TOBB UNIVERSITY OF ECONOMICS AND TECHNOLOGY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

EXPLORING ARCHITECTURAL EDUCATION FROM THE RESILIENCE PERSPECTIVE: THE CASE OF THE PANDEMIC EXPERIENCE

MASTER OF ARCHITECTURE

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APRIL 2022

DECLARATION OF THE THESIS

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work. This document is prepared in accordance with TOBB ETU Institute of Science thesis writing rules.

Merve Nur Sağlık

ABSTRACT

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There had been numerous disastrous events in the last decades, including natural disasters such as tsunamis, droughts, heatwaves, forest fires, and earthquakes. Moreover, there had been pandemics, economics crisis, social conflicts, poverty, the gradual decrease in world resources, effects of climate change, terrorism, and war. In the midst of this time of conflicts and disasters, resilience capacities of natural and social systems became more relevant than before. Resilience is a concept that emphasizes the ability or capacity of a system to absorb disturbance and prevent its function in the face of shocks, disturbances or while undergoing a change. Nowadays, resilience is utilized by many fields to understand the behavior and attributes of complex systems in the face of disturbances.

With the global health crisis, namely the COVID-19 pandemic, the need for architectural education to be flexible and resilient in the face of disturbances has been brought into the focus. Moreover, new tools, ways, and methods were experienced during the “emergency remote learning” that took place to prevent the

spread of the virus. It is predicted that positive aspects of emergency remote learning will remain, and higher education would transform. This response of the education system is similar to the adaptive resilience framework. In this manner, the recent pandemic experience provides an observable example of the adaptation process of architectural education in the face of disturbances. To understand and lead the transformation of the architectural education to new conditions, it is crucial to understand and analyze current changes that architectural education goes through.

This study adopts resilience perspective and takes the example of the pandemic experience to provide insight into the transformation of architectural education in the face of future challenges. To do this, first, the concept of resilience and the genetic characteristics of the architectural education (curriculum, tools, learning environment and interaction) are discussed. A new understanding of resilience is developed, which is then used as a foundation to explore architectural education from the resilience perspective. After setting the framework, a literature review on architectural education is conducted in order to address the disturbances that education systems went through in relation with their transformations. Finally, the pandemic experience of TOBB ETU Department of Architecture is examined to provide data to develop strategies to increase the resilience of education systems and insights for adapting better to future disturbances.

Keywords: COVID-19, Pandemic, Architectural education, Resilience, Adaptation

ÖZET

Yüksek Lisans Tezi

DAYANIKLI ESNEKLİK PERSPEKTİFİNDEN MİMARLIK EĞİTİMİNİ KEŞFETMEK: PANDEMİ DENEYİMİ ÖRNEĞİ

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Son yıllarda tsunami, kuraklık, sıcak hava dalgaları, orman yangınları ve depremler gibi dünyada çok sayıda felaket meydana geldi. Doğal afetler dışında, ekonomik çöküş, salgın hastalıklar, sosyal çatışmalar, yoksulluk, dünya kaynaklarının giderek azalması, iklim değişikliğinin etkileri, terör ve savaş gibi pek çok krizle karşılaşıldı. Bu felaket ve afet döneminde, beklenmedik ve zorlayıcı olaylar karşısında sağ kalabilmek için dayanıklı ve esnek sistemlere ihtiyaç vardır. Dayanıklı esneklik (Resilience) kavramı bir sistemin, şoklar, krizler karşısında veya bir değişiklik sonrasında kendini toplama kabiliyetini ifade eder. Bu kavram, zorluklar karşısında karmaşık sistemlerin davranışlarını ve niteliklerini anlamak amacıyla birçok alanda kullanılmaktadır. Dayanıklı esneklik (resilience) kavramı farklı kaynaklarca farklı şekillerde dilimize aktarılmıştır. Bunlardan bir kısmı dayanıklılık, direnç, esneklik, yılmazlık, toparlanma, sağlamlık ve metanettir. Tek başına bu terimler yetersiz kaldığı için kavramın hem değişim, dönüşüm ve yenilenme boyutunu yansıtan esneklik; hem de güçlükler karşısında ayakta kalma boyutunu temsil eden dayanıklılık kavramı beraber kullanılmıştır.

Pandemi ile birlikte, mimarlık eğitiminin esnek ve dirençli olma ihtiyacı gündeme gelmiştir. Dahası, pandemi sürecinde pek çok yeni araç ve yöntem deneyimlenmiştir ve bunların bazılarının kalıcı olacağı tahmin edilmektedir. Eğitim sisteminin pandemi sürecinde dönüşmesi, adaptif dayanıklılık çerçevesi ile uyuşmaktadır. Bu bağlamda, pandemi deneyimi, mimarlık eğitiminin zorluklar karşısında dönüşüm sürecine dair gözlemlenebilir bir örnek sunmaktadır. Yaşanan ve yaşanacak diğer zorluklar karşısında mimarlık eğitiminin dönüşümünü ve yeni koşullara uyumunu anlamak ve yönlendirmek için yaşanan güncel değişimleri anlamak ve analiz etmek büyük önem taşımaktadır.

Bu çalışma, gelecek zorluklar karşısında mimarlık eğitiminin dönüşümüne dair içgörü sağlamak için pandemi örneğini ele almaktadır. Bu bağlamda mimarlık eğitiminin yaşadığı değişimler dayanıklı esneklik perspektifinden incelenmektedir. Bu amaçla öncelikle dayanıklı esneklik kavramı ve mimarlık eğitiminin bazı temel karakteristikleri (müfredat, araçlar, öğrenme ortamı ve etkileşim) tartışılmıştır. Böylece mimarlık eğitimine dayanıklı esneklik çerçevesinden bakmaya yardımcı olacak bir zemin oluşturulmuştur. Çerçeveyi belirledikten sonra, mimarlık eğitiminin daha önce geçirdiği dönüşümleri karşılaştığı zorluklarla ilişkili şekilde ele almak için mimarlık eğitimi üzerine bir literatür taraması yapılmıştır. Son olarak, TOBB ETÜ Mimarlık Bölümü'nün pandemi deneyimine ilişkin hocalar, öğrenciler ve idari kadro ile mülakatlar yapılmıştır. Bu çalışma ile Türkiye'deki mimarlık eğitim sisteminin dayanıklılığını arttırmaya dair veri toplanması, stratejiler üretilmesi ve eğitim sisteminin gelecekteki krizlere daha iyi uyum sağlamasına katkı koymak hedeflenmiştir.

