to a surface to bring the virtual plane and the physical environment together and one of the 3 modeling techniques is chosen. In Figure 5, the operations of the program are explained. There are 3 main methods that can be changed during the design process.

Figure 5. Main operations for the model.

3.2. Application Interface

In the proposed mobile media interface, the upper portion of the screen is used for augmented reality video streaming. At the lower part there are buttons for program commands. Gray colored left side buttons are available in all three interfaces. Red, green, blue colored buttons represent the three main model making methods. Method switch button is at lower right for changing the modeling technique. In Figure 6, there are three main screens.

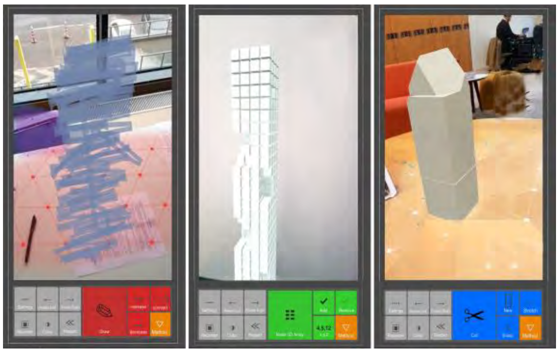


Figure 6. Mobile environment interface: From left to right; 3D sketch, Virtual Bricks, Virtual Model Making screens and an application example.

General command buttons are seen in Figure 7.

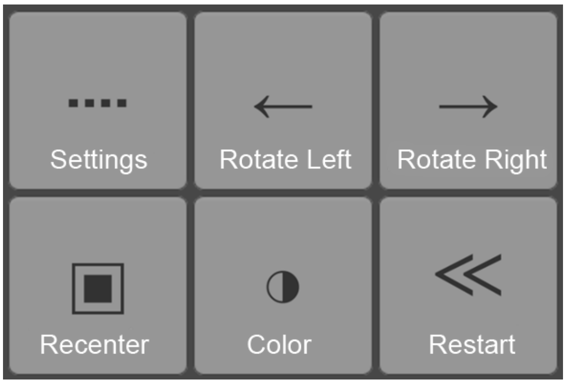


Figure 7: Assisting buttons for all methods.

The functions of the keys are explained below:

1. Settings: File export, scale and other secondary commands appear when this is selected.
2. Rotate Left: Rotates all objects counterclockwise. (User can also walk around the object.)
3. Rotate Right: Rotates all objects clockwise.
4. Center: This is used when recentering is necessary.
5. Color Change: With every new object there is a new color assigned to the new unit.
6. Restart: Erases all objects in the scene.

Figure 8: Line scale: Normal positioning means 1:1 model, it can be changed by sliding left or right.

3-dimensional sketching (digital freehand drawing) button layout is shown in Figure 9.

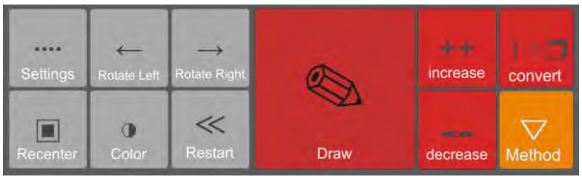


Figure 9: Button layout for sketching interface.

1- Draw button: As user holds the button and move the mobile device in the air, a 3-dimensional line is drawn. When user releases the button and press it again, a new line is drawn. It is an action emulating the pen touching the paper and leaving a trace.
2- Increase thickness button: Next line will be drawn thicker.
3- Decrease thickness button: Next line will be drawn thinner.
4- Convert the line button: A circular section profile is drawn along the line from start to the end.

Figure 10 shows the graphic depicting the location of the virtual pen in the 3D sketch and a drawing. The user draws freehand lines in the air by moving the device freely.

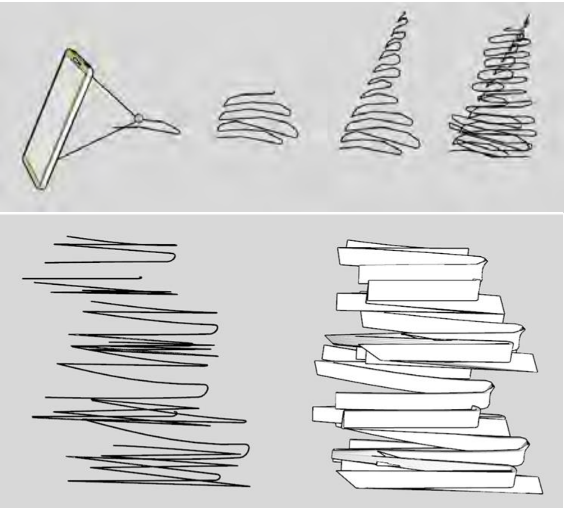


Figure 10: The drawing shows the positioning for the virtual pen and two examples of free-hand 3D sketches.

Green colored buttons for voxel-based production called virtual bricks are shown in Figure 11.

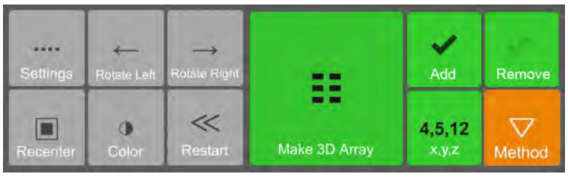


Figure 11: Button layout for voxel-based production.

1. Create an array: It produces a 3-dimensional array based on the measurements entered by the user.
2. Size: User enters new dimensions for a new array.
3. Add: With the adding mode selected, each time users touches a cube, a volume is created nearby on the adjacent surface.
4. Remove: When remove mode is chosen, the target unit is erased with touch input.

In Figure 12, the graphics about addition and subtraction are explained. An application of this modeling is shown in Figure 13. It is possible to create a volume in digital space by creating a unit on the X, Y then Z axis and applying add and subtraction actions. In the addition mode, when the surface of the unit is touched, a new object is created on the neighboring surface.

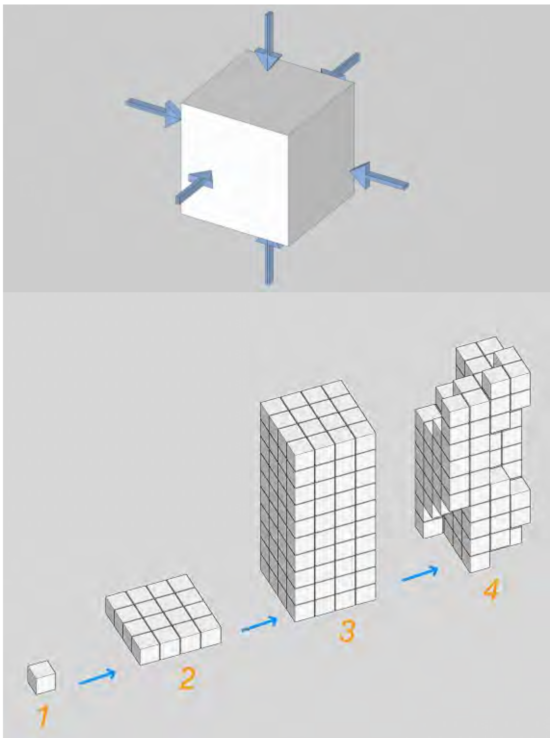


Figure 12: Actions in voxel-based method.

Figure 13: Example studies for two different masses using virtual bricks method (Url-5, Url-6).

In the virtual modeling (solid modeling) method, the buttons are highlighted in blue (Figure 14). In this method, a starting object is placed and manipulated by cutting it and pulling its edges.

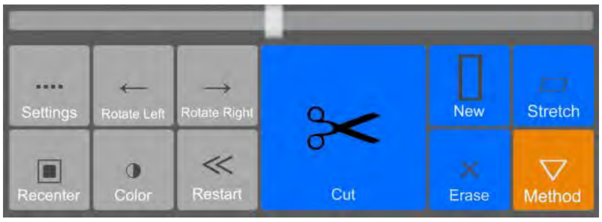


Figure 14: Button layout for virtual modeling.

1. Slice / Cut: It cuts the object with the cutting plane that intersected with it.
2. New Object: Creates a new box primitive to the virtual environment.
3. Pull/Push: User moves the object's edges to deform it.
4. Remove: Erases object.

Figure 15 shows the relationship of the cutting plane with the object and the final view after several cutting operations.

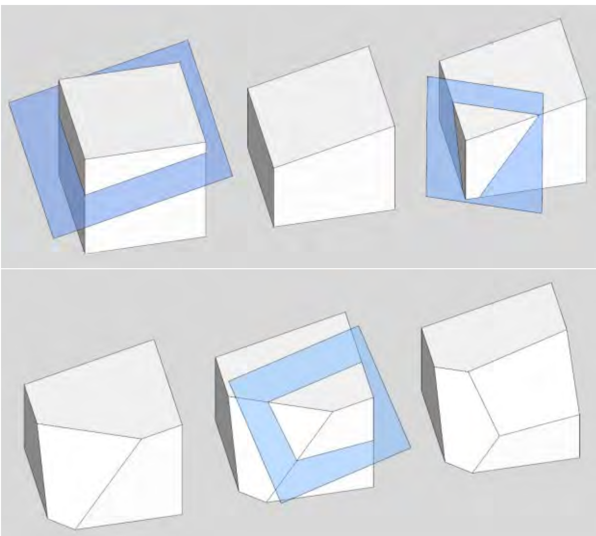


Figure 15: Image explaining relation between cutting plane and the mass.

To test the mobile application, the subject of high-rise building is chosen. Since the form design problem is more prominent in high-rise buildings, this building typology will provide a suitable basis for evaluating the proposed digital workspace (Figure 16).

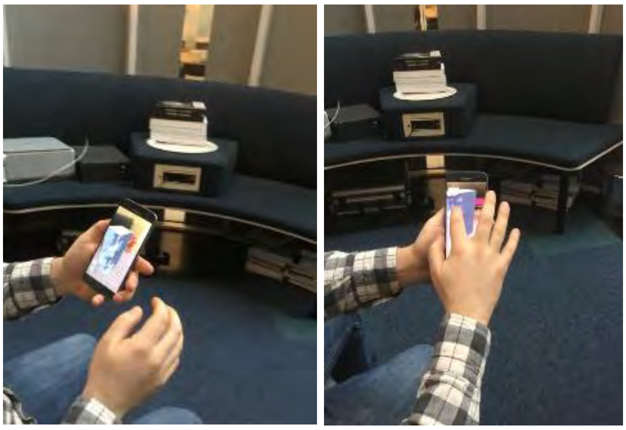


Figure 16: An architect using the application.

In Figure 17, comparisons of two studies are displayed. While testing with the users, building examples are shown to each user. The buildings list consists of 30 projects designed by architects in various parts of the world. They are selected by their different characteristics in terms of form and they have different façade properties. These initial sketches or models are shown to the users and they are asked to make similar models by using the mobile application.

At the end of the application, solid models developed in mobile environment can be sent to rapid prototyping tools and 3D prints can be produced (Figure 18). OBJ formatted output files can be transferred to other modeling software, giving the opportunity to continue and develop for designing in detail.

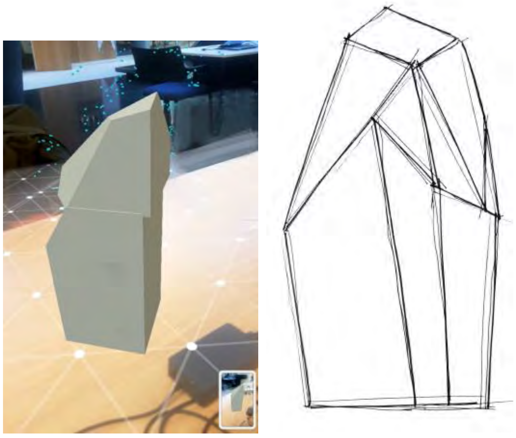


Figure 17: Objects are modeled using cutting and scaling techniques (Url -7).

Figure 18: Prototyping examples for the forms developed in the mobile application.

3.3. Evaluation of the Application

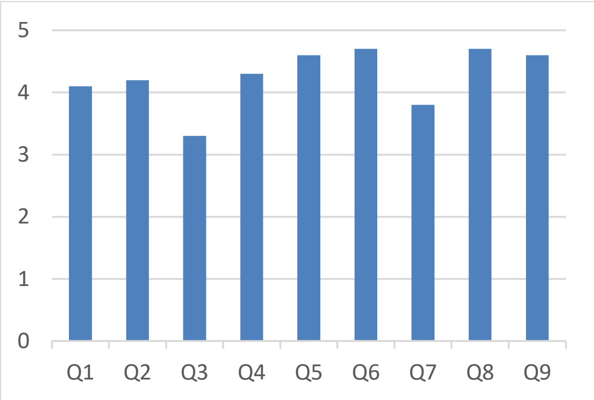
To evaluate the mobile AR application, 10 architects with professional experience were asked to select a project from the example high-rise building list and model a similar form. At the end of the study, feedback about the process were measured with the help of a 9-question survey. The answers have 5 ratings in Likert standard with the options; “Absolutely disagree, Disagree, Undecided, Agree and Strongly agree" as shown in Table 1.

Table 1. The questionnaire for the evaluation of the mobile application.

Question 1	It allowed me to quickly visualize my thoughts on design.
Question 2	I developed new ideas during the study.
Question 3	I was able to visualize my thoughts on design faster than the drawing / 3D program I used.
Question 4	I can transfer the model to my drawing environment and continue to develop it.
Question 5	Solid modeling method is useful.
Question 6	Sketching in 3D is useful.
Question 7	It was easy for me to learn how to use the tool.
Question 8	I think the application is a suitable environment for the form design problem.
Question 9	I can use this tool to start a new design.

The design processes and final products of the users participating in the experiment were recorded with the screen recorder on the device, and then the scores in the questionnaire were collected. As we can see from the results in Table 2, the expectation of being fast and effective in the proposed application criteria are met. In addition, potential in generating new ideas were there, and the method of drawing with a 3D pencil, which architects were familiar with before, got the highest score. Also, these results show that users rely on their preferred 3D modeling software for fast modeling. Although 3 completely new methods were presented to users, it is clear that there was no difficulty in terms of adaptation to these approaches.

Table 2. Questionnaire results.



4. Conclusion

Within the scope of this study, a digital mobile tool has been developed that will provide rapid production of alternative form generation in the early design. To support productivity in the design process, the software has been shaped with the following five goals:

- Sketch-like thinking: The model being worked on is not a finished product. The vague nature in the sketch study can be reflected in the digital working environment and the search for form can be supported.
- Fast creation: It allows the model generation to be quick and the remaining time can be used with the design again.
- Natural interaction: It allows to utilize the hand and brain coordination that the architect is used to work by, in a virtual environment.
- Real time feedback: Operations in virtual environment are done in real time. The actions and the results seen on the screen are experienced at the same time.
- Transformation operations: Simple transformations can be applied on the object in the virtual environment.

This study aims to contribute to the creation of ideas in the early architectural design phase. It presents an augmented reality supported approach for initial design activity. It is tested by 10 architects with professional experience and the research goals are consistent with the survey results. This tool can be transformed into a design environment that is not only limited to tall buildings, but also it can help with design problems of all types and scales.

Created virtual objects can be exported to another file. Later, it can be used with other design tools in the computer environment. In addition, the collaborative working feature can be added to the digital production environment. Multiple users can participate in the study synchronously. This mobile environment, which can also offer the opportunity to work remotely, is expected to increase communication and add more value to the activity.

References:

Ackerman, J. S., & Slosburg-Ackerman, J. (2002). *Origins, imitation, conventions: representation in the visual arts*. MIT Press.

Akin, O. (1978). How Do Architects Design? *In Artificial Intelligence and Pattern Recognition in Computer Aided Design*, ed. J.-C. Latombe. IFIP: North-Holland Publishing Company.

Arashpour, M., & Aranda-Mena, G. (2017). Curriculum renewal in architecture, engineering, and construction education: Visualizing building information modeling via augmented reality. In *9th International Structural Engineering and Construction Conference: Resilient Structures and Sustainable Construction, ISEC 2017*. ISEC Press.

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE computer graphics and applications*, *21*(6), 34-47.