Anahtar Kelimeler: COVID-19, Pandemi, Mimarlık eğitimi, Dayanıklı Esneklik, Adaptasyon

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EAAE	: European Association for Architectural Education
ENHSA	: European Network of Heads' of Schools of Architecture.
ERT	: Emergency Remote Teaching
ESN	: Erasmus Student Network
ESU	: European Students' Union
HEI	: Higher Education Institutions
IAU	: International Association of Universities
ICT	: Information and communications technology
IESALC	: UNESCO International Institute for Higher Education in Latin America and the Caribbean
MOOCS	: Massive Open Online Courses
UNESCO	: The United Nations Educational, Scientific and Cultural Organization
YERUN	: Young European Research Universities Network

1. INTRODUCTION

1.1 Background

The world was witnessing a significant number of disastrous events in the last decades, including natural disasters such as tsunamis, droughts, heatwaves, forest fires, earthquakes. Even in the year 2020 alone, it is confronted with several disasters including bushfires in Australia, flash floods in Indonesia, earthquakes in several counties including Turkey, and the global COVID-19 pandemic. Moreover, people struggled with the challenges such as economic collapse, pandemics, social conflicts, poverty, the gradual decrease in world resources, effects of climate change, terrorism and war. In the midst of this time of conflicts and disasters, the response to these disruptions come to the fore. There is a need for systems to be able to cope with these disturbances. Thus, there is a need for more resilience systems, for being able to survive in this changing world. In this manner, the concept of resilience gains great importance. Today, resilience is widely discussed in many fields such as psychology, environmental science, architecture and education.

Resilience was first introduced by Holling in 1973 in his study on Psychology and Ecology (Holling, 1973). In the study, Holling defines resilience as "a measure of the ability of the systems to absorb changes of state variables, driving variables, and parameters, and still persist." (Holling, 1973, p.17). Since then, different disciplines have utilized the term as a conceptual framework to indicate a system's ability or capacity to persist and even to continue to grow in the face of disruptions or change (Laboy & Fannon, 2016; Folke, 2016). Resilience becomes a topic of interest in many sciences after major disasters like Hurricanes Katrina and Sandy, Typhoon Haiyan, earthquakes in Japan, and terrotist attacks of September 11th and many others. These recent large-scale natural and manmade disasters have clearly demonstrated the need

of building resilience systems in every domain (Laboy & Fannon, 2016). Accordingly, most studies adopted the resilience concept as it is served as a basis and tool for understand behavior and attributes of complex systems (Folke, 2006). The concept of resilience has emerged as a tool to identify and overcome the rising complexity and severity of risk.

Campuses have been closed due to natural disasters in past such as wildfires and hurricanes in recent years (Johnson, 2019; Fink,2019; Samson, 2020), and public health and safety concerns will be likely to continue in the future. In this manner, resilience of educational systems also has emerged as an important field of research in the last decade. In terms of resilience in education, UNESCO indicates, "There is growing evidence of the need to strengthen the resilience of education systems" ("Education system resilience", 2020). In the World Education Forum 2015 in Incheon, new decisions were made, and a new vision for education set out for the next fifteen years. The need for education systems to be resilient is highlighted as an important issue and it is noted that education systems must respond to different disturbances or stressors, including changing labor markets, technological advances, migration, natural hazards and disasters, demographic challenges, and threats to peace and safety (World Educators Forum, 2015).

"Education in emergency situations" was one of the topics and some of the articles were dedicated to the resilient educational systems. According to article 9:

> "It is, therefore, critical to develop education systems that are more resilient and responsive in the face of conflict, social unrest and natural hazards; and to ensure that education is maintained during emergency, conflict and post-conflict situation" (p.27).

The need for the education system to be flexible and resilient to the uncertainty of the future has been brought into more focus with the disturbance of the COVID-19

pandemic of 2019[1]. In other words, the interest in resilience in higher education has grown. Recio and Colella refer to this situation as an opportunity to make the higher education system more inclusive, flexible and resilient (2020). Similarly, the International Association of Universities argued that this situation reflects the resilience capacity of the higher education system as the universities demonstrated resilience in the pandemic by contradicting its static, against-to-change model and exceeding expectations (2020). In the COVID-19 Global Impact Survey, Marinoni et al. indicate that the pandemic "may lead to increasing the institution's resilience and agility when responding to unforeseen challenges in the future." (2020). However, most of the studies ignore this unique relationship with the resilience and pandemic, and focus only on the delivery mode of the education. Although it is mostly referred to as "online teaching", distant education during the pandemic took place under a crisis situation and called “emergency remote teaching”[2] (ERT). The current situation was misused as a case study for "distance education" or "online education". Within this perspective, nearly every aspect of the distanced education during the pandemic evaluated, including its pros and cons, its feasibility for architectural education, the use of new technologies, the pedagogy of the distance education, the views of students, views of teachers, online evaluation methods, so on. However, what is missing out is the uniqueness of the situation and the uncertainty of the next disturbance.

Considering the disturbances to the education systems worldwide, the pandemic is one of the most extensive ones. However, it is not the first and may not be the last one. It

[1] Although it is referred in different names such as ”Coronavirus disease”,”COVID-19”,”coronavirus pandemic”, this study would refer it simply as “pandemic”

[2] The educational methods take place during the pandemic should referred as “Emergency remote teaching”(ERT) which differs from online education or traditional distanced education (Hodges et al., 2020).

is evident that events such as wars, natural disasters, diseases and epidemics that disrupt education occur time to time (Kahraman,2020). Moreover, in the 21. century, we are facing an increasing number of natural hazards, and with climate change, the disturbances are also increasing (Figure 1.1). Not only natural hazards but also various large-scale disasters, including diseases, technological accidents, terrorist attacks and major disruptions to critical infrastructures are also disruptive events to education.

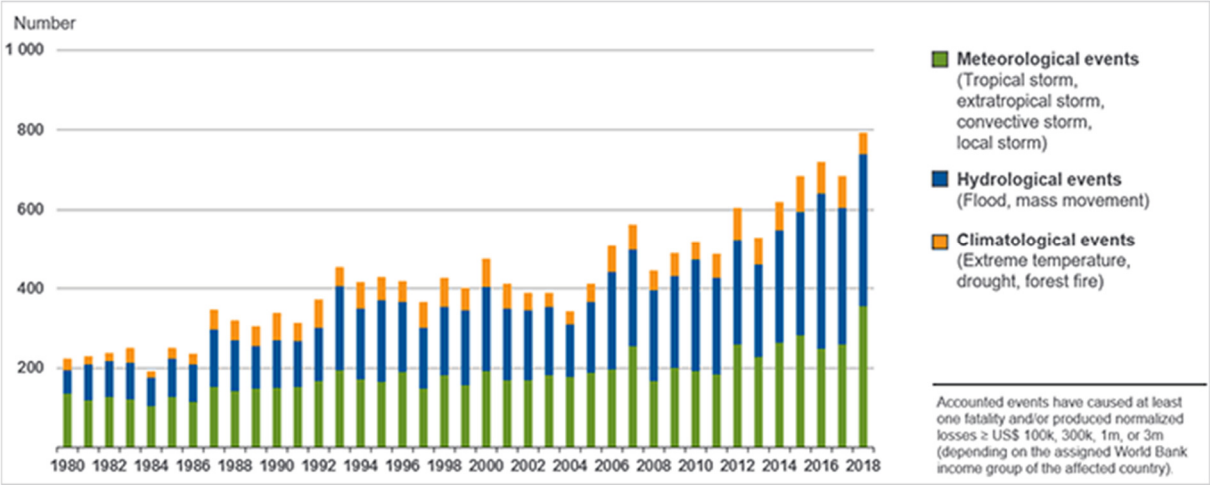

Figure 1.1 : World weather-related natural catastrophes, 1980-2018. Source: Munich Re, 2019