Bayazit, N. (2004). Investigating design: A review of forty years of design research. *Design issues*, *20*(1), 16-29.

Birt, J., Manyuru, P., & Nelson, J. (2017). Using virtual and augmented reality to study architectural lighting. *Me, Us, IT*, 17-21.

Füssler,U 2008, "Design by Tool Design', in *Proceedings of Advanced in Architectural Geometry (AAG'08),* Vienna, Austria.

Goldschmidt, G. (1991). The dialectics of sketching. *Creativity research journal*, *4*(2), 123-143.

Kerr, J., & Lawson, G. (2020). Augmented reality in design education: landscape architecture studies as AR experience. *International Journal of Art & Design Education*, *39*(1), 6-21.

Koutamanis, A. (2003). A Biased History of CAAD: The bibliographic version. In *Proceedings of eCAADe* (Vol. 23).

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995, December). Augmented reality: A class of displays on the reality-virtuality continuum. In *Telemanipulator and telepresence technologies* (Vol. 2351, pp. 282-292). International Society for Optics and Photonics.

Mitchell, W. J. (1990). The logic of architecture: Design, computation, and cognition. MIT Press.

Suwa, M and Tversky, B What do architects and students perceive in their design sketches?: A protocol analysis, *Design Studies Vol 18,* No:4 (1997), pp 385-403.

Smith, K. S. (2012). *Architects Sketches*. Routledge, 2-11.

Sutherland, I. E. (1964). Sketchpad a man-machine graphical communication system. *Simulation, 2(5), R-3.*

Thomas, P. C., & David, W. M. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. In *Hawaii international conference on system sciences* (pp. 659-669).

URL-1, *Pivot App.* Retrieved 06.10.2020, from http://www.pivottheworld.com,

URL-2, *Google Developers Blog.* Retrieved 06.10.2020, from http://developers.googleblog.com /2020/08/instant-motion-tracking-with-mediapipe.html

URL-3, *Unity*. Retrieved 06.10.2020, from http://www.unity3d.com

URL-4, *Google ARCore.* Retrieved 06.10.2020, from http://developers.google.com /ar/discover

URL-5, *MahaNakhon – Büro Ole Scheeren*. Retrieved 15.11.2020, from https://buro-os.com/projects/mahanakhon

URL-6, *DownTown One Tirana – MVRDV*. Retrieved 15.11.2020, from https://www.mvrdv.nl/ projects /388/downtown-one-tirana

URL-7, *Taipei Twin Towers – MVRDV*. Retrieved 15.11.2020, from https://www.mvrdv.nl/ projects/371/taipei-twin-towers

Journal of
Design Studio
v:2 n:2 December 2020

Artistic Skills and Scientific Abilities in Architectural Education

Adil Zamil Manshad Al-Saidi
Al-Nahrain University / College of Engineering / Department of Architecture, Jadriah, Baghdad, Iraq,

Received: November 24th 2020, Revised: December 12th 2020, Accepted: December14th 2020
Refer: Al-Saidi, A. Z. M, (2020), Artistic Skills and Scientific Abilities in Architectural Education, Journal of Design Studio, V.2, N.2, pp 143-152,

ORCID: 0000-0002-8488-459X
DOI: 10.46474/jds.830497 https://doi.org/10.46474/jds.830497

Abstract: The integration between art and science is required for the student in the department of architecture. This paper concentrates on the importance of integration between artistic skills and scientific abilities for the student to achieve high quality level of learning in the department of architecture in Iraq. It analyses the criteria of the architectural education and the educational method used. It demonstrates the integration relationship between art, science and architecture. It follows a descriptive analyses methodology to investigate the skills and abilities required for the student to cope with the criteria of architectural education. It conducted a case study on students in the department of architecture in Iraq to explore the impact of having these skills and abilities on the student's progression. It explains why a few students only graduate with high grades. The results obtained showed that the integration between artistic skills and scientific abilities is very important for the students. On the other hand, developing the artistic skills is harder than developing the scientific abilities in architectural education.

Keywords: Architectural education, artistic skills, scientific abilities, creativity, aesthetic sense.

1. Introduction

There are two types of requirements for the student in the department of architecture. One of them is related to science and the other is related to art. What is related to science includes the new technologies in building construction materials and systems and computer programs used in architectural presentation. These requirements are important and if they are not met by the student, they will be negative points that cannot be defended and they are similar at all projects and will be a justification for challenging the project. The artistic requirements are related to the distinction of a project from other projects and a student from another. The evaluation is based on the opinion of the public, whether local or global, and that the evaluation criteria are linked to prevailing and renewed values and what is proposed in these projects in terms of new ideas, forms and different methods of treatment for new problems such as sustainability. The variation in the artistic aspects differs from one student to another depending on the experience, specialization and culture in the field of architecture. The aesthetic requirements appear in the external form, the internal perspective and the presentation technologies. They could be seen in new principles proposed in specific time such as flowing space, mega structure and sustainability. The new product is often compared with well-known things to see the extent of its distinction and its compliance with artistic requirements.

Art was associated with architecture since its inception, as in the caves paintings inhabited by man, where the drawings on the walls documented the nature of the life he lived. On the other hand, the continuous scientific developments have a great impact on architecture especially in building materials and technologies and in architectural presentation. Art, science and architecture developed and there was a relationship between them in each stage of this development. Classical architecture extended for a long time and when the art movements developed in Art Nouveau and the discovery of new building materials, modern architecture emerged. This resulted in moving away from details and historical elements. The new concepts in art and science had new and different influences on the new architectural movements such as post-modern architecture, international approaches in architecture, and high- tech approaches in architecture, deconstruction, and sustainable architecture.

2. Architectural education

Architectural education requires many artistic skills and scientific abilities. Artistic skills are drawing, presentation, projection and imagination. Scientific abilities are building codes and standardization, cope with new building materials and technologies, cope with computer programs used in architecture and Dealing with recent problems emerged. These requirements related with thinking, designing, presentation and building. The main course of this education is design where the students should learn two types of knowledge; conceptual design and materialization. Conceptual design deals with forms and compositions. Materialization is based on forms affected by building materials and systems. Architectural education depends on artistic ability, dealing with building materials and cope with new technology (Völker, H., et al, 1996, pp.90). The integration between artistic skills and scientific abilities is very important to achieve high level of learning for the students as it is shown in figure 1.

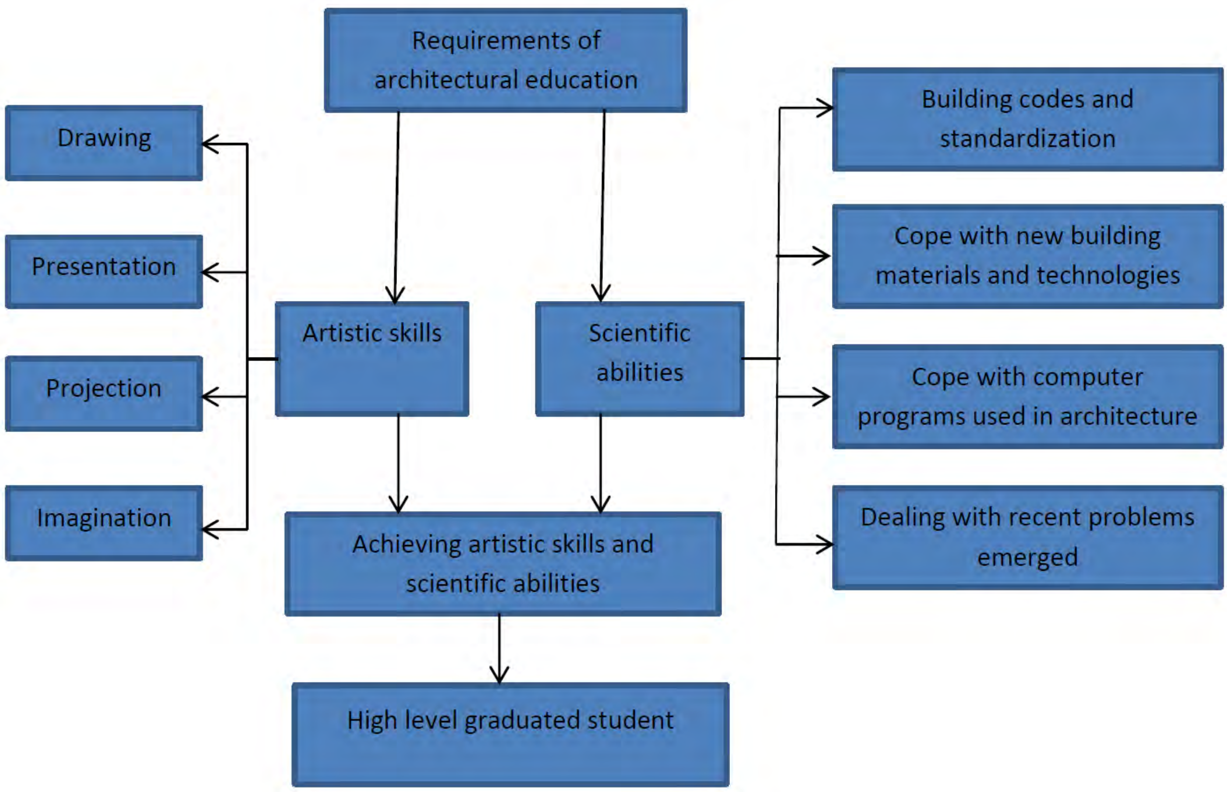


Figure 1 *The artistic skills and scientific abilities in architectural education*

The main objectives of the architectural education about design according to the UNESCO are the requirements of beauty and the building technologies as creative abilities for the students (Uzunoglu, S., 2012, pp. 93). Architectural education involves acquiring the ability to create architectural designs that meet both aesthetic and technical requirements. Adequate knowledge of architectural history and theories, related arts, technology and human science, knowledge of the fine arts as an influence on architectural design quality. The academic program prepares students who can further their knowledge of the art and architectural sciences (Farahat, B., 2011, pp.749).

The core criteria for architectural education varied widely across countries, the core requirement areas could be generally defined as design philosophy, technological frameworks, design documentation and professional practice (Bhattacharjee, S., and S., Bose, 2015, pp. 586).The educational programs were implemented in architectural education and included experimental studies to familiarize students with the basic principles of artistic movements that form the basis of the visual arts (Dizdar, S., 2014, pp, 277). In architectural education the studios are the locations where education in architectural design is encountered. They depend on the concept of skill building and exchanging ideas. The basic problem for the educational element and the student in the design studios is that there is no method which fits every student (Dizdar, S., 2014, pp. 278).

2.1. Educational methods

The integration between science and art should be applied in the educational methods. Educational methods are the way to organize the cognitive activity of the learner to ensure the acquisition of the student's knowledge and skills in the education process. Teaching methods used in an educational environment such as: lecture method, group discussions, individual presentations, assignments, seminars, workshops, conferences, brainstorming and role-playing. Brainstorming is a form of discussion for generating ideas that allows group members to participate equally and develop listening abilities. It is used to solve problems, to make decisions and to think creatively. Brainstorming also fosters team building.

Listening to music is also an effective method for awakening the senses. It is important for experiencing and exploring the aesthetic feelings. Reading/listening poems of famous poets, reading sections from classics are also valid for stimulating the senses, watching films is another way of understanding aesthetic experience (Uzunoglu, S., 2012, pp. 94).

The art of reading can be of great benefit to the brain. The architecture students should have the ability to learn as much as they can; in fact about all related things. Books exercise the brain and provide motivation and fill it with knowledge that makes it easy to create creative connections.

When considering all the details about the educational history of students in architectural design, it is clear that learning needs to be addressed from the perspective of creative thought. Given the characteristics of architectural design students who were short of imaginative training in their former school research and the real situation of our conventional frontal teaching model, the question of enhancing creative thinking in architectural education needs to be addressed (Irouke, V. and J., Ahianba, 2013, pp. 82).

2.2. The integration in practice

Learning architecture depends mainly on practice. The question of the relationship between the education provided and the skills required for successful practice is obviously of paramount importance in academic institution, which offers a professional degree in architecture. The design and general philosophy of the program are in line with the expertise provided in the school and the role of architects in society. In offering better conditions for contemporary communities, architecture as a discipline would be justified. In recent years, the architectural profession has shifted, but the educational method, especially in architectural education in the Middle East, has changed.

The Gropius Bauhaus tradition influenced architectural education with on the one hand, the 'learning by doing' approach and on the other hand, the interest in analyzing spatial associations with the human body and objects encountered by individuals. In the Bauhaus curriculum, which evolved with the theory of Gestalt perception, the student proceeds through apprentice, traveler and master during the educational phase, which includes all the required applications for the level of creative work and the science fields (Dizdar, S., 2014, pp, 277).

The Gropius program at the Bauhaus honored craftsmen and apprentices: Gropius envisaged practical training of artisans as individual artists or architects (Rosenberg, F., 2012, pp. 102). It is believed that only a minority of the student body, since only a handful has an eye for architecture, would become professional architects. Thus, creative thought in architectural education was removed from the teaching of basic tools. Artistic training contained instructions on how to achieve successful design and beyond those parameters only the genius was tolerated. Art can be interpreted with romantic approaches some of which can be disregarded as rational. Architectural research was explored in two ways: establishing an aesthetic purpose and establishing scientific expertise for architectural practice (Rosenberg, F., 2012, pp. 108).

2.3. The integration between art and architecture

Many architects are masters of art before they have been architects such as Le Corbusier and Da Vinci. Being craftsmen helped them in dealing with formal details in architecture and was a direct reason for their success and distinction in architecture. They are artists in the first place and this provided the appropriate background for the practice of architecture, as it is highly related to artistic requirements. They practiced architecture as part of their artistic work and they used to mix art and architecture in their work. They use paintings in the walls and ceilings, as well as the sculptures that adorn the interior and exterior spaces of the buildings. In addition, they design the fountains, the gardens, and the statues within the architectural forms of the buildings.

In comparison between art and architecture, cubism is very similar to modern architecture in terms of the physical forms found in the paintings and what are resembled the facades and plans of buildings. The layouts and the colors are inspired architects to produce their architecture such as the works of Picasso and Mondrian. Also, the techniques used in forming shapes are similar, once there are straight lines and sharp geometric shapes similar to architectural products and flexible shapes such as Dalí's time plate resemble molded architecture as in the Aliyev Center for Zaha Hadid.

Architecture, described as the mother of all arts, is recognized as a valid form of creative art, because something is formed where nothing once existed. Any architectural training includes making, drawing, modeling or constructing, the belief that architectural education is inherently creative (Snell, K., 2014, pp. 38). Architecture is a collaborative method for the planning, design and construction of building structures. While the artist’s work from the reality to abstract, the architects have to work from abstract to fact. Although art may legitimize itself as an entity or as a case, architecture dissolves into a flourishing structure. Architecture, with all its constraints on engineering protection, efficiency, climate responsibility and economy, is a discipline to inspire us in the abstract with ideas on space and light quality (Bhattacharjee, S., and S., Bose, 2015, pp. 579).

In terms of aesthetics, such as variety, harmony, rhythm, contrast and hierarchy, there are common concepts between architecture and art. In architectural education, these concepts have a great influence on architecture. The use of these concepts allows students in their projects to create successful forms, spaces and masses.

Insert visual materials are important in class to improve the students' sense of aesthetics. The literature related to art and architecture encourages the students to understand the main items of aesthetics in their presentations. It improves their abilities to interact with art from different points of view. It is also growing up the ability to discuss and understand architectural design with its relationship with art. The philosophy of aesthetics that support their projects will be easy to understand by the students (Uzunoglu, S., 2012 pp. 93). Architecture should be seen as an art in order to combine the philosophy of aesthetics with architecture (Uzunoglu, S., 2012 pp. 96).

In Iraq as a part of Middle East architecture schools, where students are encouraged to study picture books, the attitude of viewing architecture as an art can be found. What makes the situation worse is the influence of Western trends that have conquered architectural education in the Middle East and that even Western architecture has influenced the profession crisis (Farahat, B., 2011, pp.744)

A certain art world agent recognizes the historical or artistic significance of an object or type of thing. In this way cave paintings, religious objects, distinctive pieces of furniture, some embroidered quilts and some modern Italian cars were taken over by the art world and were given art status even though they were not art before this recognition (Davies, S., 1994, pp.10).

Although some buildings designed by architects are works of art, most buildings designed by architects are not of any type. Arguing that architecture is an art form is simply to argue that architects are artists who while performing their position, must produce works of art. Whereas if architecture is not an art some architects may achieve the status of artists. On the other hand, some buildings may have seen as art. Since architecture practice is subject to all kinds of regulations and restrictions, architecture can't be an art form. The construction of permanent, stable buildings shall abide by the gravity laws and the related properties of the material used.

The knowledge of fine art is also important to improve the design quality for the students. Artists give their ideas physical form, rendering abstract concepts, tangible by their creative action on the materials of their art. They integrate these immaterial concepts into their work, from their imagination (Snell, K., 2014, pp. 9). Art has the potential to inspire and transform the public by helping them to transcend their everyday worries and feelings.

2.4. The integration between science and architecture

The scientific development in construction techniques and the production of new building materials have greatly influenced architecture even since the early periods. The production of huge buildings such as pyramids and the techniques of stone lifting and the observation of the movement of the sun and its entry at specific times to certain places of the building.

On the other hand, the techniques used in hanging gardens and the mechanisms used to transport water to trees have had a great impact on the development of architecture. In modern architecture, the discovery of iron and concrete led to major change in the shape of architecture as its move away from arched shapes and domes to the horizontal shapes and openings. The possibilities provided by the new materials and glass, high-rise buildings, skyscrapers and towers of various forms have appeared. The development of forming iron and concrete, many architectural shapes have emerged. Base on the vision and ideas of the architectural designer, buildings were formed with organic and circular shapes.

With the industrial development, many new building materials such as plastics, polymers, as well as facade cladding materials, have appeared and have become popular in use recently. So, construction methods and materials are moving away from traditional approaches. Construction methods are developed and it became possible to extend the space of the cantilever to longer distances and to produce suspended, inflated, shell and many free shapes. This development gave a great freedom to the designer in the forms that s/he thinks about or even that s/he imagine. It gave a strong impact on architectural forms and develops the designers' ideas.

As a result of energy saving and carbon mitigation, new types of architecture have been emerged such as sustainable architecture and green architecture. Buildings have been produced in forms that help to adopt these principles, such as the Gherkin tower, Madrid tower, and the Central Bank of Iraq.

At the same time as industrial revolution and advancement in various fields of science such as structural engineering , architecture departed from the modern structural applied technology and such a delay caused architecture to lose its control over the materials and construction of new buildings such as the grand hall of exhibits, shops and large roofed factories and other types of large-scale infrastructure buildings and even structural engineers sit back from work space.(Ranjazmayazary, M., et al, 2016, pp1).

Structure has undeniably been an integral part of architectural art throughout history, in reality. As historical architectural considerations tend to incorporate structure as an aesthetic feature, the structure and its association with architecture were expressed in the changes that took place in the 18th century, an era in which iron and glass were later known as large-scale construction materials. These industrial-era materials and architectural principles of manufacturing and higher steel strength were recognized and seen more in the factories, exhibition buildings and bridges. This can more or less be seen in the façade and structures of the Crystal Palace building, the Eiffel car gallery and the Sun bridge structure.

Two main characteristics were defined by the architectural type: the creation of a free plan and the creation of continuous glass surfaces on the house façade. Concrete, steel, glass and timber are the most common materials for use in the field of modern building. This attitude is obvious in Nervi's works. These innovations, later known as high-tech architecture, led to the introduction of new types of architecture. An aesthetic structure combined with technology to create architectural work is stressed by his architectural school supporters.

2.5. Creativity

The main task for the students is how to produce creative works. Creativity is an original form of cognitive skill and problem-solving that encourages individuals to use their knowledge in a way that is special and oriented toward a product (Irouke, V., and J., Ahianba, 2013, pp 78). It is artistic while traditional artistic practices (painting, sculpting, drawing, writing, dancing, performing or composing music to name a few) are widely accepted as creative activities. Art is not the only model on which a concept of creativity can be focused. The aim of the creativity form has been organized so that architectural education is included under the fine arts roof (Dizdar, S., 2014, pp, 277).

Creative thinking in architectural design education a series of actions to address a design problem need to be done. Studying at design studio, According to architectural education objectives, students should be prepared not only to acquire theoretical knowledge but also to turn this knowledge into practical practice through their imagination. Design is focused on know-how, practice and knowledge gained. It's understood as the product of cycles of thought. The architectural designer thinks about the entire spectrum about design parameters and specifications such as the proposal's esthetic and formal qualities (Irouke, V., and J., Ahianba, 2013, pp. 79).

In every discipline where one encounters new challenges which require a unique solution, creative problem solving is required. Having artists give ideas physical form, rendering abstract principles, tangible through their creative action on the materials of their craft. It is a non-scholarly platitude that creative people make creative objects, engaged in creative processes (Snell, K., 2014, pp. 38). Architectural design process is situated on a linear scale between two opposites which are science and artistic processes, one of which considers this process to be fully opaque and the other to be completely transparent (Abowardah , E.,and M., Khalil, 2016, pp. 3).

Architecture schools should take action to promote student innovation. They should encourage students to participate in brainstorming. It helps them to come up with new ideas and help them to choose the creative ones. They should promote the habit of carrying small papers, pen and pencil. This is because certain ideas come as a spark, and once it happens, the student will find it quickly. Every design project requires a clear description of its design problem. Often the design role can appear very vague before specifics of the problem are identified. If a student is stuck to think when trying to solve a problem with design, he should possibly go for a stroll. At this time, a change of environment is good and some researchers have noted that gentle exercise helps to shake the brain cells

2.6. Aesthetic Sense

The curriculum should give considerable importance to the subjects in order to improve the students' aesthetic senses, helping them to solve aesthetic-related problems. For architectural projects, these issues inspire students to create new mental pictures. In all art disciplines, enhancing the sense of aesthetics could be seen as a foundation and it allows students to exercise art work with architectural design. Aesthetics broadened the students' architectural knowledge by making them gain significant values such as aesthetic philosophy and its importance in architectural design. The students who took the course aesthetics considered these values on their architectural design projects (Uzunoglu, S., 2012 pp. 97).

2.7. Presentation methods and technologies

The development of drawing and presentation methods also had a great impact on the development of architecture, especially after the use of computer programs such as AutoCAD, 3DMax, Revit, Lumion, and Photoshop. These programs assist the architect to produce complicated shapes and they provide the ability to see these shapes before implementation and modification. This is available to all architects, which led to develop their potentials. The wide use of computer programs by architects develops new architectural shapes and movements with new capabilities such as parametric and dynamic architecture. It also, led to find new techniques such as creating masses and openings that are changed according to heat at the elevation of the Arab culture institute in Paris.

Different strategies have been explored to develop the presentation technologies in architectural education. Some of them have turned tracking points into individual objects, varying their size and/or rotation based on movement speed to create expressive appearance. Others were lofting a surface along the tracking tracks. These technologies began developing a design identity for the students. They assist the students to face the challenge of turning the projects into physical sculptures. The students had to invent a construction logic which could be implemented using the laser cutter to build their models for example.

In turning motion capture paths into digital models the students followed different procedures. They focused on form generation through movement. Sculpting motion is taught at IAM and the Harvard GSD schools of architecture. Creating suspended sculptures of motion is usually helpful in their projects with limited amount of time. The task context involved reflection on motion in art and architecture, where it has long been a central theme. Theories about its importance and its expression were developed especially in the modern movement, inspired by contemporary discoveries in mathematics and physics (Spiridonidis , C., and M., Voyatzaki, 2007, pp. 30).

Interaction between humans and computers focuses not explicitly on the creation of objects, but on the possibilities for interaction between

Table1. The detailed evaluation of the students in the academic courses

Students under evaluation	Courses					
	Freehand drawing	Architectural graphics	Computer applications	Building construction materials	Advanced building technologies	Design
Student No. 1	2	3	3	1	3	2
Student No. 2	2	2	3	2	2	2
Student No. 3	1	2	2	2	2	1
Student No. 4	2	2	2	1	3	2
Student No. 5	1	2	3	1	2	1
Student No. 6	4	4	5	4	5	4
Student No. 7	1	1	2	1	2	1
Student No. 8	2	2	3	2	3	2
Student No. 9	2	2	4	1	3	2
Student No. 10	3	4	3	2	4	3
Student No. 11	1	1	2	1	2	1
Student No. 12	3	3	5	4	4	4
Student No. 13	2	3	3	2	3	2
Student No. 14	1	1	1	1	2	1
Student No. 15	3	2	2	1	2	2

them. The challenge is how to build resources that allow students to bring their imagination and new possibilities into the design process. By using computer software in a very unconventional way the students had to create, change and envision formations of different objects and the relationships between them as design proposals in reality.

The computer is becoming a tool for both the mind and the hand, increasingly. It is a construct tool which the students can build their projects virtually. The students utilize their computer using skills as part of their design process. The use of rapid prototyping systems such as 3D Printer, Laser Cutter, CNC milling machine was available and must be viewed as part of the overall context of the student's work. It is conceived that the process of design as being augmented by things- such as hybrid meta model of things and machines that help in thinking.

3. Case study

The case study is conducted on 86 undergraduate students in the department of architecture in Iraq. It depends on the student's grades in the departments courses. These courses at Al-Nahrain University have been classified into two classes. One of them is the courses that require artistic abilities such as architectural graphics, freehand drawings and computer programs used in architectural presentation. The other courses require scientific abilities such as building construction and materials, advance building technologies and computer applications. The grades of these two types of courses have been compared with the students' grades in the design course. The evaluation of the students was divided into five categories which are 1 from 50-59, 2 from 60-69, 3 from 70-79, 4 from 80- 89, 5 from 90-100 as they are shown in table one.

3.1 The results for the case study

The results obtained demonstrate that the students who have artistic skills and they cope with the new scientific developments in building construction and computer applications achieve high grades in the design course. The ability of imagination, thinking, drawing and presentation of those students is higher than those who have less artistic skills and scientific abilities. These skills and abilities are important for the student as tools to continue at the department of architecture with high grades.

Table2. The ratio of students with artistic skills and scientific abilities

Ratio of students	Freehand drawing	Architectural graphics	Computer applications (Drawing programs)	Building construction materials	Advanced building technologies
	Artistic skills			Scientific abilities	
8%		●		●	
14%		●		○	
30%		○		●	
48%		○		○	

● High level, ○ Low level

Note: Computer applications (Drawing programs) involve artistic skills and scientific abilities

The results show that 8% of the students represent high level of artistic skills and scientific abilities especially in computer applications and they got the highest scores in the design course. The students, who have high level in artistic skills and lower level in scientific abilities form 14% and they gain the second highest grades. About 30% of students present high level of scientific abilities and lower level of artistic skills and they got the medium grades in design. The students with lower artistic skills and scientific abilities got the lower grades and they form 48% of the students.

The curriculum of the school in case study presents a lack in practicing new building construction systems and materials and using advanced building technologies. On the other hand, it contains a high level of knowledge in computer applications using in drawing and presentation such as Revit, 3D Max and AutoCAD. The curriculum involves two year courses of architectural graphics and freehand drawings but they take less importance than computer programs

4. Conclusions

The paper explored the reason behind the low rates of most of the graduated students in the departments of architecture in Iraq. As there is a difficulty in developing the artistic skills for them and finding the integration with the scientific abilities in architecture. The integration between the artistic skills and the scientific abilities is very important for the students. They form the main tools to continue with studying at the department of architecture. It is important for the department to support these skills and abilities through the curriculum especially in practice. Developing the artistic skills is harder than developing the scientific abilities in the department of architecture. The accepted students with higher level of artistic skills cope faster and easier than those who have less level. Artistic skills are more important than the scientific abilities for the students but the integration between them is the best. Creative thinking in producing form, function and construction is the main task the student should practice.

References:

Abowardah , E.,and M., Khalil, (2016), "Design Process & Strategic Thinking in Architecture" ,Conference Paper · March 2016, https://www.researchgate.net/publication/328130631 , Proceedings of 2016 International Conference on Architecture & Civil Engineering (ICASCE 2016) London, March 26-27, 2016.

Bhattacharjee,S., and S., Bose, (2015), "Comparative analysis of architectural education standards across the world", ARCC 2015 Conference – The Future of Architectural Research (Chicago, IL).

Dizdar, S., (2015), "Architectural education, project design course and education process using examples, Procedia - Social and Behavioral Sciences 176 (2015) 276 – 283, IETC 2014, Available online at www.sciencedirect.com 1877-0428 © 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license.

Farahat, B., (2011), "Architectural Education Future Experience in Designing a New Curriculum for Undergraduate University Education in Architecture", Proceedings of EDULEARN11 Conference. 4-6 July 2011, Barcelona, Spain. ISBN: 978-84-615-0441-1.

Irouke, V., and J., Ahianba, (2013), "Advancement of Creativity in Architectural Design Education" A.A.U. Journal of Environmental Studies Volume 1, Number 1, June 2013.

Ranjazmayazary, M., et al. (2016), "Comparative Study on Architectural Contemporary Schools Based on Interaction of Form, Function and Structure", Journal of Architectural Engineering Technology, J Archit Eng Tech 2016, 5:4 DOI: 10.4172/2168-9717.1000174, Volume 5 , Issue 4 , 1000174.

Rosenberg, F., (2012), "Science for Architecture: Designing Architectural Research in Post-War Sweden", Architecture Culture and the Question of Knowledge: Doctoral Research Today, Spring 2012, pp. 97-112.

Snell, K.,(2014), "Towards a New Paradigm in Architectural Education", Faculty Publications and Scholarship. Paper 2.http://source.sheridancollege.ca/fast_arch_publ/2.

Spiridonidis , C., and M., Voyatzaki, (2007), "Teaching and Experimenting with Architectural Design: Advances in Technology and Changes in Pedagogy", EAAE-ENHSA Architectural Design Teachers' Network Coordinator, School of Architecture, Aristotle University of Thessaloniki, Greece EAAE-ENHSA Construction Teachers' Network, ISBN 2-930301-32-5.

Stephen Davies, S., (2015), "Is Architecture Art?", In book: Philosophy and Architecture (pp.31-47), Rodopi, University of Auckland, ResearchGate.

Uzunoglu, S., (2012), "Aesthetics and Architectural Education", Procedia - Social and Behavioral Sciences 51 (2012) 90 – 98, ARTSEDU , Elsevier Ltd.

Völker, H., et al, (1996), "The Next Generation of Architecture within Computer Science" Proceedings 6th EFA-Conference, Vienna, pp. 89-96.

Journal of
Design Studio
v:2 n:2 December 2020

Teaching Architectural Design Studio Remotely: The Introduction to Architectural Design Course at METU

Esin Komez Daglioglu
Middle East Technical University, Faculty of Architecture, Ankara, Turkey (Corresponding author)
Ekin Pinar
Middle East Technical University, Faculty of Architecture, Ankara, Turkey
Ipek Gursel Dino
Middle East Technical University, Faculty of Architecture, Ankara, Turkey
Pelin Yoncaci Arslan
Middle East Technical University, Faculty of Architecture, Ankara, Turkey
Funda Bas Butuner
Middle East Technical University, Faculty of Architecture, Ankara, Turkey

Received: November 3rd 2020, Accepted: November 11th 2020
Refer: Daglioglu Komez, E., Pinar, E., Gursel Dino, I., Yoncaci Arslan, P., Bas Butuner, F., (2020), Teaching Architectural Design Studio Remotely: The Introduction to Architectural Design Course at METU, Journal of Design Studio, V.2, N.2, pp 153-157,

E. Komez Daglioglu ORCID: 0000-0002-8598-6213, E. Pinar ORCID: 0000-0002-8367-1234, I. Gursel Dino ORCID: 0000-0003-2216-9192, P. Yoncaci Arslan ORCID: 0000-0003-3908-0653, F. Bas Butuner ORCID: 0000-0002-6203-9002,
DOI: 10.46474/jds.820352 https://doi.org/10.46474/jds.820352

Abstract: This paper aims to briefly assess the potentials and limits of online learning environment for studio education by focusing on the case of 2019-20 spring semester studio of Introduction to Architectural Design course at Middle East Technical University's Department of Architecture. As a transitory course between basic design principles and architectural design, Introduction to Architectural Design addresses the issues of site, program, structure, form, and material in reference to small scale architectural interventions. Reviewing the usual course of the semester until the COVID-19 outbreak as well as the effects of the unexpected switch to the emergency distance teaching, the paper highlights both the creative advantages and material shortcomings of the course's adaptation process into the online studio format.