Other than natural disasters, OECD foresight that changes in demography, the environment, technology and socio-economic structures would also affect systems in the future (OECD, 2003, p.10). Thus, there is a need for education systems to adopt a resilient perspective in order to be prepared for not only pandemics but also the unknown crises of the future. In this manner, the exploration of the pandemic experience of education systems, including architectural education within the resilience perspective has significant potential. The response of the system to the past disturbances is one of the vital elements in predicting current and future changes and understanding resilience (Thorogood et al., 2020; Bekres,2007).

This study explores architectural education from a resilience perspective through past and present (pandemic) disturbances alongside with the transformation of architectural

education within its *genetic characteristics*. In general, architectural education has faced many disturbances throughout its existence, including both instant shocks and long-time changes. Being one of the most significant disturbances, the recent pandemic experience provides an observable example. In this manner, with the data and the insight it provides for future disturbances, the pandemic experience is used as a case to explore architectural education in the context of resilience.

The study acknowledges architectural education as a complex adaptive system and adopts the adaptive resilience framework as a lens to address and understand the transformation of architectural education. The adaptive resilience framework acknowledges a new normal for the system after the disturbance and also acknowledges the changes in the context as triggers. Moreover, it favors the role of the actors of the system in the resilience capacity (Laboy & Fannon, 2016). Regarding the effect of individual efforts in the transformation of architectural education, the adaptive resilience framework best sits for this study.

Today, the definitions and use of the term resilience varied and resolved from its original ecological perception; thus there is no consensus in the definitions and use of the term resilience in the literature (Roostaie et al., 2019). The concept of resilience in this study is rooted in its origin, which is in ecological and biological systems. It is acknowledged that the ability of resilience is learnt from the natural systems in the world.

In natural systems, many of the disturbances are a question of survival. Therefore, organisms have developed advanced strategies to sustain themselves in the face of these disturbances. If they survive, they become better adapted after ever disturbance they have been through. With evolution, these successful strategies are passed to the next generations, enabling resilience at systems level. In line with these, in this study, resilience is defined as the ability of the (architectural education) system to persist, adapt and even develop in the face of disturbances. Both instant disasters, chronic stresses, and changes are acknowledged as disruptive events, as Holling (1973) and many others do, and they will be referred as “disturbance” from now on.

As Walker emphasizes, one of the central elements in the resilience studies is the disturbances and discussion on resilience should begin by questioning 'The resilience of what to what?' (Walker, 2002, p.187). Accordingly, this study discusses the architectural education system within the resilience perspective with reference to the disturbances, specifically the pandemic experience. In addition to the pandemic, based on ecological origins of resilience which prioritizes past experiences of systems, the previous disturbances and past transformations of architectural education also have significance in this study. As it said that" if we can uncover how elements of the system have responded to past perturbations, then this information will become helpful for predicting current and future change." (Thorogood et al.,2020).

This study took the pandemic experience as an example of bending in the face of disturbances; in this manner, the pandemic experience of the TOBB ETU Department of Architecture was used as a case study. Architectural education is a complex phenomenon that should be considered with many elements. In this manner, by considering the TOBB ETU Department of Architecture's structure and the pandemic experience, the research addresses the resilience within four characteristics of architectural education: "curriculum"," tools"," learning environment" and" interaction". Alongside with the pandemic experience, the thesis aims to develop a broader perspective to increase resilience capacity of architectural education.

1.2 Scope

Both the study field of architectural education and Resilience are complex and extensive areas. In this manner, after the literature view on resilience, it is decided to limit the study with focusing on the disturbances that architectural education faces and transformations of past and present. Moreover, as mentioned above, the study limits itself with the four characteristics of architectural education that are: "curriculum"," tools"," learning environment" and" interaction" (Figure 1.2).

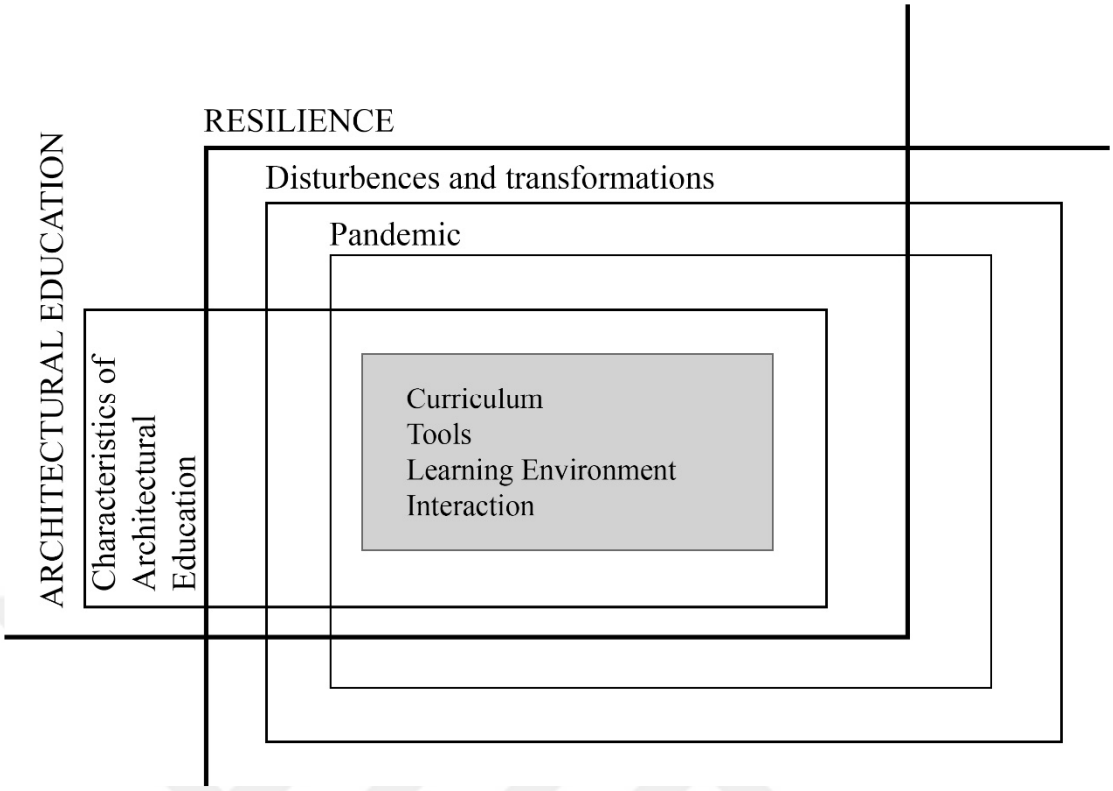

Figure 1.2 : Scope of the study. Source: Author's archive

In this manner this study explores *architectural education* from the *resilience perspective* within the four characteristics: "*curriculum"," tools"," Learning Environment" and" Interaction";* benefiting from *disturbances and transformations* from the *past and present*, more specially by the use of *the present disturbance of pandemic* as an example, even more specifically by the use of *the pandemic experience of TOBB ETU Department of Architecture* as a case study.

Regarding the development of architectural education throughout history, four primary forms of architectural education could be identified that are pre-institutionalization, Beaux-Arts education, the Bauhaus and the present-day era (Ozersay, 2003). This study follows this classification in the examination of the past disturbances and the past transformation of architectural education except for Pre-institutionalization form as it could not mentioned the characters of architectural education such as curriculum or tools. Thus, the architectural education examined from the very first formal

architectural education intuition that is Academie Royal d'Architecture, its successor Beaux-Arts, and continued with the Bauhaus. The examination of the history of these institutions enables the in-depth examination of disturbances and transformation of characteristics in institutional scale, alongside with the influences of great events such as World Wars, French revolution and industrial revolution on architecture schools. This examination through architectural institutions covers the period between 1671 – 1932. For the period after 1930 until today, the disturbances and developments in characteristics would be examined from an upper perspective and with a focus on disturbances as it is impossible to cover the extensive number of architecture schools within the limits of this study. This is understandable, as this study do not attempt to make a historical journey on architectural education, instead tries to understand the transformations that architectural education goes through in relation with disturbances, which will help to understand future alterations in architectural education against future disturbances. In this manner, development of architectural education from 1930s to today would be examined in a general manner, from an upper perspective and through disturbances that forced architectural education to transform in order to adapt. It is argued that these disturbances are mainly a part of the long-term changes which categorized under five field:

- Technological developments
- Advancements in building technology
- Change in educational settings
- Social and political changes
- Changing of architectural profession

In terms of the present disturbance of the pandemic, the pandemic experience of TOBB ETU department of architecture used as the case study in order to collect data. In this manner, TOBB ETU Department of Architecture considered as important asset in

exploring the pandemic experience as the department's experimental structure and its character, which is open to new possibilities, catalyze the adaptation to online education, especially in design courses. In the data collecting process, semi-structuring interviews used. In this manner, students, professors and educators who have administrative duties interviewed which diversified the data and strengthened the original side of the study. The students selected from 4th grade undergraduate as it is believed that their extensive experience in face-to-face education could enrich their analysis and reflection on the current situation. In other words, the experiences of students, who are the main actors of education, were discussed together with the experiences of decision-making mechanisms and implementers.

1.3 Aim

The motivation for this research stems from mounting evidence that a resilience perspective is required to ensure the continuity of architectural education when it confronts disturbances. It is said that the COVID-19 pandemic would cause a permanent transformation in education systems as it triggered digitalization and allowed exploring technology within the educational context (Recio & Colella, 2020; Marinoni, Van't Land & Jensen, 2020; Schulte et al., 2020). However, there is a need to understand this transformation specific to architectural education to prepare architectural education for future disturbances. This study accepts that architectural education has to and would transform in the scope of resilience to cope with the pandemic. The thesis also agrees with Geoffrey M. Cox, who theorizes about the Resilience of American Higher Education, and indicates that "higher education has been remarkably adapted at changing with the times, and there is no reason to think that this capacity has been lost." (2019, p.7). Higher education, including architectural education, did change and adapt to the past disturbances, and it would also adapt to the pandemic. However, to ensure educational systems cope with disturbances, we need to understand the current example of bending during the pandemic alongside with the transformed characteristics of architectural education, how and through which direction.

In this manner, this study aims to understand attempts that help architectural education to adapt to the changing conditions and disruptive events. Identifying organizational and structural features of the architectural education system will also enable us to look ahead to the transformation of architectural education would have. In order to provide insight into the future, it is necessary to understand and evaluate the current reactions of architectural education in the face of the pandemic and other past disturbances that push the architectural education system to change. In this sense, the fundamental problem of the study is not to criticize if architectural education is resilient or not, but how.

Therefore, to update architectural education regarding the requirements of today, this thesis aims to reveal the potential of the changes and adaptations implemented during the pandemic.

In this respect, the research question of the study is:

- How will architectural education transform and adapt to new conditions after the disturbances?
- What could be done to increase resilience capacity of architectural education?

To answer this, there are some other research questions to be explored. In this respect, the guiding research questions are:

- How did architectural education react to past disturbances? How did it transform in the face of past disturbances?
- How did architectural education react to the pandemic? How did it transform during the pandemic?
- What changed in architectural education practices beyond transferring the same system to online?
- How do the genetic characteristics of architectural education transform in the face of disturbances? How do they react in the face of disturbances?

- What qualities, methods, and components of architectural education helps to deal with disturbances?

1.4 Significance

In this era of hazards, that all kinds of systems are challenged, systems should adopt the resilience perspective, including the architectural education system. However, the studies on the resilience of architectural education are limited. There is a significant need for more research and studies on resilience in architectural education. In this manner, this study aims to contribute to the literature by studying the architectural education system from a resilience perspective.

Moreover, most of the existing studies on pandemic approach to this emergency situation wrongly as traditional distance education and focus on subjects such as positive and negative influences of online education, e-learning and digitalization. However, this is an extraordinary situation that requires considering remote education alongside with different aspects of the pandemic, such as the curfew, the feeling of isolation, and health concerns of students. Moreover, studies are generally limited in terms of focusing on only one perspective (such as students or instructors), focusing only on one lecture such as design studio or focusing on only one dimension such as the comparison of the utilized tools.

The significance of this study is to discuss the pandemic experience of architectural education from a holistic view by including different perspectives, dimensions and within the scope of resilience. Thus, the significance of this study is:

- Exploring pandemic experience from a resilience perspective.
- Adopting a holistic perspective that:
    - Includes different perspectives of different actors: students and academic staff (including head of the department and the Dean)
    - Includes lectures from different areas within the field of architecture.