Keywords: Architectural Design Studio, Exploratory Design Education, Emergency Distance Teaching

Introduction to Architectural Design course, given at the second semester of the first-year design studio at Middle East Technical University (METU) Department of Architecture, is a transitory course between the basic design studio of the first semester and the architectural design studios of the following years. It aims at developing the skills for rapport between basic design principles and architectural design. Therefore, it addresses the issues of site, program, structure, form, and material in reference to small scale architectural interventions. These objectives shaped the principles of three distinct yet interrelated assignments of the spring semester studio of 2019-20. In the first assignment titled "Bodyscapes," our main aim was to understand the relation between the body, movement and space. This assignment asked the students to position their body in physical relation to a specific land that they would choose from the METU Campus. Following the example of artist Dennis Oppenheim's work *Parallel Stress*, students photographically captured this moment highlighting the tension between the body and land. Afterwards, students were asked to design a vertical milieu that defines a flow of spaces, which accommodate the body postures captured and analyzed in the previous step. The second assignment titled "Eventscapes" intended to analyze and understand the relation between topography, event, and movement. In the scope of this assignment, students first observed and recorded the human movement, various uses, events and activities of a given site from the METU Campus during the course of a day as well as a week. They, then, developed an abstract map based on their site-reading, which they subsequently used as a diagram for rearticulating the topography of the assigned site.

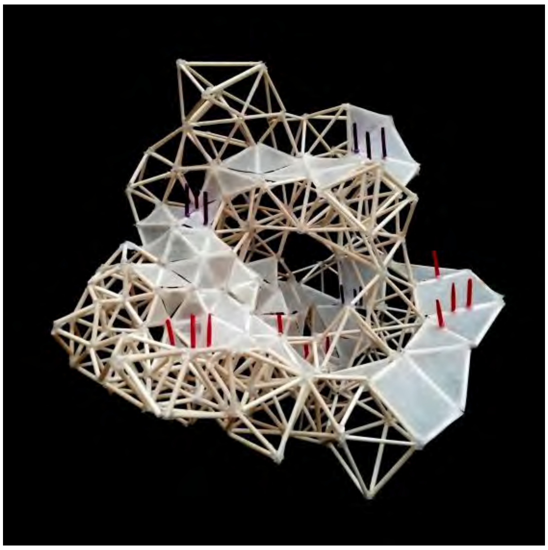


Figure 1. Dican Deniz Köse, Perform-a-scape, model technique: 3D frame with wooden sticks

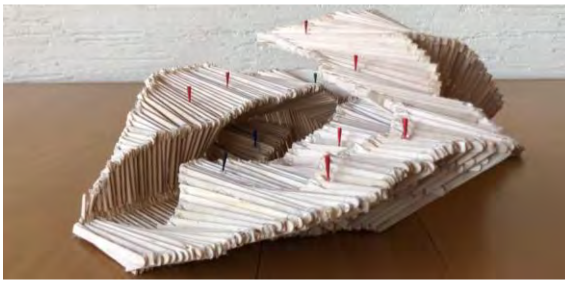


Figure 2. Nusret Atakan Harmancı, Perform-a-scape, model technique: vertical sectioning with ice-cream sticks

Figure 3. Bet l Din , Perform-a-scape, model technique: aggregation with folded paper

By the end of these two assignments, we switched to emergency distance education due to the global COVID-19 pandemic. This final assignment became our first experience in implementing studio education through online means. The final exercise titled "Perform-a-scape" began with watching the movie *Grand Budapest Hotel* (2014) directed by Wes Anderson. We asked the students to pick three scenes from the film and analyze them by using plan, section, perspective, axonometric drawings, photographs, or collages. These analytical drawings showed the characteristics (scale, indoor/outdoor, altitude, people density, color, light, enclosure degree, etc.) of each space represented within the scenes as well as the movement and interaction between them as the story unfolds. Following this analysis, we asked the students to design a *perform-a-scape* by transforming these scenes into three interrelated stages for a live performance of *The Grand Budapest Hotel*. This perform-a-scape was expected to conceptualize and accommodate these stages as well as the movement of the performers and the audience. During the digital desk crits, we emphasized that the final design should focus not on the set design of the stages but on the abstraction of their spatial aspects and positioning as well as their relation to the audience and to each other. These spatial aspects also had to take into account design considerations such as human scale, various degrees of enclosure, sequence, proportions, permeability, and accessibility. For the construction principles of the *perform-a-scape*, students used 3D frame, weaving, aggregation, or vertical sectioning. Some used readily available materials such as sugar cubes, pasta, matchboxes, etc. as their design units. Others generated units from newspapers, sketch papers, toilet paper rolls, etc. by applying operations such as folding, bending, twisting, or rolling.

hours via online platforms. Thus, we engaged with the photographs and video clips of their projects instead of the physical models. A rather indirect, digitally enhanced visual involvement replaced the immediate tactile experience. In other words, the 'flattening' effect of the computer screen became part of our online studio life. Furthermore, the scarcity of the materials and limited access to stationaries led students to use daily objects such as staplers, clothespins and sugar cubes more creatively. Along with these unusual architectural models, students also used digital drawing tools more intensely in order to improve, test and present

Figure 4. Sena Nur Cabadağ, Perform-a-scape, model technique: aggregation with staples

This final exercise was a great experiment for us to discover, test, and evaluate the potentials and limits of online learning environment for studio education. We continued to meet regularly with the students during the studio

their design decisions and consequently most of them developed mature graphical communication skills faster than those of the previous years did. In conclusion, although the remote education cannot replace the direct

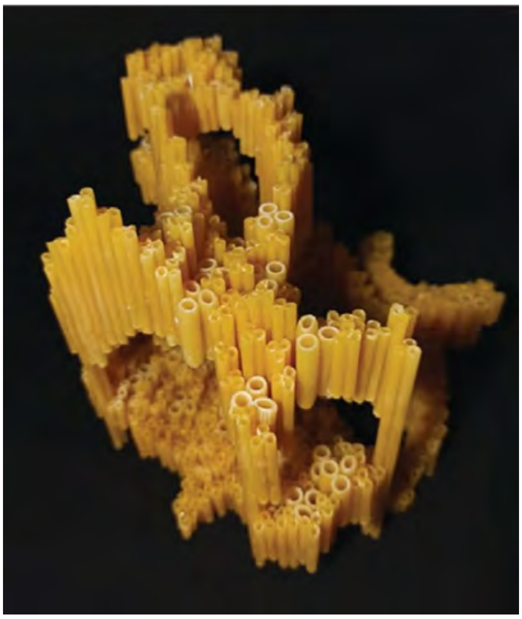


Figure 5. Suhenda Demir, Perform-a-scape, model technique: aggregation with pasta

Figure 6. Meltem Şahin, Perform-a-scape, model technique: aggregation with sugarcubes

physical interaction of the studio environment, the studio adapted to “the new normal” very quickly and established a new routine for online discussions and crits. Students continued without any substantial break by making good use of materials at their disposal in their homes. This resulted in a great diversity among the final models in terms of the variety of materials and model-making techniques. The final projects clearly demonstrate how the design skills of the students have developed in articulating the relation between form, program, structure, and material even when instructed remotely. The teaching methods and design pedagogies pursued in this particular case may provide a basis for other distance teaching and learning practices that aim to generate an interactive studio environment despite the limits posed by physical and social distance.

Acknowledgments

We would like to thank all our students for their hard work, our research assistants Zuhal Acar, Caner Arıkboğa, Elif Bekar, Ayça Duran, Beril Önalan, Öncü Özalp and Duygu Simser for their contribution and our master teacher Şenol Yağız for her support.

Figure 7. Moustafasamir Saada, Perform-a-scape, model technique: sectioning with cardboard

Figure 8. Zeynep B ra Bekar, Perform-a-scape, model technique: weaving with wooden sticks and string

Journal of
Design Studio
v:2 n:2 December 2020

Exploring Media Architecture Design in Virtual Design Environments

A Case Study of Undergrad Architecture Studio

Waldemar Jenek
Queensland University of Technology | CSIRO's Data61, Brisbane, Australia.
Glenda Caldwell
Queensland University of Technology Brisbane, Australia.
Jared Donovan
Queensland University of Technology, Brisbane, Australia.
Veronica Garcia Hansen
Queensland University of Technology, Brisbane, Australia.
Matt Adcock
CSIRO's Data61, Canberra, Australia.
Mingze XI
CSIRO's Data61, Canberra, Australia.

Received: November 13th 2020, Accepted: November 21th 2020
Refer: Jenek, W., Caldwell, G., Donovan, J., Garcia Hansen, V., Adcock, M., XI, M., (2020), Exploring Media Architecture Design in Virtual Design Environments, Journal of Design Studio, V.2, N.2, pp 159-163,

W. Jenek ORCID: 0000-0001-8771-9111, G. Caldwell ORCID: 0000-0003-0837-9310, J. Donovan ORCID: 0000-0002-8025-1947, V. Garcia Hansen 0001-5934-5554, M. Adcock ORCID: 0000-0001-6191-9887, M. XI ORCID: 0000-0003-1291-4136,
DOI: 10.46474/jds.825715 https://doi.org/10.46474/jds.825715

Abstract: This case study explores how architecture students can learn to design media architecture within virtual design environments tools. The target participants of this study are advanced (i.e. 3rd year) architecture students at the University of Applied Science, Bochum, Germany. To evaluate the student-experience, students were asked to develop a media architecture structure during the semester. Once the project finished the students provided feedback via surveys and interviews. The feedback was analysed employing thematic analysis. The case study shows that students are curious about technology in the design process and that technology has a growing relevance in an architecture career. The feedback will be used to improve future teaching approach.

Keywords: Design Education, Design Studio, Immersive Design Environment, Media Architecture, Virtual Reality.

Introduction

Architecture does not have to be something static anymore; it can be interactive and/or temporary and capable of shifting in a short time to address different problems or needs. Media Architecture is an emerging discipline which incorporates materials or objects with dynamic properties, such as interactive sources of light or moving elements, that embody physical space on an architectonic scale. Most Media Architecture installations allow dynamic interaction or show interactive content (Brynskov et al, 2015).

Immersive virtual design environments (VDE) refers to a digital environment that allows the users to interact with the digital space with devices such as VR-headset (Obeid, 2019). In this case study Virtual Reality was used with Twinmotion and VR-headsets to explore the design of Media Architecture in an undergraduate architecture studio. VDEs have the potential to refine the methods and tools of existing design processes in Media Architecture. In higher education context, they can refine the traditional teaching approaches while discovering new ways of design thinking and design solutions in architecture schools (Obeid, 2019). The purpose of this case study is to investigate virtual design environments, such as virtual reality, as a design-decision-making tool in the education process of architecture with the focus of learning about technology. It uses a modified version of Kellers ARCS Models (Attention, Relevance, Confidence, Satisfaction) (Keller, 2010). Students were asked to design a Media Architecture structure employing virtual-design-environment tools. Besides, interviews and surveys were conducted with the students to research their perceptions of the learning experience to provide recommendations for teaching architecture design using virtual-design-environment tools in the design process of Media Architecture.

Background

Virtual design environments and Media Architecture are typically not incorporated in traditional architecture curriculum at the undergraduate level when learning how to design buildings (Zhigang as cited in Haeusler et al., 2012). Zhigang (as cited in Haeusler et al., 2012) outlines that Media Architecture projects are not just shiny lights on the building. In his opinion, the purpose and function of Media Architecture cannot be designed and developed with traditional architectural approaches. He argues that new and advanced technological solutions for Media Architecture require novel approaches in the design process to be taught and learned. In response to this and to address the dynamic elements of Media Architecture this case study explores the implementation of virtual design environments with undergraduate architecture students in Germany. Most of the literature regarding design studio education focuses on how to implement software in a traditional design studio context (Gonavaram Bala Sai, 2004; Gross & Do, 1999; Guney, 2015; Kuhn, 2001; Salman et al., 2008) with limited perspectives on immersive virtual design environments for architecture. Therefore, it is necessary to introduce techniques for learning architectural design that allow students to engage, visualise, communicate, test, and develop Media Architecture with dynamic properties.

Study Design

This case study was conducted as part of an undergraduate architecture studio in Germany in December 2019. The study was designed as a five-day design intensive workshop with a mixture of lectures and design studio activities to allow students to address the assignment brief. Students were asked to design a small interactive Media Architecture structure. Figure 1 is an example of the student work that was visualised in Twinmotion during the studio.

Figure 1: Student Project by Ahsen Cavlak

This study employed qualitative methods of data collection such as semi-structured interviews (n=10) and surveys (n=9) with participating students, and observations conducted by the lead author. Ethical clearance was approved from the Queensland University of Technology QUT Human Research Ethics Committee and complied with the requirements for a negligible or low risk application (approval number: 1900000811). Design researchers such as Wei et al., (2015), Salman et al., (2008) or Mathews (2010) have used the architectural design studio to investigate the effects of technologies in the context of architectural education. This case study works to expand on their findings to further examine the impact of immersive virtual design environments. The recruiting process took place in October 2019 where students could elect to participate in this studio and the research. The participants were a mixture of undergraduate architecture students at different year levels. Overall the design studio had 28 students, and 27 submitted a project.

Figure 2. Student using VR Headset, photo by the author

Students used Twinmotion (Epic Games, 2020) which is real-time immersive 3D architectural visualization software for virtual reality and Archicad (Graphisoft, 2020) a common architectural drawing and 3D modelling software. All students had access to high-performance hardware and two virtual reality headsets (oculus rift and HP mixed reality headset) to engage with the learning content as part of the proposed immersive virtual design environment as seen in Figure 2. The qualitative data from the interviews and surveys was analysed using thematic analysis (Braun & Clarke, 2013). Therefore, following steps have been conducted: familiarisation with the data, initial coding, searching for themes, reviewing themes, defining themes, reporting findings (Braun & Clarke, 2013). Keller's ARCS motivational model (Keller, 2010), which explores the *attention, relevance, confidence* and *satisfaction* that students experience was used as a framework to evaluate the themes that emerged. The following section presents and discusses the findings in relation to the ARCS model. During the interviews, the first author careful communicated to students that critical responses and evaluations were welcome and that the purpose of the study was to improve the pedagogical approach of the design studio. Data for the evaluation of the design studio were drawn from student questionnaire and interview responses as well as observations of the learning activity by the researcher. These data were analysed to inform a recommendation for the use of virtual design environment tools in architectural education. Data was analysed by the first author to categorize themes of importance and gaps in understanding. While broadly similar in approach to studies such as Obeid (2019) and Wei et al., (2015), the analysis taken here followed a more qualitative approach in order to understand student experience and show evidence of learning success employing Keller's ARCS Model.

Findings: Student Learning Transformation

The data shows that students are highly motivated to employ developed skills in future design projects. The themes that were identified are organised under the ARCS model sub-headings.

Attention

A leading emerging theme of the conducted interviews and surveys is the significant interest in the field of extended reality. Students believe virtual design environments are an addition to the traditional design process rather than being an alternative.

Immersive design environment: One of the main emerging themes is there is a significant interest in the field of immersive design environment. Students describe the benefit of the perception of the space experiences their design proposal in virtual reality and how it allows them to make more sophisticated design decisions. Students made additional comments that immersive experiences are engaging, as they differ from other tools they have previously employed. All students enjoyed using immersive reality tools, but some express criticism if these technologies are necessary for the design process. Most students agreed that designing in a virtual design environment has an impact on their discussions, and a small number did not believe that their design ideas are impacted by the tool.

Non-immersive design environment: One of the students outlined the limitation of CAD software within the design process. He argued that he would only design looking at a screen but not experiencing space. Thus, this is an indicator of the need to employ an immersive design environment to foster a more bodily experience within the general design process.

Relevance
Students described virtual design environments as relevant for future work with clients. All participants agreed that the developed skills would have an impact on future design units mainly on the CAD skillset limitation. Many agreed to see the benefit of a future career, such as client interaction. All students agreed that the developed skills would have an impact on future design units mainly on the CAD skillset limitation. Using virtual immersive environment tools is seen more as an addition to visualisation architecture, rather than to test dynamic properties such as changing light sources, displays and moving elements. Students mentioned that they had been limited in developing their design ideas because of their limited knowledge of the immersive technology as it was new to them in the context of the architecture studio.

Content Understanding and Issues: Students had trouble defining Media Architecture, augmented reality and virtual reality or connect these topics with each other. At the beginning of the workshop, students described that they had trouble understanding the design task, which became more evident after the lecture. They indicated that they would have liked to have more time working and designing with virtual-reality headsets. One participant believed that the themes of Media Architecture and virtual design environments were not the central concept that were meant to be understood within this workshop, which indicates that the explanation of the software tools overtook the learning experiences. Therefore, the definition of Media Architecture and virtual design environments have to be presented with more depth to ensure that student comprehend these novel concepts.

Previous learning experiences: One student illustrated the limitation of their skillset at the beginning of their studies in their first assignment. He expressed a deep learning success after the workshop in reporting that the perception of this limitation disappeared. He was confident to use the software as a tool and does not feel the constraints anymore.

Identified knowledge gap: Students reported that there is a lack of software-skill-knowledge, this gap is limiting their design ideas, as students are more likely to stick to an idea which is easier to display in CAD then something complicated.

Confidence
Students reported that they are confident to employ the skills they have gained and learned in the workshop for their future architectural design work.

Learning Format: Students stated that questions during the workshop were addressed successfully. Students reported that they had the opportunity to explore VDEs themselves but also that there was enough time for the tutor to take care of the questions. Students enjoyed the clear structure of the workshop, split into two main parts. The first part was about learning the CAD and visualisation software, and the other part was a hands-on design task. On the one hand, students could employ their new skills immediately on a design task, and one the other hand, they could still access support from a tutor if something did not work out. Hence, this is an indicator to keep a clear, separated structure in the proposed learning and teaching design. In addition to that, some participants report that they enjoyed the speed of content delivery. They described that there was enough time to think things through and consider if they had missed something, but it was also not boring, which would lead to a loss of attention. Further, participants described the little breaks in between as a positive aspect; it allowed them to repeat the content for themselves or help others while the tutor was walking around helping with questions. Thus, fostering students to talk to each other and reflect for a short amount of time in between the primary content delivery helped to foster the student community experiences. This approach encouraged a collaborative design studio culture.

Satisfaction: Students reported that they were happy overall with their design and reported tremendous learning success. Many of them said that the limitation of the software tool was better understood. Students reported that they were satisfied with their design which resulted despite the short amount of time they had to work on it, regardless that they realised there is room for improvement. Therefore, students could prove their concept with the new tools and did not get frustrated because of their limitation of the knowledge how to employ the tools. The amount of content they produced was appropriate for that level of learning and in comparison, to other architectural studio outcomes.

Conclusion/ Future Work

Students were curious about Media Architecture and how to design it. The data analysis showed that there is a knowledge gap in understanding Media Architecture and virtual design environments. Students mix the definitions of the concept of Media Architecture as physical interactive structure with the virtual design environment, which was employed as a design tool. Besides, the content for the following case studies as part of a larger research project will be adjusted to place more emphasis on the understanding of Media Architecture and virtual design environments as design tools.

References

Braun, V., & Clarke, V. (2013). Successful qualitative research: A practical guide for beginners. SAGE.

Brynskov, M., Dalsgaard, P., & Halskov, K. (2015). Media Architecture: Engaging Urban Experiences in Public Space. In J. Lossau & Q. Stevens (Eds.), The Uses of Art in Public Space (pp. 51–66). http://site.ebrary.com/id/10994059

Epic Games. (2020, November 13). Twinmotion. https://www.unrealengine.com/en-US/twinmotion

Gonavaram Bala Sai, S. S. (2004). Interactive teaching model: A proposal to integrate basic architectural design pedagogy with digital media [M.S., University of Missouri - Columbia]. http://search.proquest.com/docview/305162912/abstract/9DAE3AE8C951488BPQ/13

Graphisoft. (2020, November 13). Archicad. https://graphisoft.com/

Gross, M., & Do, E. (1999). Integrating digital media in design studio: Six paradigms. Proceedings of the American College Schools of Architecture Conference, Minneapolis, gub.

Guney, D. (2015). The Importance of Computer-aided Courses in Architectural Education. Procedia - Social and Behavioral Sciences, 176, 757–765. https://doi.org/10.1016/j.sbspro.2015.01.537

Haeusler, M. H., Tomitsch, M., Tscherteu, G., & Berkel, B. van. (2012). New media facades: A global survey. Avedition.

Keller, J. M. (2010). Motivational Design for Learning and Performance. Springer US. https://doi.org/10.1007/978-1-4419-1250-3

Kuhn, S. (2001). Learning from the architecture studio: Implications for project-based pedagogy. International Journal of Engineering Education.

Mathews, J. M. (2010). Using a Studio-Based Pedagogy to Engage Students in the Design of Mobile-Based Media. English Teaching: Practice and Critique, 9(1), 87–102.

Obeid, S. (2019). The influence of virtual reality on design process creativity in basic design education [PhD Thesis]. Bilkent University.

Salman, H., Laing, R., & Conniff, A. (2008). The Changing Role of CAAD in the Architectural Design Studio. The Built and Human Environment Review, 1, 25.

Wei, X., Weng, D., Liu, Y., & Wang, Y. (2015). Teaching based on augmented reality for a technical creative design course. Computers & Education, 81, 221–234. https://doi.org/10.1016/j.compedu.2014.10.017

Journal of
Design Studio
v:2 n:2 December 2020

Lacunae in the Forest: A Phenomenological Approach in the Interior Design Studio

Veli Şafak Uysal
Istanbul Bilgi University, Faculty of Architecture, Istanbul, Turkey (Corresponding author)
İpek Kay
PhD Candidate, Istanbul Technical University, Architectural Design Computing Program, The Department of Informatics, Istanbul, Turkey

Received: November 6th 2020, Revised: November 26th 2020, Accepted: November 29th 2020.
Refer: Uysal, V.S., Kay, I.,(2020), Lacunae in the Forest: A Phenomenological Approach in the Interior Design Studio, Journal of Design Studio, V.2, N.2, pp 165-171,

V. Ş. Uysal ORCID: 0000-0002-2362-3994, I. Kay ORCID: 0000-0001-6302-1341,
DOI: 10.46474/jds.822690 https://doi.org/10.46474/jds.822690

Abstract: This brief case study presents the general framework, process, and results of a vertical design studio unit, titled Phenomenologies, at Istanbul Bilgi University's Interior Design Program, supported by student work samples. Centralizing the tensions between interiority and the natural environment, the studio explores the role that nature plays in interior design. The process begins with an experiential inquiry on windows; later to be expanded and complexified by other spatial elements such as doors, stairs, ramps, and bridges. In the end, the students develop proposals for a research, learning, and recreation center that aims at problematizing and restoring our relationship to nature in the context of a lake ecosystem.

Keywords: Spatial experience, spatial narratives, architectural phenomenology, nature, water, window

Introduction:
Interaction between man and nature has always been critical to the design and development of the built environment ever since the very first instances of human shelters. Today, however, natural elements usually find their way into architectural and interior design projects as a visual accessory and an ocular-centric object of affection: that is, in the form of decorative greenery, natural light, and various bodies of water (i.e. fountains, water canals, and reflective pools). These aestheticized approaches perhaps unintentionally but inevitably end up moving us further away from our inherent connection to nature by disregarding the abundant multiplicities and values that nature retains. It is our belief in this regard that the studio environment provides for an excellent opportunity for facilitating an explorative inquiry into the recent transformations in the ecological, socio-cultural, religious, political, and economic significance of nature. We thus ask: In the cross-section of the relationship between the interior and the exterior, how can we genuinely contest deep-seated sensitivities about the natural environment through interior design and negotiate these multiplicities throughout various scales and concerns?

With these concerns in mind, in the Fall semester of 2019-2020 academic year, we focused on Gölcük Nature Park, Bolu (GNP) and its nearby surroundings as part of a vertical design studio unit, titled Phenomenologies, at Istanbul Bilgi University's Interior Design Program. The studio consisted of seventeen third- and fourth-year interior design students. In approaching the problem, we conceptualized GNP as a lacunary site. 'Lacunary' here referred both literally to the Gölcük Lake, which is an artificial lake itself, and metaphorically to the notion of *lacuna*, which means "a gap, emptiness, cavity, void" and "an interval, spacing, aperture". In responding to their problem, all students approached the Gölcük Lake as a negative space and a clearance for restoring our relationship to nature.

Approach:
Interior design is not only a cultural medium that reveals characteristics of a historically typical design attitude with a particular set of values but is also a mechanism of negotiating our relationship with nature. Within this framework, we approached GNP as a site that embodied various narratives of framing, accessing, and consuming nature. It was a conscious choice to invite interiority into nature, rather than vice versa. We deliberately approached natural environment as the existing 'shell' during the analysis phase and still tried to create a sense of interiority within an outdoor space during design phase. Our pedagogical approach was distinctly phenomenological: The students not only centralized multi-sensory experience of the natural and built environment as a design method but also formulated their design ideas and architectural programs via their own experiences of and engagements with the site. Another important factor was the iterative nature of the process: The students were exposed to a cyclical series of exercises that gradually grew more complex in nature and broader in context. All in all, these exercises helped foregrounding different aspects of the problem at each iteration, all the while allowing students to follow and refine a singular impulse that they developed at the very beginning of the process throughout the whole semester.

Process:
In Phase 1, titled "Window Narratives", the students' assignment was to develop a strategy and a series of tactics to experientially analyze a spatial situation at a given site. In formulating their strategy, each student first chose a painting within which windows take center stage as subject matter. They studied and interpreted their painting from several perspectives (i.e. meaning, atmospheric quality, and representational style as well as uses of color, pattern, texture, objects, and people). These interpretations became the basis of their atmospheric narrative and vocabulary for a preliminary phenomenology of windows. Secondly, the students analyzed and documented an actual window from their own surroundings (i.e. their home, campus, or neighborhood) in order to abstract a particular spatial/experiential quality. It was important that the students established a correspondence between these two analyses in such a way that, even if their approaches were mostly intuitive, their findings in their painting and in an everyday situation demonstrated an atmospheric, semantic, or conceptual resonance.

Finally, each student was assigned a particular spot in the campus at which our relationship to nature was emphasized. They studied this site by means of the strategies and tactics developed in the previous two stages. They then installed "A Hole on a Surface" that not only characterized their personal experience of the site but also organized their bodily relationship with the natural element in question. The parameters to be considered by the students in developing their proposal included: materiality of the frame, surface, and the void; the depth, size, and shape of the window; the height and location of the opening on the surface; the students' physical, bodily, and functional relationship to the window; the relationship of the natural element to the window.

In Phase 2, titled "Interiors Without Exteriors", students first formed groups to inquire, question, and criticize how our relationship to nature has been changing over the centuries. These inquiries were conducted within the contexts of heritage, industrialization, pollution, privatization, religion, climate change, and tourism so as to establish a preliminary position regarding how to approach nature (Tvedt, 2016). The students then visited Gölcük and developed a macro-analysis of the site in order to arrive at a close reading of its programmatic and experiential functioning through the lens of their own design strategy.

Following this analysis, they problematized the existing configuration of GNP and formulated a project brief prescribing their reaction to the site. This reaction was not to entail a fully enclosed volume, but rather consisted of a series of disparate spatial elements (i.e. window, door, stairs, tower, bridge, ramp, etc.). These elements were to be loosely put together as "A Collection of Architectural Objects" which nevertheless defined a sense of inside without an outside (i.e. a non-exclusive, non-perspectival relation to nature). Each of these spatial elements was taken into consideration in relation to: 1) metaphors with which they were associated (i.e. window as perspective, frame, screen, space, etc.); 2) functions they assumed (i.e. the window as aperture, ventilation shaft, viewer, etc.); and 3) as multi-sensory mechanisms that allowed or prevented our exposure to various natural elements (i.e. window as means of accessing or blocking view, light, sound, smell, wind, air, temperature, etc.) (Koolhaas, 2018). At this stage, the individual components of this collection were not yet assigned a particular function other than the kind of bodily experience they provided for.

Finally, in Phase 3, titled "Lacunae in the Forest", students refined, multiplied, extended, and varied their architectural collection by introducing various surfaces (i.e. floors, walls, façades, roofs, etc.). Throughout this expansion, their aim was to spatially re-configure a particular corner of GNP by means of specific inter-related, semi-open, and semi-closed interior systems and elements. At this point, the students proposed an architectural program for a Lakefront Center incorporating several forms and opportunities of research, learning, and recreation. It was important that the students themselves chose at exactly which point in and around the lake their collection/center was to be located. It was also important that the program was developed completely in response to the site rather than being pre-given. In this regard, each project was to be formulated at a scale appropriate for the operation and legibility of the student's own design approach (defined in principle all the way back in Phase 1) and design problem (defined in principle in Phase 2).

Student work samples:

In the project *Window in the Ground*, Gözde Ergül was inspired by the uncanny atmosphere in her painting, caused by the excessively revealing qualities of the large window-frame pictured. She approached the window as a 3-dimensional framing tool that highlighted layers of the look (i.e. exaggerated by the use of glasses, magnifiers, and lenses of differing thickness and size) (Fig. 1). Her project capitalized different bodily orientations (i.e.

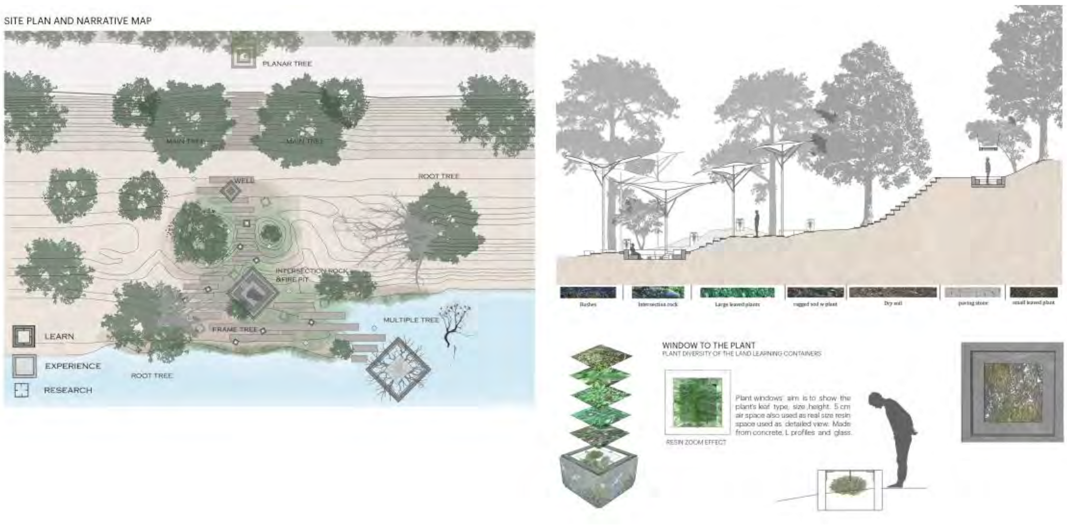


Figure 1. Site plan and narrative map, site section, and window detail; by G. Ergül, 2019.

horizontal windows that allowed looking down and being on top of or under a window while directing our attention to the ground and the sky) (Fig. 2). She also invited the users into uncanny encounters with the site (i.e. getting wet when climbing on a window) as well as into a direct experience of the constructive properties of her windows (i.e. size, shape, thickness, joinery, transparency, materiality, reflection, and light). In general, she aimed at cultivating our awareness of the natural environment by revealing invisible layers and micro-elements/qualities of natural elements that were otherwise sealed from our experience (i.e. tree roots, branches, and foliage; different layers and qualities of the earth; paths traversing the ground and the lake basin; shoreline changes; reflections of the earth and sky; degrees of moisture; hidden creeks and cascades) (Fig. 3).