1.5 Limitations

Resilience is a vast concept used in various meanings and in a broad range of disciplines. The academic discourse on resilience is dominated by disciplines such as environmental sciences, ecology, psychology, and ecology (Hosseini et al., 2015). It is a term that is both global in scale and also complex. However, the use of the term in education is respectively new compared to social and ecological domains, and the adaption of the resilience concept in architectural education is even more rare. Moreover, the architectural education system is a controversial subject itself with various approaches, sub-subjects and ideologies. Therefore, this study confronts severe challenges concerning complexity, uncertainty, scale, and complication. To narrow the study, this thesis moves through the pandemic experience and focuses on the TOBB ETU department of architecture as a case study that presents accessible data. Moreover, an intentional decision of the study was to cover four characteristics of architectural education, which are curriculum, tools, learning environment, interaction extracted from the TOBB ETU system and pandemic experience. These limitations are coherent with the character of resilience, as resilience should be considered within the context that is specific to disturbances and the system.

Although this thesis limits itself because of the limitations and practical reasons, it would be helpful to investigate schools from different regions and with different structures, examine different examples of disturbances, and different characteristics in the education system in order to draw a broad and holistic view on the resilience of architectural education.

1.6 Research Design

This study employs grounded theory as the conceptual framework to address the research questions. In the grounded theory methodology, the study begins with research questions instead of hypotheses, and the theory emerges throughout the research process from the data (O'leary,2004,p.273). It "seeks to investigate a setting holistically and without preset opinions or notions" (Groat &Wang, 2013). Moreover,

it is "likely to offer insight, enhance understanding, and provide a meaningful guide to action" (Strauss & Corbin, 1998 in Groat &Wang, 2013). The grounded theory framework is the most suitable method for the thesis with these features. The required steps of the method, which are data collection, analysis, and theory building (Groat &Wang, 2013), are carried out simultaneously in an intensive, open-ended, and iterative process. A mixed-method of data collection was employed to address the research questions, including quantitative and qualitative methods. According to O'Leary, mixed methods allow to "build a broader view by adding depth and insights to 'numbers'" and "add precision to 'words' through the inclusion of numbers and statistics." (2017).

The study is threefold and consists of three interrelated processes (Figure 1.3). In the first stage, a literature review on resilience was held to build the conceptual framework of the study and used to develop an understanding on resilience. This stage also covers the definition, scope and relationship of determined genetic characteristics of the architectural education (curriculum, tools, learning environment and interaction) alongside with the relation between characteristics and resilience. This stage forms the foundation of the study as it gives prior knowledge on resilience and its parameters, levels, approaches, capacities, and uses in the academic environment.

In the second stage, a preliminary reading is conducted through this framework regarding past disturbances to architectural education and its transformation. In this manner, the disturbances that trigger the transformation of architectural education examined in relation with the transformation itself. In this stage, it is aimed to extract key fields to adapt in architectural education and the bending capacity of education concerning resilience. In the evaluation of this stage, the data is divided into various categories of disturbances accompanied by the reaction of characteristics of architectural education.

In the third stage, the pandemic experience was examined based on the TOBB ETU Department of architecture as an example of the reaction of architectural education in the face of a disturbance. In this stage, semi-structured interviews are conducted,

which enables the examination of data specific to the context in depth. The qualitative data analyzed with the content analysis method. In this manner, the data transferred to MAQDA software and coded. After the first cycle of code, it is observed that some themes are repeated which matched with the genetic characteristics. Based on the knowledge extracted from these stages, it is aimed to hold a discussion on the resilience of architectural education and build a broader perspective.

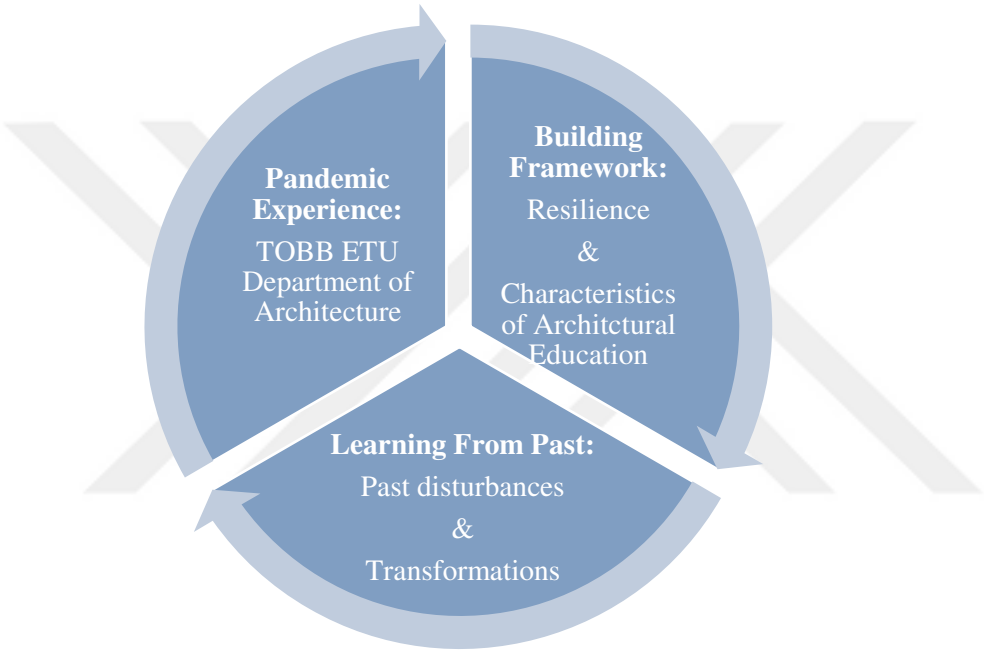

Figure 1.3 : Research process. Source: Author's archive

2. SETTING THE FRAMEWORK

This section consists of two main parts. Firstly, with an extensive literature review, the concept of resilience was explored, and its importance is demonstrated. As previously mentioned, resilience is broadly discussed and studied in many areas. Accordingly, it is approached differently in these areas. In this part, these approaches are examined with the aim of revealing the most appropriate conception to study in architectural education. Secondly, genetic characteristics of architectural education, which are curriculum, tools, learning environment and tools, are discussed alongside with their relevance to resilience. These characteristics are first decided by the literature review and observation at TOBB ETU Department of Architecture, and then proved by the interviews that are made with the students and lecturers.

2.1 The Concept of Resilience and Its Relevance

With roots in ecological systems, resilience emphasizes the ability or capacity of a system to absorb disturbance and prevent its function in the face of shocks, disturbances or while undergoing a change (Folke, 2006). It offers insights into systems' behavior and attributes, such as the ability to self-organize, system memory, and response mechanisms (Cumming et al., 2005). However, there is an ambiguity in the use of the term as it has been adopted by and adapted to numerous disciplines with different natures (Roostaie et al., 2019; Hosseini et al., 2016). Moreover, the original perception of ecological resilience has significantly varied for some reasons, such as having a wide application area, being used for various purposes, using in a broad sense, and being regarded as a perspective rather than a well-defined concept (Roostaie et al., 2019). In this manner, approaches to resilience vary in some respects, such as

definition, the scope of resilience, the scope of disturbance, properties, and resilience models. Some featured definitions of resilience include:[3]

Table 2.1 : Some definitions of resilience. Source: Author's archive

Publication	**Definition of Resilience**
Laboy & Fannon, 2016	The ability or capacity of a person, object, entity, or system to persist in the face of disruptions or difficulty
Walker et al., 2006	The capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity
Rockefeller Foundation & Arup, 2015,	The capacity of individuals, communities and systems to survive, adapt, and grow in the face of stress and shocks, and even transform when conditions require it
Folke, 2016	Having the capacity to persist in the face of change, to continue to develop with ever changing environments
Cumming et al., 2005	The ability of the system to maintain its identity in the face of internal change and external shocks and disturbances
Holling, 1973	A measure of the ability of the systems to absorb changes of state variables, driving variables, and parameters, and still persist.
Bruneau et al., 2003	the ability of the system to reduce the chances of a shock, to absorb a shock if it occurs, and to recover quickly after a shock

[3] For more, please look at: Roostaie et al., 2019; Brand & Jax,2007; Hosseini et al., 2016; Shah, 2019.

Resilience is mainly examined under three conceptual frameworks, which are engineering, ecological, and social-ecological (or adaptive) resilience. These frameworks could be best understood by the use of the ball in the cup model of Carpenter et al.(1997,1999) and Scheffer (1993) (Figure 2.1). According to this model, the ball represents the system, the surface represents the context, arrows represent disturbances, and the valleys represent stability domains. After being exposed to a disturbance, the system (ball) loses its stable condition for a while, then re-constructs its stability. While in engineering resilience, the system has to go back to the first stable condition; ecological and social-ecological (or adaptive) resilience acknowledges a new normal (Figure 2.2).

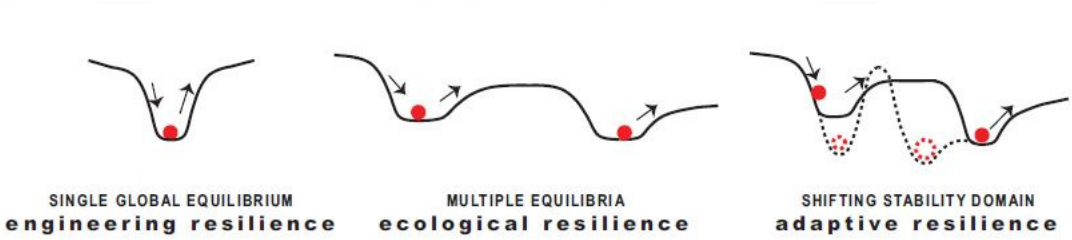

Figure 2.1 : Ball and cup model. Source: Laboy & Fannon, 2016

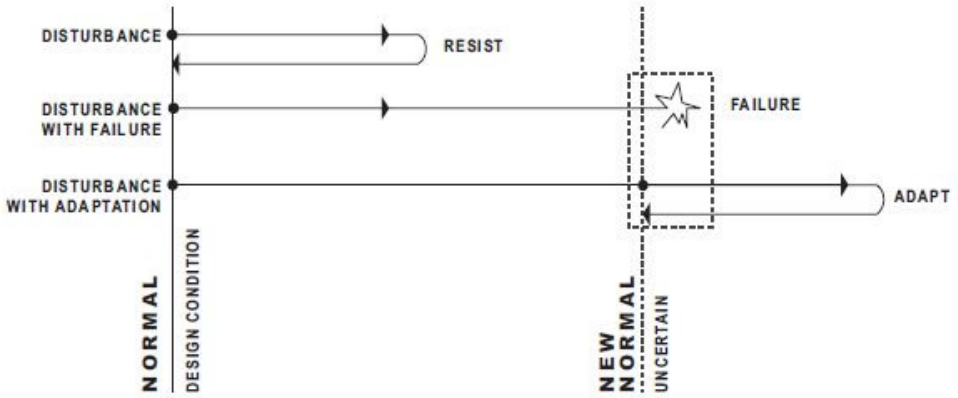

Figure 2.2 : “Normal” and “New Normal”. Source: Laboy & Fannon, 2016

Engineering resilience considers resilience as a return to previous status (defied as normal) and concentrates on requiring time to return to the normal (Folke, 2006). This

normal state refers to the original condition or previous equilibrium; therefore, engineering resilience leaves out the adaptation concept and is criticized for being fragile and static (Laboy & Fannon, 2016). Engineering resilience mainly focuses on systems with a single equilibrium and is associated with technological systems with a focus on disaster studies (Berkes & Folke, 1998).

The engineering resilience concept mainly approaches resilience as the capacity to absorb disturbance. However, as Folke indicates, "resilience is not only about being persistent or robust to disturbance but also about the opportunities that disturbance opens up in terms of recombination of evolved structures and processes, renewal of the system and emergence of new trajectories" (2006). In this manner, ecological resilience considers the transition of the system to another stable state, which is defined as the new normal (Pendall et al., 2009). This is reflected in the Figure 2.1, as the shift of the ball to another valley. For ecological resilience, Holling underlines that complex and dynamic living systems have distinct stable states that systems could shift in the face of disturbance (1973). Thus, the ecological resilience concept acknowledges alternative stable states and dynamic systems with multiple equilibria and complex relations (Laboy & Fannon, 2016). The main focus of ecological resilience is on the amount of disturbance that a system can absorb (Gunderson, 2000).

Different from engineering and ecological resilience, which consider the context is stable and the only moving component is the system, adaptive (or socio-ecological) resilience presumes that the context (surface) and the shape of systems (not just position) might also be changing. The adaptive resilience concept underlines that as long as the context around the system changes, even unperturbed systems are not stable (Laboy & Fannon, 2016). Moreover, this framework acknowledges the learning capacity of the system and focuses on attributes such as adaptive capacity, transformability, innovation and self-organization. According to the adaptive resilience concept, "resilience provides adaptive capacity that allows for continuous development, like a dynamic adaptive interplay between sustaining and developing with change" (Folke, 2006). It is adopted to examine resilience in systems where the

agents and variables interact dynamically in unexpected and unpredictable ways (Folke et al., 2016). The adaptation process is mainly determined by the self-organization and learning capacities of the system, which are necessary to deal with change (Folke, 2006).