In the project *Peribolos*, Burcu Özgen was inspired by the idea of an abandoned building looking onto itself while at the same time being re-introduced life by the apparently recent arrival of a bird in her painting. She approached the window as a multi-layered and multi-directional opening that framed our exchange with the outside through various layers (i.e. curtains, joineries, eaves, fringes, shades, awnings). Her project played on the directionality of the window experience, which

Figure 2. General view, bodily orientations, and model; by G. Ergül, 2019.

Figure 3. General panorama of the site; by G. Ergül, 2019.

framed the look in many directions (i.e. windows opening in and out, objects looking in and out, buildings looking at each other and themselves). She was inspired by the domestic aura implied by the existing objects at the site (i.e. a bench partly buried in the lake) and several instances where nature and built environment folded and reflected upon itself (i.e. a tree dropping its apples back to the lake; another tree leaning into the water and extending its branches like roots; a hornbeam tree and a guest house reflected upon water). With these inspirations in mind, she re-interpreted windows as an instrument of self-reflection so as to criticize the domestication of the natural environment (Fig. 4). The project revolved around a central, elevated walkway, directing visitors through various learning/research areas and spatial sequences. It framed these experiences by means of a series of artificial domestic ruins that gave the impression of an abandoned archaeological site and a series of sound experiences that augmented the findings from scientific inquiries carried out at each corner of the site (Fig. 5).

Figure 4. Site plan and domestic instances; by B. Özgen, 2019.

Figure 5. Spatial Sequences; by B. Özgen, 2019.

In the project *Di-Aura*, Işınsu Kaya was inspired by the anxiety, unease, and sense of curiosity characterizing her painting. She found these affective states to be supported by various contrasts and dualities between real-surreal, natural-artificial, masculine-feminine, animate-inanimate, human-animal elements (Fig. 6). She interpreted the window as an intermediary between the inner and outer worlds, the self and the other, which offered insights into the hybridities between natural and man-made worlds. These insights were to be guided by a series of massive, tumulus-like constructs, each housing a different instance of a research process about how trees learn and procreate (i.e. tree barks turned inside out, graft samples, a hole in a tree stump forming a miniature lake, an open green-house functioning like a plant hostel) (Fig. 7). The steps of this process were informed by a bifurcating network of pedestrian paths, made up of a warm liquid poured and frozen over the earth. Each junction on this network of paths was marked by another tumulus stimulating our curiosity (i.e. crevices into the ground on the main road, the experience of coming face-to-face with one's own image in the miniature lake, a pier with some missing pieces floating in and at the same level as the lake water, inclined steps that rest on the slope, a horizontal door frame opening into the lake) (Fig. 8).

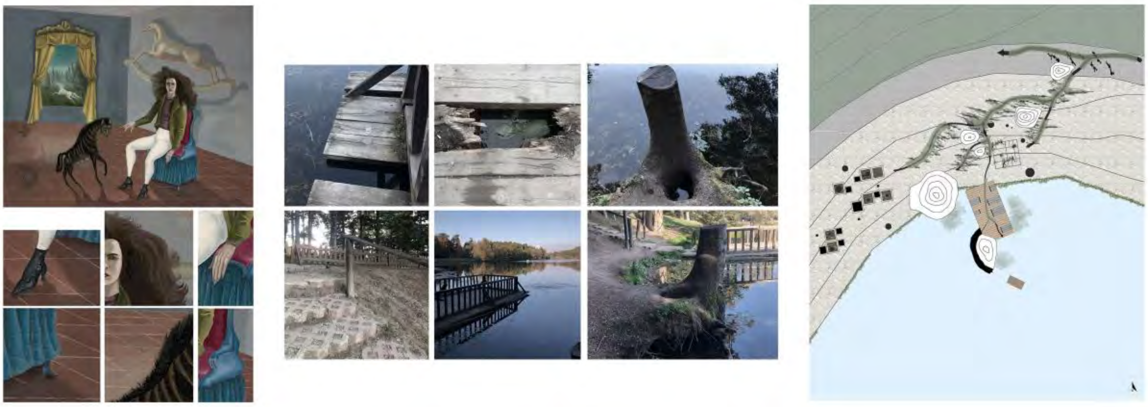


Figure 6. Hybrid situations and site plan; by I. Kaya, 2019.

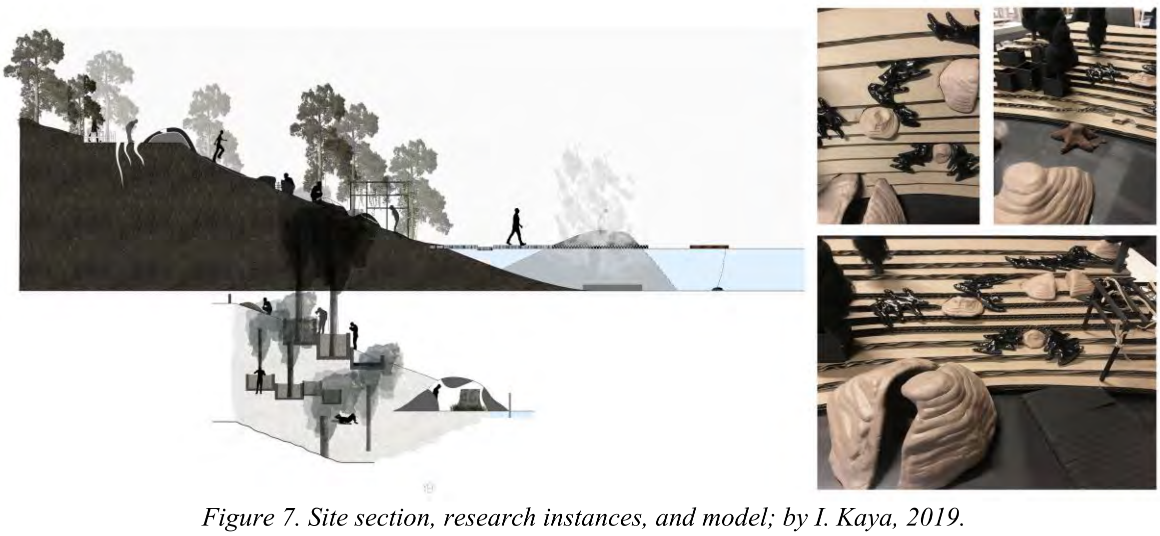


Figure 7. Site section, research instances, and model; by I. Kaya, 2019.

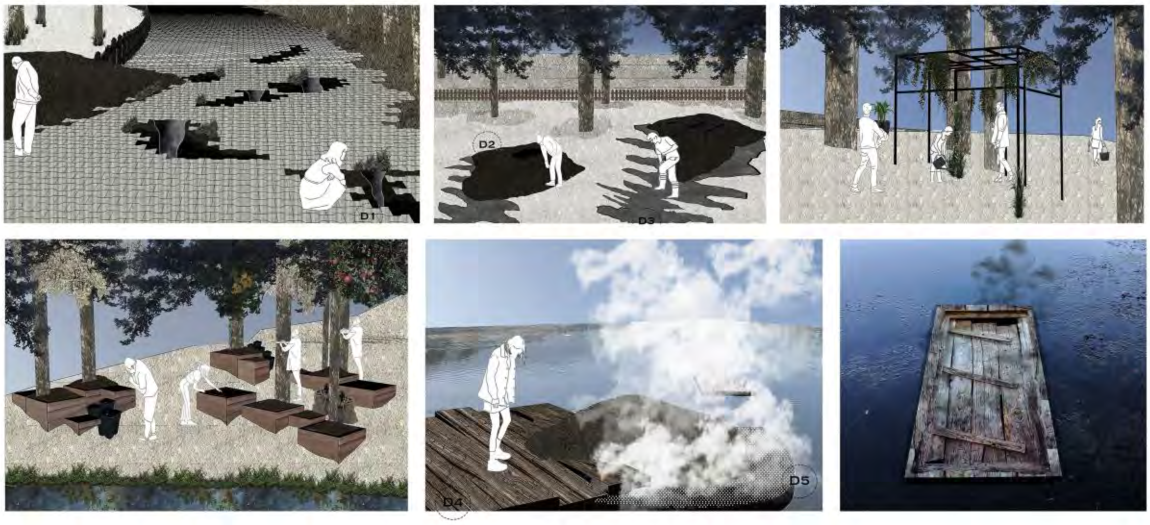


Figure 8. Experiential path; by I. Kaya, 2019.

Conclusion:
As summarized above, our starting point for the “Lacunae in the Forest” project was to look at the long history of visual arts where nature is conventionally and conveniently represented as revealing itself through doors and windows alike. It was our observation that this long-standing convention found its most emblematic basis in the Cartesian *cogito*’s depiction of the way in which a human figure was positioned inside a *camera obscura* (i.e. an interior) and looked at the outside (i.e. nature). In this historical relationship, we realized that it was always nature that was excluded but then grounded and interiorized by the *interieur* in an act of self-reflection (Haverkamp, 2016). We thus were interested in interiorities and interiors that opened out, onto, or into nature without transforming it into ‘landscape’. Students, therefore, were expected to construct a scenario that problematized what we understood from research, learning, and recreation. They at the same time engaged with GNP in such a way to suspend, neutralize, or reverse the set of relations that were designated, reflected, or represented by the given site. All in all, they tried to uncover and speculate the ways in which designs of the built environment (i.e. systems, processes, places, objects, and details) challenged or perpetuated our various attributions to nature, all the while asking “What kind of a ‘universe’ at large does my proposed collection belong to?” at every stage of the process.

Acknowledgments
We would like to extend our grateful thanks to our students for generously sharing their experience and work with us as well as to Burcu Yasemin Şeyben for guiding our inquiries into multiplicities of nature and water.

References:
Haverkamp, A. (2016). In/Doors: The Dialectic of inside and outside. In E. Lajer-Burcharth & B. Söntgen (Eds.), Interiors and interiority (pp.103-118). Berlin: De Gruyter.

Koolhaas, R. (2018). Elements of Architecture. London: Taschen.

Tvedt, T. (2016). Water and society: Changing perceptions of societal and historical development. London and New York: I.B.Tauris.

Journal of
Design Studio
v:2 n:2 December 2020

From Movie to Design: Interpretation of "Passengers" in the Form of Basic Design Principles

Damla Atik
Trakya University, Faculty of Architecture, Edirne, Turkey (Corresponding author)

Received: November 29th 2020, Revised: December 6th 2020, Accepted: December 7th 2020.
Refer: Atik, D., (2020), From Movie to Design: Interpretation of "Passengers" in the Form of Basic Design Principles, Journal of Design Studio, V.2, N.2, pp 173-181,

D. Atik ORCID: 0000-0003-3963-3844,
DOI: 10.46474/jds.833050 https://doi.org/10.46474/jds.833050

Abstract: Design is a tough process in which knowledge, skill, awareness, sophistication, inspiration, time and creativity should be brought together efficiently within artistic and aesthetic approach. Design education involves observing, researching, thinking, interpretation, designing and producing processes concordantly. Due to its unusual formation; students face difficulties while transforming intangible concepts into tangible products in basic design courses. An encouraging and inspiring teaching-learning process is required in this unique course. Conventional basic design education is structured on teaching the design elements and principles that make up a visual composition. Basic design curriculums of different departments are correlated with various branches of art and present interpretation diversity within students' applications and basic design studio experiences. It is aimed to make a contribution to the wide range of basic design course within a case study themed on cinema in this study. Regarding to experimental method and watching a movie, students designed three dimensional models representing their inferences. Interpretation diversity has been observed due to students' cognition, observation, ways of access to information and creativity. As a result, deductive thinking and visual depiction of the movie through basic design principles have resulted creative products and benefited students' teaching-learning process.

Keywords: Basic Design, Creativity, Design Education, Interpretation, Passengers the movie

1. Introduction: About (Basic) Design Education

According to Yürekli ve Yürekli (2004), design education is comprehensive with its complex and contradictory structure based on abstract concepts. The authors find it difficult to define, understand, classify and form this education because it is not obvious. Onur and Zorlu (2017) emphasize the purpose of design education in terms of revealing and developing the creative thinking potential of students. In addition to this, Ertok Atmaca (2014) states about learning to make benefit from design elements, creating a design language through two and three dimensional compositions and solving form-space relationship. Regarding to this, Canbakal Ataoğlu (2015) suggests that the basic design education essentially aims to create the optimum environment for the development of creativity and present new methods that will improve students' abilities to produce new and authentic solutions by purifying them from prior knowledge. In another words, San (2010) and Pazarlıoğlu Bingöl (2016) claim that basic design education is a process that brings the student's perception, impression, observation, research, connotation, invention, knowledge, evaluation and many other intellectual processes into a unique form with new regulations. Besides, Eysenck (1994) mentions that cognitive, personal and environmental variables are effective on creativity also.

Creativity is the ultimate goal of the teaching-learning process. Smith et al. (1995) state that creativity includes the stages of producing and discovering within the framework of the individual's mental activities; this process can also be said as an intuitive thinking. This creative process includes the production of creative thinking, creative exploration, interpretation and product development according to them. The individual and cultural components of the designer are effective in the creative process at the same time. Alsaggar and Al Atoum (2019) mention that interests, intelligence and the effectiveness of senses vary. Thus, the students respond differently to the learning-teaching methods. Their commitments in the learning process depend on their experience and their interaction with each other and with their environment. Related to these approaches Ketizmen Önal (2011) gathered the main components that are effective in the emergence of creative product and thought under three main headings (Table 1).
Alsaggar and Al Atoum (2019) believe that the more senses of perception are involved, the higher is the learning potential of the students; by reason of perception is the basis of learning and each student is unique. Besides, each product is an indicator of interpretation in basic design studios (Figure 1). Because, products are designed upon a given concept and by listening, watching and reading, observing or imagining experiences within cognition of basic design fundamentals in basic design applications (Atik, 2020). Similarly, Düzenli et al. (2017) who think that a practical and creative education approach should be followed in basic design courses, determined that the course have significantly contributed to creativity and learning process of students besides their ability of producing.

In the light of these, purposes of basic design courses are put forward finally, with its difficulties. Beşgen et al. (2015) mention the purposes as educating the personality, enabling to construct relation among design constructs and with environment through design and using the basic language of design. The basic design education in its centenary history, accepted the

Table 1. Components of creative product (Ketizmen Önal, 2011)

Cognitive variables	Individual's intelligence Knowledge level Technical and special abilities
Environmental variables	Political factors Religious factors Cultural factors Socio-economic factors Educational factors
Personal variables	Individual's intrinsic motivation Belief system Creative capacity

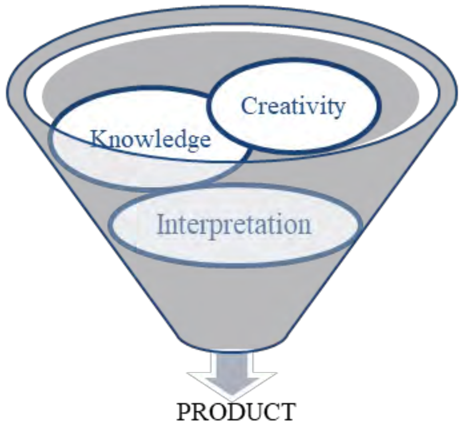


Figure 1. Production process in basic design studio (Atik, 2020)

visualization as a base, tried to systematize the presence of a visual language and developed methods according to this (Seylan, 2005). Aydınlı (1996) suggests that basic design course is one of the most challenging courses for students in the first semester of university education as intuitive teaching methods are used. Kavas et al. (2016) draw attention to the difficulties which students face during the process of the basic design course. These difficulties are at the level of knowledge, skills and competence according to the authors (Table 2). This study intends to overcome these difficulties within a case study.