The scope of resilience also varies in different studies and different approaches. While some studies utilize resilience with a focus on disaster prevention, there is also a growing interest in considering the protection of functions and even continue to develop. Especially in earlier studies and in the engineering resilience framework, the expected response of the system is to "bouncing-back," which refers to returning to pre-disturbance status (Roostaie et al., 2019). In this manner, the extent of resilience ranges from being able to absorb disturbances to maintaining functions, recovering, growing, and transforming. For example, Shah (2019) indicates three forms of system response within the resilience concept, which are absorptive, adaptive and transformative. In this manner, absorptive resilience capacity refers to the ability of systems to absorb the disturbances and minimize their influence; adaptive resilience capacity refers to the ability of systems to adjust and make changes to cope with disturbances; and transformative resilience capacity refers to the ability of systems to learn from past and enabling environment for systemic change (Shah,2019). Other examples from different studies include the inclusion of "withstand, adapt to, and recover" (UNESCO-IIEP, 2015; European Commission, 2013; USAID,2012); "recover, perform and even grow" (World Bank, 2013); "mitigate, maintain functions and recover" (UNESCO IIEP, GEC, UNICEF,2011) (in Shah, 2019).

Moreover, the scope and understanding of disturbances were redefined and extended according to the disciplines that adopted the term. As disciplines deal with different stresses following the scope and character of the area, they have their own definitions of disruption, particular to that field; thus, there are critical differences in the understanding of disturbances. This variety could also be observed in the definitions of resilience (Table 2.1). While some studies include only instant shocks or hazardous events within the resilience definition, others extend the scope of disturbances by

including processes such as changes, chronic stresses, difficulties, ever-changing environments, and internal change. For example, Shah (2019) points out natural disasters, disease epidemics, armed conflict, violence, economic crises, and instability as disturbances in the education sector which are studied under two categories: shocks and stressors. Shocks are defined as "typically short-term occasions that have substantial negative effects on people's current state of well-being, level of assets, livelihoods, and safety". And the stressors tend to be "chronic, long-term trends, pressures, or protracted crises that undermine the stability of a system and increase vulnerability within it" (Shah, 2019).

Another ambiguity in resilience studies is on the properties of resilience, which have close relationships with its characterization. In this manner, the 4R concept was adopted by a variety of studies, especially in the engineering domain, to understand, conceptualize, or evaluate systems' resilience. According to the 4R concept developed by Bruneau et al. (2003), resilience systems have the four attribute that are robustness, redundancy, resourcefulness and rapidity[4], which are also referred as properties and

[4] Robustness: strength, or the ability of elements, systems, and other units of analysis to withstand a given level of stress or demand without suffering degradation or loss of function.

Redundancy: the extent to which elements, systems, or other units of analysis exist that are substitutable, i.e., capable of satisfying functional requirements in the event of disruption, degradation, or loss of functionality.

Resourcefulness: the capacity to identify problems, establish priorities, and mobilize resources when conditions exist that threaten to disrupt some element, system, or other unit of analysis. Resourcefulness can be further conceptualized as consisting of the ability to apply material (i.e., monetary, physical, technological, and informational) and human resources to meet established priorities and achieve goals.

Rapidity: the capacity to meet priorities and achieve goals in a timely manner in order to contain losses and avoid future disruption. (Bruneau et al.,2003)

dimensions. On the other hand, the dimension of resilience varies regarding the approach to resilience and the field adopting it. For example, Laboy and Fannon extended the 4R model to the 6R model by including "Risk avoidance" and "Recovery" (2016). Moreover, as mentioned before, dimensions such as the learning capacity come to the fore in the studies based on the adaptive resilience framework, as the focus is on the adaptation. Accordingly, Berkes (2007) defines four main properties of building resilience in social-ecological systems, which are:

1. learning to live with change and uncertainty,

2. nurturing various types of diversity for increasing options and reducing risks,

3. increasing the range of knowledge for learning and problem-solving,

4. creating opportunities for self-organization, including strengthening of local institutions and building cross-scale linkages and problem-solving networks.

Features such as the extensive participation of actors, diversity, connectivity, and adaptive systems thinking also proposed dimensions in building resilience in social-ecological systems (Folke et al., 2016). On the other hand, studies from the ecological domain emphasize the role of diversity in building resilience. In this manner, the variability in terms of stable states, species, time and space are helpful in increasing resilience (Holling, 1973). If there is more than one stable state, the system could simply shift to other domains in the face of disturbance. Variability in time and space means being in heterogeneous environments both in space and time (in different places and times), which results in diversity in the species. Moreover, the variety of species is directly proportional to resilience. For instance, "the commercial fishery systems of the Great Lakes have provided a vivid example of the sensitivity of ecological systems to disruption by man, for they represent climatically buffered, fairly homogenous systems with relatively low variability and hence (with) low resilience" (Holling,

1973). On the other hand, insect pests of man's crops are highly resilient as they are open systems that are heterogeneously distributed over time and space.

The variations in the conceptualization of resilience mentioned above made it difficult to adopt a particular framework for architectural education. To overcome this ambiguity, this study benefits from the original conceptualization of ecological systems, especially from Holling's work (1973).

The study regards architectural education as a dynamic and complex system, like the natural systems and organisms, that displays relationships between its agents and variables. Moreover, it is highly dependent on long-term changes in cultural, economic, and ecological contexts. This conflicts with the engineering concept of resilience, as it should be expected from the system to transform in the face of long-term stresses. Even if there is no disturbance as defined in the engineering domains (hazardous events such as earthquakes or floods), the changes in other contexts, such as the technology or economy would disrupt and eventually transform architectural education system. For this reason, an understanding of disturbance alike in the adaptive framework that encompasses long-term changes is more suitable for architectural education. In addition, architectural education itself is alterable and has the ability to learn and self-organize with actors within it. In this manner, the adaptive framework that acknowledges the learning ability of the system best fits with the architectural education. As a result, this study adopts the adaptive resilience framework as a lens to address and understand the transformation of architectural education (Figure 2.3). This view is not conflicting with the ecological resilience concept, which acknowledges alternative stable states and dynamic systems. Rather, it extends the ecological framework with the inclusion of learning capacity and the long-term changes as disturbances. The conception of resilience adopted in this study shown in the Table 2.2.