2. Material and Method

In Boucharenc's perception and practice (2006), the pedagogy of basic design promotes a holistic, creative and experimental methodology that develops the learning style and cognitive abilities of students with respect to the fundamental principles of design. Similarly, Soliman (2017) asserts that experimental learning is an important part of design education. It is important to produce methods that support connecting the abstract-concrete, to develop the imagination devoted to stimulate the creative design process and the creative thinking by experiences in the studio according to him.

Table 2. The difficulties in basic design course (Kavas, Erbaş, & Danacı, 2016)

Knowledge	• Students are used to memorize the knowledge from prior education style. • Students must gain analytical and critical perspective.
Skill	• Students' incapability in using abstract language of design for understanding the environment and expressing new proposals should be improved.
Competence	• It is about thinking through alternative solutions, deriving criteria of evaluation. • It is about learning how to make selections among these alternatives and developing the selected alternative into a finished end product.

Basic design studio experiences and applications enable interpretation diversity within the themes of drawing, modeling, cinema, music, literature, apparel and fashion, creative drama and so on. For instance Zülfikar and Ertin (2014) have experienced creative drama method to abstracts concepts. The main theme of their experimental study was fictionalizing the movie "Skhizein" and interpreting it with body language to enrich the design through a workshop. The students produced alternative answers by critical thinking and realized a transformation process by images. Canbakal Ataoğlu (2015) has asked her students to analyze, interpret and design the given problem by creating two-dimensional abstract compositions first, and then transforming them into a concrete product and applying on the goods that are used in daily life; finally a street fashion show was organized. Bostancı et al. (2016) emphasized the necessity of music in terms of the development of visual perception, thinking, hand-eye-brain abilities of the individual who received basic design training, and activation of imagination-intuition powers. Atik (2020) has studied a literary text "Invisible Cities" by Calvino with her students in order to experience an evaluation method. Beşgen and Köseoğlu (2019) have organized a "Cine-Design Workshop" as an exemplification of the potentials of the combination of two disciplines, cinema and architecture in a philosophical discussion.

Inspiring from these researches, an experimental method was followed relating to students' products in which design principles were used and the Passengers movie was chosen as the material in this study. The steps of the method are shown in Figure 2.

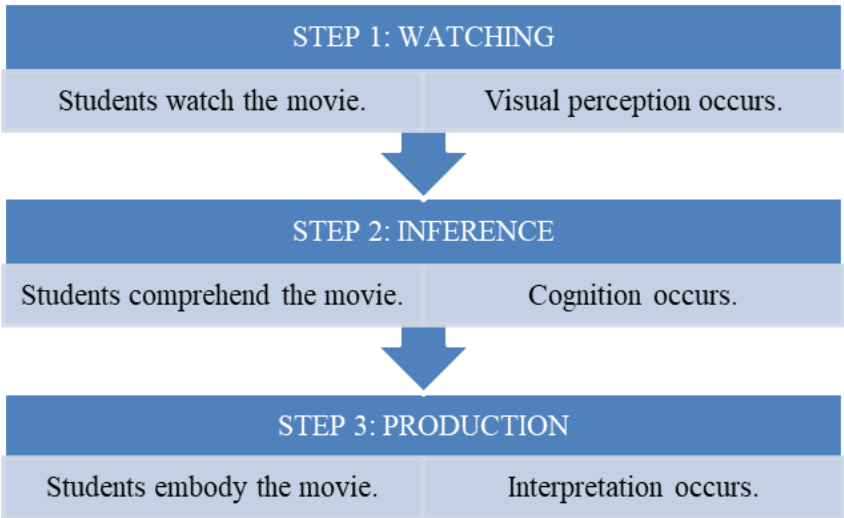


Figure 2. Method for the design process of the movie

"Passengers" is a 2016 American science fiction romance film directed by Morten Tyldum and written by Jon Spaihts (2016). The film stars Jennifer Lawrence and Chris Pratt as Aurora Lane and Jim Preston, respectively, with Michael Sheen and Laurence Fishburne in supporting roles. The plot depicts two people who are awakened ninety years too early from an induced hibernation on a spaceship, transporting thousands of passengers, travelling to a colony on a planet in a star system sixty light years from Earth. The Avalon, a sleeper ship transporting 5,000 colonists and 258 crew members in hibernation pods, is on course to the planet Homestead II, a journey lasting 120 years. In the thirtieth year of the journey, an asteroid collision damages the ship and causes its computer to awaken one passenger, mechanical engineer Jim Preston 90 years early. Jim grows despondent and contemplates suicide until he notices a beautiful young woman named Aurora Lane inside her pod. Jim views Aurora's video file and is smitten with her. After struggling with the morality of prematurely reviving Aurora for companionship, therein robbing her of her future/planned life, he awakens her, letting her believe that her pod also malfunctioned. Over the next year, Jim and Aurora slowly grow closer, eventually falling in love with each other. Eighty-eight years later, the ship's crew is awakened on schedule, shortly before arrival at Homestead II. In the ship's grand concourse area they discover a huge tree, lots of trailing vines and vegetation, birds flying, and a cabin. Aurora's voice-over is reading her story, describing the wonderful life she and Jim had together on the Avalon (Figure 3) (URL 1, 2020).

3. Case Study

The case study was carried out at Trakya University, Faculty of Architecture, Department of Landscape Architecture in spring semester of 2018-2019 academic years. The curriculum of the course at the faculty involves design elements (point, line, form, size, color, value, pattern, direction, space) in Basic Design I and design principles (Gestalt theory, repetition, harmony, contrast, hierarchy, hegemony, balance) in Basic Design II. The courses are conducted within forty minutes for theoretical and two hours for practical sessions in both semesters. The instructor shares theoretical information with the students through written sources, visual samples and tangible materials in the theoretical session. In the practical session on the other hand, the students are asked for individual application using determined materials beforehand and make a presentation with either two or three dimensional product. Following the presentation of the products, the students get critique and instructor has feedback at the end of the sessions.

The instructor recommends and initiates the process of acquiring knowledge by related clues and basic concepts. The theoretical session is studied in an integral way with practical one (practical-theoretical integrity method). Avoiding from copy or imitation of earlier template studies, the vision of students is improved by offering modern samples (template studies method). The motivation and awareness of students are increased by the instructor with positive attitudes also (modern method). Besides, schematic, mechanics, mental and perceptive tendencies are considered (multiple intelligence theory method) in basic design courses. The application session is enriched within visual and spatial intelligence by using colors, shapes, textures, images and other visual symbols. These methods are mentioned by Aypek Arslan (2012). In this case study differently from studio applications, a movie is chosen to study as an end of term assignment.

Figure 3. Passengers the movie (URL 2) (URL 3) (URL 4) in order

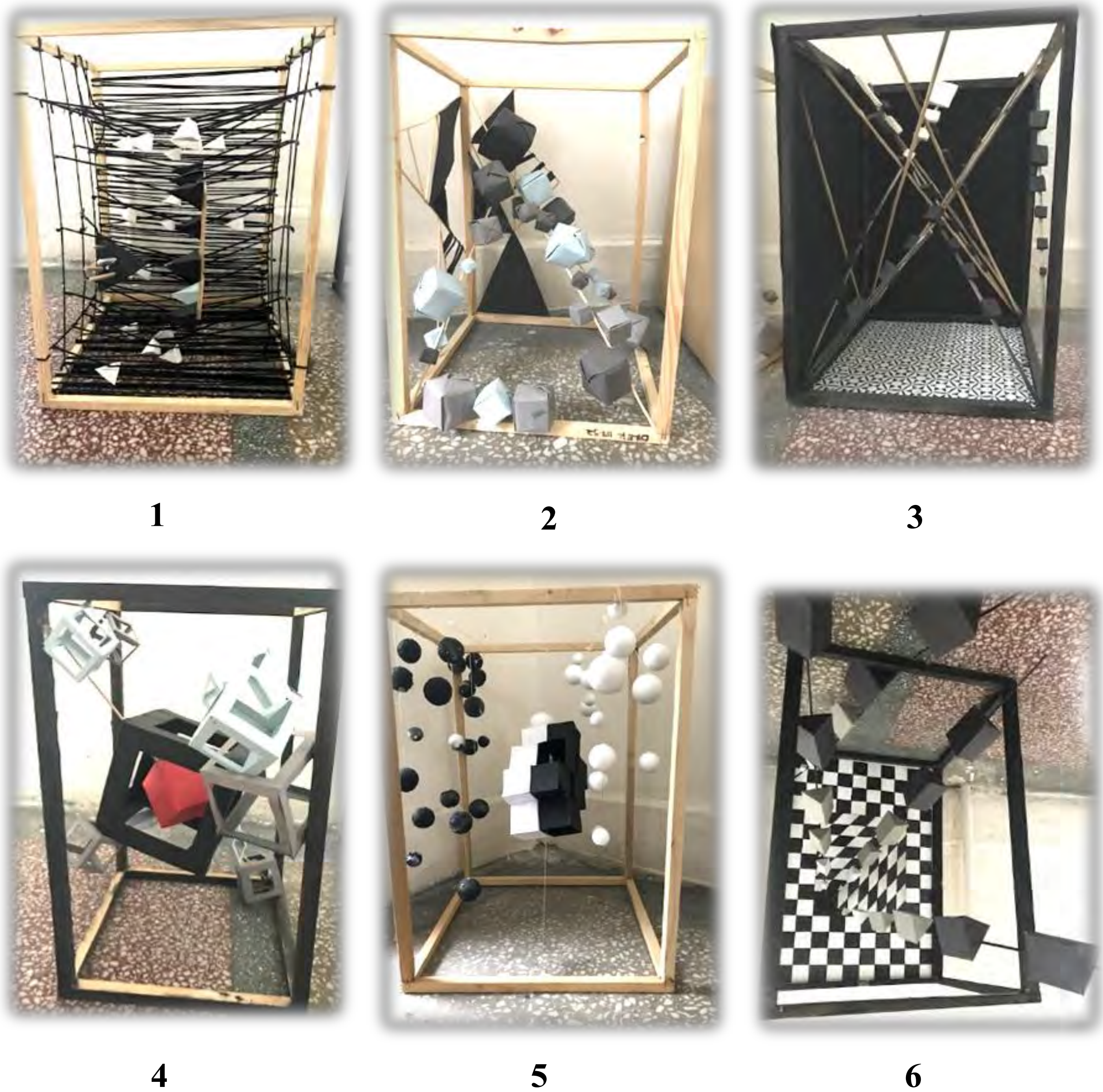


Figure 4. Products - Presentation of "Passengers" in the form design principles

The students were asked to watch the movie Passengers first and then to make a presentation with a product that reflects their creativity, interpretation and visual language. The students were expected to make a description about the movie depending on their inferences and using design principles in a wooden frame with size of 30 x 30 x 40 cm; size of the shapes, materials and color usage were not limited.

4. Findings

Six proper products reflecting different principles were chosen among the products which the students delivered (Figure 4). Each of the products was based on a theme that got inspired from the movie.

The principle of first product was "Balance". The balance between the planned voyage of the ship and unknowns/handicaps of outer space was intended to be shown within the order of the ropes and usage of colors. The second product has reflected the usage of “Harmony” principle based on a statement that the characters who have sought out solutions to the problems encountered on the ship and has put everything in order as seen with the gray toned cubes. The cubes which are getting bigger and bigger in the third product represent the destination oriented progress and ship's arrival over the years. Thus, the third product pointed out “Hierarchy” principle. The fourth product has reflected another principle: “Hegemony”. This is the hegemony of the ship with red cube and the main characters of the story with black hollow cube. The principle of fifth product was “Contrast” with the exact usage of black and white which were representing problems and solutions besides, gender difference. The statement has focused on the main characters being two different parts of a whole depending on being man and woman. “Repetition” principle has been used in the sixth product and it has depicted the ship's voyage and space spatially. The usage of chessboard and equal sized forms has explained the end that has been reached by repeating each other every year both before awakening and after death.

5. Results and Discussion

Based on various statements related to the movie, it has been seen that different principles could be used. The students have watched the movie; they have encountered the main theme, the message to be given, the images and the metaphors of the movie referring to the first step of the method of the study shown in Figure 2. Following this visual perception, when they have comprehended the movie, they made their inferences; step two has been actualized. Finally as the third step of the method, students have embodied the movie and the products have been shown out within students’ cognition and interpretation. The results of the study within discussion of literature are put forward below:

- The design process can be fed by visual, intellectual and spiritual aspects of cinema. Referring Pallasma’s (2008) statement “cinema with its temporal and spatial structure is the closest art branch to architecture”, the relationship between cinema and landscape architecture were experienced in the context of design education.
- Cinema defines a virtual architectural space and reproduces the existing architectural spaces in its own virtual universe (Tanyeli, 2001). Although the students were not expected to make an architectural spatial design in this study contrary to Beşgen and Köseoğlu’s (2019); the students made descriptions of the movie impressed by spatial expressions.
- The difficulties that students face at levels of knowledge, skill and competence (Kavas, Erbaş, & Danacı, 2016) in design education have been overcome with the guidance of the method that has been used in this study. Since the students had a movie as a study material, they have enjoyed basic design more than the other courses.
- Since the students need to be encouraged for thinking, designing and producing (Atik, 2020), the students determined their own visual and conceptual language without any critique and advice.
- Düzenli et al. (2017) suggested that design educators need to produce information through original methods and share them with all design trainers. A contribution to the teaching-learning process by an experimental method has been revealed in this study.
- Boucharenc (2006) indicated that basic design principles are still relevant in contemporary design education. Thus, a term assignment dealing with interpretation of a movie though basic design principles has been examined.
- Basic design education is the effort of expressing the abilities and power of creativity in aesthetic level and is the transfer of thinking, emotions and impressions of students (Beşgen, Kuloğlu, & Fathalizadehalemdari, 2015). It has been reconfirmed that students' cognition, observation, ways of access to information and creativity are determinant in

transforming intangible knowledge into tangible practice.

6. Conclusion

Transformation of intangible concepts into tangible products requires quite attention. Students are leaded to research and learn the techniques which they can use in all kinds of arrangements; through applied studies and visual language. Visual language diversity can be seen in the products of the case study (Figure 4). Because of the visual memory has strong effects, a designer should always make careful examination and observation around her/his living environment. Thus, creative ideas should come to light due to inferences and selective perception; which can also be gained during basic design education. Within the method (Figure 2) of this case study:

- Students developed their observation and examination ability. By watching the same movie, they made unique observations and gained visual perceptions.
- Inspiring from the movie, students achieved an improvement of creative thinking through cognition in design process.
- Production of various three-dimensional design outcomes related to the movie has put forward the interpretation diversity.

References

Alsaggar, M. A., & Al Atoum, M. S. (2019). The image as a method of teaching in art education. Gazi University Journal of Science Part B: Art, Humanities, Design and Planning, 7(2), 211-221.

Atik, D. (2020). An evaluation experience for interpretation diversity of basic design products. International Refereed Journal of Design and Architecture, 20, 97-127.

Aydınlı, S. (1996). An approach to architectural education based on hermeneutical understanding. ACTA Politechnica Scandinavia, 105, 97-101.

Aypek Arslan, A. (2012). An analysis of teaching methods used at the course of basic design. Procedia - Social and Behavioral Sciences, 51, 172-176.

Beşgen, A., & Köseoğlu, Ş. (2019). Sinema-mimarlık arakesitinde bir mekana dokunmak: Sine-tasarım atölyesi. SineFilozofi, 26-52.

Beşgen, A., Kuloğlu, N., Fathalizadehalemdari, S. (2015). Teaching / learning strategies through art: Art and basic design education. Procedia - Social and Behavioral Sciences, 182, 428-432.

Bostancı, B., Akbulak, B., & Akgül Yalçın, E. (2016). The transformation of music into form: basic design education in architecture. Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi (İpekyolu Özel Sayısı), 16, 2196-2207.

Boucharenc, C. (2006). Research on Basic Design Education: An International Survey. International Journal of Technology and Design Education, 16, 1-30. doi:10.1007/s10798-005-2110-8

Canbakal Ataoğlu, N. (2015). Basic design, theory and practice. Procedia-social and Behavioral Sciences, 197, 2051-2057.

Düzenli, T., Alpak, E. M., & Özkan, G. D. (2017). Effects on learning and creativity of basic design course in landscape architecture. Electronic Journal of Social Sciences, 16(64), 1450-1460.

Ertok Atmaca, A. (2014). Temel tasarım. Ankara: Nobel Akademik Yayıncılık Eğitim Danışmanlık Tic. Ltd. Şti. .

Eysenck, H. J. (1994). The measurement of creativity. In M. A. Borden (Ed.), Dimensions of Creativity (pp. 199-242). Cambridge: MIT Press.

Kavas, K. R., Erbaş, İ., & Danacı, H. M. (2016). A reinterpretation of the suprematist painterly space for the comprehension of basic design in architectural education. Journal of Human Sciences, 13(3), 5813-5825.

Ketizmen Önal, G. (2011). Architectural design process in creativity and cultural schema. Uludağ Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, 16(1), 155-162.

Onur, D., & Zorlu, T. (2017). Tasarım stüdyolarında uygulanan eğitim metotları ve yaratıcılık ilişkisi. The Turkish Online Journal of Design, Art and Communication, 7(4), 542-555.

Pallasmaa, J. (2008). 11 2020 tarihinde http://v3.arkitera.com/g143-sinema-ve-mimarlik.html?year=&aID=2621 adresinden alındı

Pazarlıoğlu Bingöl, M. (2016). Temel tasarım eğitiminde kavramdan üç boyuta geçişe yönelik bir uygulama örneği. İdil Dergisi, 21(5), 339-362.

San, İ. (2010). Sanat eğitimi kuramları. Ankara: Ütopya Yayınevi.

Seylan, A. (2005). Basic design. Ankara: Dağdelen Publishing.

Smith, S. M., Ward, T. B., & Finke, R. A. (1995). Creative cognition approach. Cambridge: MIT Press.

Soliman, A. M. (2017). Appropriate teaching and learning strategies for the architectural design process in pedagogic design studios. Frontiers of Architectural Research, 204-217.

Spaihts, J. (Writer), & Tyldum, M. (Director). (2016). Passengers [Motion Picture].

Tanyeli, U. (2001). Sinema ve Mimarlık , Temsiliyet / Nesnenin Temsili, Sanatın Sanallıkla İfadesi. Arredamento(11), 66.

URL 1. (2020). Retrieved from https://en.wikipedia.org/wiki/Passengers_(2016_film)) at 08 2020

URL 2. (2020). Retrieved from https://www.imdb.com/title/tt1355644/ at 08 2020.

URL 3. (2020). Retrieved from https://www.amazon.com/Passengers-Blu-ray-Jennifer-Lawrence/dp/B01LTI0BPU at 11 2020.

URL 4. (2020). Retrieved from https://www.overthinkingit.com/2017/01/03/morality-passengers-part-2/ at 08 2020.

Yürekli, İ., & Yürekli, H. (2004). Mimari tasarım eğitiminde enformellik. İTÜ Dergisi / A Mimarlık Planlama Tasarım, 3(1), 53-62.

Zülfikar, H. C., & Ertin, D. G. (2014). A case study in design education: Creative drama method with image. Global Journal of Arts Education, 4(2), 43-48.

Journal of
Design Studio
v:2 n:2 December 2020

A Design Studio Workshop Proposal for Comparable Evaluation of the First Year Architecture and Interior Design Students

Atlihan Onat Karacali
Istanbul Ayvansaray University, Faculty of Fine Arts, Design and Architecture, İstanbul, Turkey

Received: October 21st 2020, Revised: December 12th 2020, Accepted: December 14th 2020.
Refer: Karacali, A.O., (2020), A Design Studio Workshop Proposal for Comparable Evaluation of the First Year Architecture and Interior Design Students, Journal of Design Studio, V.2, N.2, pp 183-187,

A.O. Karacali ORCID: 0000-0003-2688-1304,
DOI: 10.46474/jds.814379 https://doi.org/10.46474/jds.814379

Abstract: Design studios are the key features of design education. These studios are carried on uniquely and distinctly. Both the progress and grade phases are very special. For architecture and interior design disciplines, the design studio consists of an architectural or interior project design. Design studios are now accepted as the main courses of the semester, and other courses serve as the supportive ones. The traditional architectural presentation techniques used in the design studio were technical drawing and physical modeling. In the last three decades, computer-aided methods joined this list. These three main methods are the base of architectural expression and are taught generally in the first year of education. The following workshop proposal aims to figure out whether the order of these methods is effective in the understanding of first-year students. The workshop is going to choose students from both high and low grades of related supportive courses and divide them into equally distributed groups. A sample structural project is going to be given and each group will follow a different permutation of technical drawing, physical modeling, and computer-aided modeling. All works will be graded at both group and individual levels. Finally, there is going to be comparable data in hand to decide both the more correct permutation and the individual student effort independent from the group.

Keywords: Design studio, Design workshop, Technical drawing, Architectural modeling, Computer-aided design.

Introduction

Design studios became the backbone of design education since École des Beaux-Arts (Drexler, 1984). Many famous design schools like Bauhaus and Mackintosh School followed this tradition. Currently, the education of near all design disciplines like architecture, interior design, landscape design, urban design, product design, and even graphic design is based heavily on design studios all over the world. And several studies confirm that the design studio occupies almost half of the design programs (Salama, 1995).

Design studios are carried on in a very special way. They generally take place in an atelier-like bigger classroom environment. Instructors and all other students are involved in the criticism of one's project. Discussions are progressed and individual design solution for each student's very own project is tried to be achieved. Design studios are also special in terms of grading criteria. On the contrary of the theoretic courses which can be graded via classical examination methods, the design studios are mainly evaluated via design juries. Students hang the boards they prepared and present their physical scale models (if any) and a jury of instructors and invitees of practicing designers comment on and grade the project.

Successful design curricula are structured on the balance of the studio and non-studio courses (Hacihasanoglu, 2019). Students come across a design studio in all semesters (Ciravoglu, 2014) and it automatically becomes the main course of the semester for its lesson hours and credits. Design studios of consecutive semesters are often linked in terms of prerequisite systems and the design problem becomes more and more complex in the latter semesters (Karacali, Toprak, Acirli & Manav, 2020). Other courses are considered supportive ones and students are expected to display non-studio teachings directly on the design studio project. Consequently, the design studio is the testing ground for all other knowledge gained.

For architecture and interior design departments, students are expected to design an architectural and interior design project throughout the semester. In these disciplines, there can be even more design studios as a construction system design or a furniture design, in which the student also is expected to design a related project. And the supporting courses of these disciplines can be listed as basic design, technical drawing, architectural sketching, computer-aided design, construction, materials, acoustics, thermal comfort, history of art, furniture, etc.

Not all design studios are progressed in a single way. Though the design studios all have different teaching methods and strategies (named as The Case Problem Model, The Analogical Model, The Participatory Model, The Hidden Curriculum Model, The Pattern Language Model, The Concept Test Model, The Doubled Layered Model, The Energy Conscious Model, and The Interactional Model in Salama's New Trends in Architectural Education: Designing the Design Studio (1995)), the architectural presentation techniques are what we have in common. Presentation is the way the designers use to externalize, communicate and express their ideas. Speaking about the presentation techniques, technical drawing and physical models are the traditional (or manual) ones. However, beginning in the 1990s, with the invention and wider use of personal computers, a brand-new architectural expression method emerged. Many design schools now invest in computational sources to enable their students to provide the necessary skills (Toprak & Hacihasanoglu, 2019). Computers are now used through augmented reality and virtual reality areas and design education and practice are now evolved into a limitless futuristic concept. With the aid of high-tech wearable devices like VR glasses and some operation tools, it is now possible to walk in the computer model of a project even in the design phase. Returning to basics, we now have three main presentation techniques, and they are taught to architecture and interior design students generally in their first year.

Method

The following part of this study consists of a design studio workshop proposal dealing with the interactive, collaborative, and experimental learning methods of first-year architecture and interior design students. A bunch of first-year students from supportive courses of technical drawing, physical modeling, and computer-aided design are going to be chosen and divided into a non-random but equally distributed mixture of groups. This criterion is stresses to ensure that not all students from similar scores are concentrated in one group. They are then going to be given a simple building. Each group is going to follow a method of a different permutation of drawing, model, and computer. Each work outcome of each student is going to be graded through a well-defined criterion. And the scores are going to be collected and compared. Finally, the most successive permutation in understanding a given structure is going to be figured out. More, the total grades of individual students are going to explain whether the permutational method or individual effort is more effective in achieving the goal.

Case Study

After the midterms of supportive courses of (technical) drawing, (physical) modeling, and computer (aided design) are graded, two students from each higher, intermediate, and lower scores are chosen (six from each course). Additional four substitute students are going to be chosen in case a student could be elected in more than one course. Temporary codes are given to each student in this phase as D1 to D10 ("D" for drawing), same for modeling ("M" codes), and computer ("C" codes) courses. Finally chosen different students are going to be called with codes as D1 to D6. Codes D1 and D2 symbolize higher grades, D3 and D4 are for intermediate grades, and D5 and D6 are for lower grades (Table 1.).

In the second phase, they are going to be divided into six groups of three, based on the different permutations of architectural presentation techniques. Each group consists of one student from different course's different score sectors (Table 2.).

In the third phase, temporary codes are going to be switched with permanent codes as S1 to S18

Table 1. Choice of Students

	Drawing Course	Modelling Course	Computer Course	
Temporary Student Codes	D1	M1	C1	Primary Students
	D2	M2	C2	
	D3	M3	C3	
	D4	M4	C4	
	D5	M5	C5	
	D6	M6	C6	
	(D7)	(M7)	(C7)	Substitute Students
	(D8)	(M8)	(C8)	
	(D9)	(M9)	(C9)	
	(D10)	(M10)	(C10)	

Table 2. Workshop Groups with Temporary Student Codes

Group	Student			Permutational Method		
A	D1	C3	M5	Drawing	Model	Computer
B	D2	C4	M6	Drawing	Computer	Model
C	D3	M1	C5	Model	Drawing	Computer
D	D4	M2	C6	Model	Computer	Drawing
E	D5	M3	C1	Computer	Drawing	Model
F	D6	M4	C2	Computer	Model	Drawing

Table 3. Workshop Groups with Permanent Student Codes

Group	Student			Permutational Method		
A	S1	S2	S3	Drawing	Model	Computer
B	S4	S5	S6	Drawing	Computer	Model
C	S7	S8	S9	Model	Drawing	Computer
D	S10	S11	S12	Model	Computer	Drawing
E	S13	S14	S15	Computer	Drawing	Model
F	S16	S17	S18	Computer	Model	Drawing

("S" for student) and their performance in previous supportive courses are going to become invisible (Table 3.).

In the fourth phase, these students are going to be given a simple structure. The structure for the first edition of this workshop is chosen as follows (Fig. 1). This is a simple modular fair stand. Both the perspective and the exploded-view are going to be given to students in question (Figure 1.).

In the fifth and the main phase, students are expected to express the structure according to their group's defined permutational model of architectural presentation techniques. For example, three students in Group E are going to study first on the computer model, then on the physical model, and finally on the technical

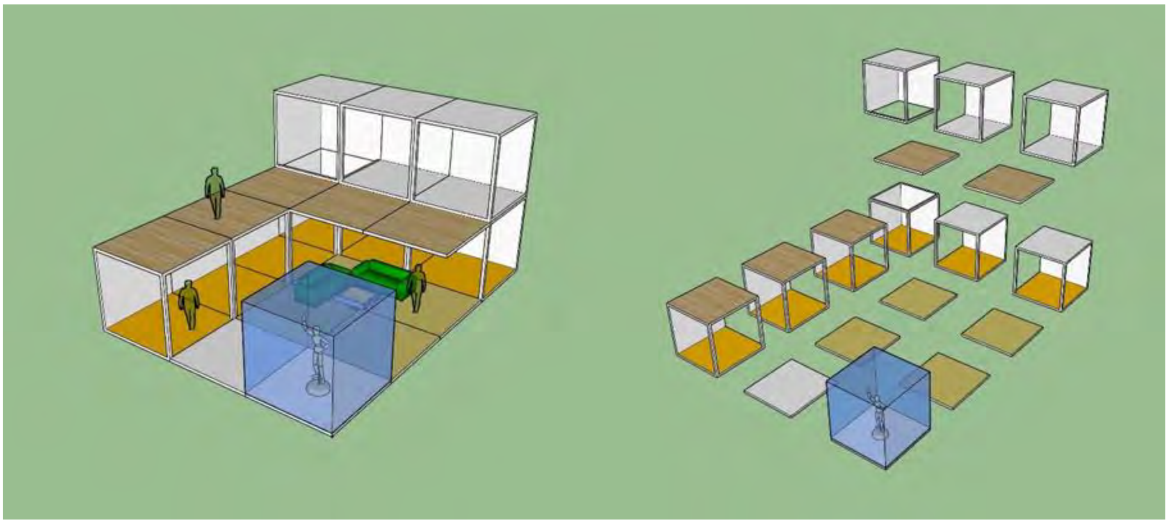


Figure 1. Modular Fair Stand (modelled by the author on SketchUp 2020 program)

Table 4. Workshop Schedule

	Day 1		**Day 2**		**Day 3**	
Environment	**Morning**	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**
Drawing Atelier	Group A	Group B	Group C	Group E	Group D	Group F
Modeling Atelier	Group C	Group D	Group A	Group F	Group B	Group E
Computer Atelier	Group E	Group F	Group B	Group D	Group A	Group C

drawing. The first edition of the workshop is expected to last three days and to be directed by three instructors in separate ateliers. Each instructor is going to be responsible for one architectural presentation technique in a different atelier classroom. Three ateliers are going to be progressed simultaneously by three instructors (Table 4.).

In the sixth and the final phase, instructors are going to grade each individual work through the well-defined criteria shared with students beforehand. All scores are finally going to be brought together for comparison.

Conclusion

This workshop has two main outcomes. One is about its availability of comparison in both group level and individual student level. The other outcome is about its renewable identity via its interchangeable features.

After this workshop ends, there are going to be comparable scores in hand. Both score tables for group level and individual student level are going to be prepared. For example, when Group C is the most successful in terms of grades, the most correct permutational method in terms of first-year students' understanding of the given structure can be listed as the physical model first, then the technical drawing, and finally the computer model. If Groups E and F result least successful, the opinion of "beginning with computer model is least useful" can be put forward. Even more, when an individual student's grades are higher separately from his/her group's ranking, yet another solution comes in hand. For example, if Group E is the least successful but Student 14 is on the top ranks in the student grade table, the result of "individual effort is more important than the permutational method" comes out. On the contrary, one may also have lower individual grades within the successful group ranking.

The second result of this workshop proposal can be made after many editions have resulted. As seen, the workshop has many parameters. Other editions must be progressed via changing the department (with another design discipline), or the year (with second, third, or even later year students of architecture and interior design departments), or the given structure (with a more complex or more basic structure), or the students (from the same school or different schools). Or simply another edition of the workshop can be progressed with the same students but in shuffled groups. Many editions are done first, there are going to be enough comparable data in hand. More editions are completed; more correct results are going to be achieved.

References

Drexler, A. (1984). The Architecture of the Beaux-Arts. London: Secker & Warburg.

Hacihasanoglu, O., (2019), Architectural Design Studio Culture, Journal of Design Studio, V.1, N.1, pp 5-15.

Ciravoglu, A., (2014), Notes on Architectural Education: An Experimental Approach to Design Studio, Procedia - Social and Behavioral Sciences 152.

Karacali, A.O., Toprak, I., Acırlı, Z., Manav, B., (2020). "İçmimarlık Eğitiminde Konutun Yeri Üzerine Bir Değerlendirme", 21st Century Housing Discussions Congress, February 14-15, Istanbul Ayvansaray University, Faculty of Fine Arts, Design and Architecture.

Salama, A., (1995), New Trends in Architectural Education: Designing the Design Studio. Raleigh, N.C.: Tailored Text & Unlimited Potential Publishing.

Toprak, I., Hacihasanoglu, O., (2019), Terms and Concepts on Design Studio in the Research Articles of the 2010s, Journal of Design Studio, V.1, N.2, pp 13-22.

Journal of design studio

Research Articles

Design Studio Cases

v:2 n:2
2020 december

ISSN 2687- 2838