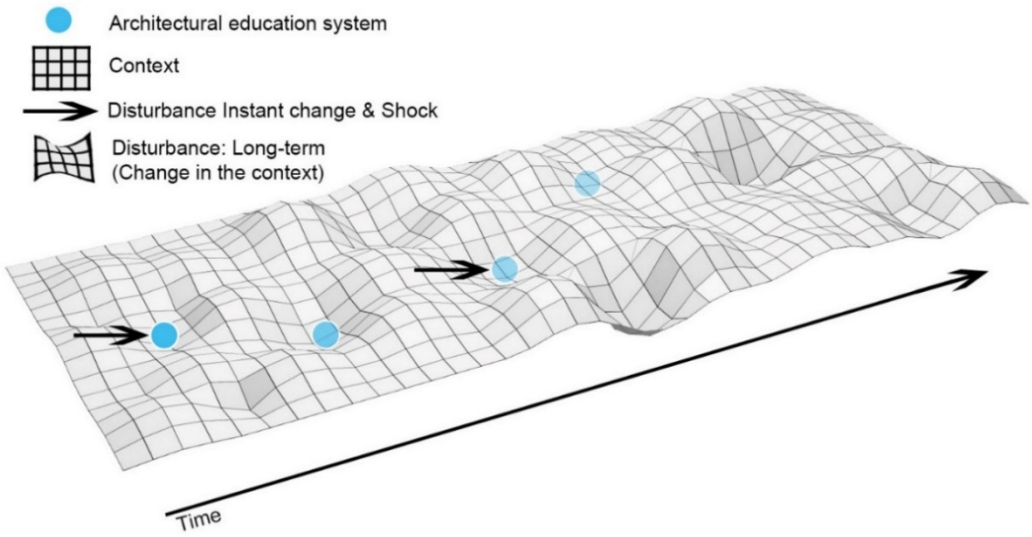

Figure 2.3: The conception of resilience adopted in this study. Source: Author's archive

Table 2.2 : The conception of resilience adapted in this study. Source: Author's archive

Definition:	The ability of the architectural education system to persist, adapt and even develop in the face of disturbances.
Scope:	To persist, adapt and develop
Disturbance:	Instant shocks, and long-term changes
Properties:	Learning capacity, diversity
Framework:	Socio-ecological model with ecological focus

As mentioned before, resilience is broadly adopted by various fields such as ecology, materials science, psychology, economics, and engineering. In terms of the application of the term in different disciplines, the most extensive one is in the psychology domain, followed by the environmental, social and ecology domain (Hosseini et al., 2016). However, the application of resilience in education is relatively small. Moreover, resilience studies in educational domains are highly related to the psychology domain, mainly focusing on the resilience of individuals, such as the resilience of students (Figure 2.4).

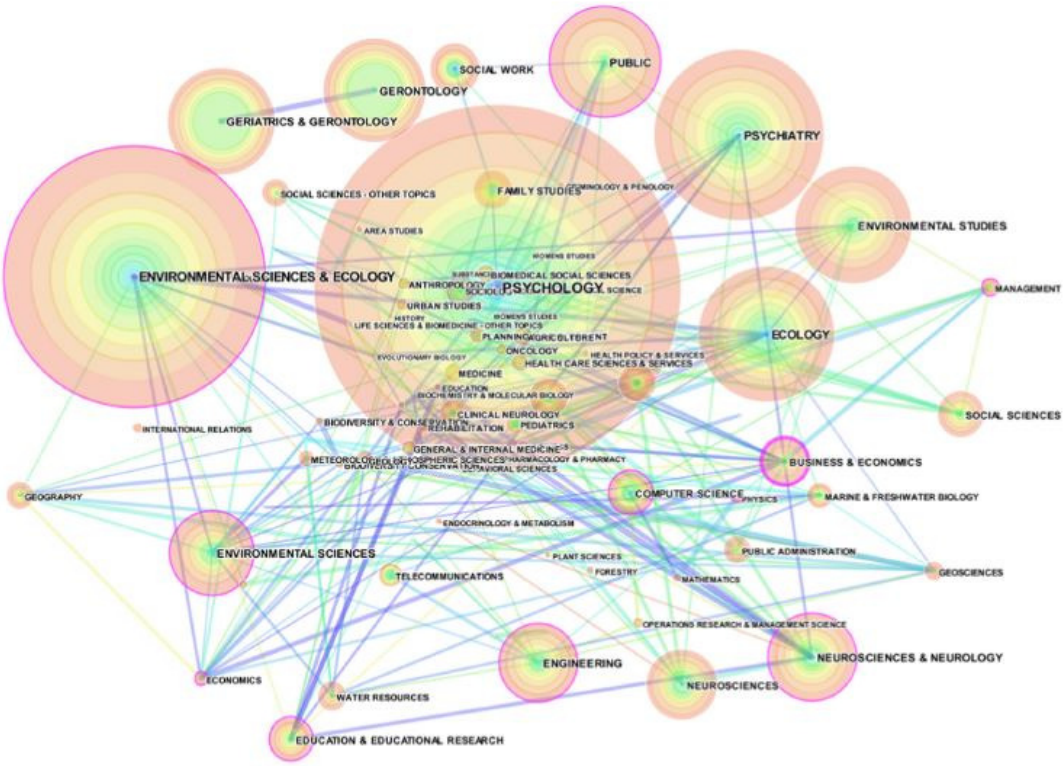

Figure 2.4 : Resilience by domains. Source: Hosseini et al., 2016

The resilience of educational systems has emerged as an important field of research recently, especially with the recent disturbance of the pandemic. In this respect, UNESCO indicates, "There is growing evidence of the need to strengthen the resilience of education systems" ("Education system resilience", 2020), which is also points out in the Education 2030 Agenda. Similarly, it is underlined that it is vital that

education systems should be resilient themselves, and for this, education systems need a range of capacities, assets, resources, and networks at various levels (Shah, 2019).

In terms of the utilization of the term in architectural education, although studies that directly refer to resilience are limited in number, some studies show a similar approach to resilience without using the term directly. In this manner, there is an increasing number of studies concerning architectural education in times of adversity. Among the studies that utilize the term resilience directly, the role of architectural education in building the resilience of the built environment comes to the forefront. For example, in "Sustainability and Resilience In Architectural Education" it is underlined that there is a need to introduce new concepts such as sustainability and resilience to students, alongside with the relevant methods to build it (Stieldorf, 2018). In this manner, it is argued that it is necessary to actively involve students in projects focused on environmental issues. With a similar approach, the doctoral thesis" Approaches to the resilience and the potential for adaptation through community-driven construction projects in the global South", Panta (2018) focuses on the potential of building materials to improve the resilience of the built environment in the Global South. The study emphasizes the necessity to include resilience within architectural education, especially by including it in the curriculum and design problems. Accordingly, it is suggested that there is a need for design problems to regard disturbances such as regular hazards in South Africa. Additionally, Brogden (2020) argued that the term resilience should be a core component of architecture education. The study approaches resilience from the engineering approach and criticizes that concepts such as disaster risk reduction and disaster mitigation are rarely taught within the main curriculum of architecture education. These studies investigate the need for architectural education to address resilience to enhance the built environment's resilience. However, they do not mention the adoption of the term itself as the architectural education system's own resilience.

Apart from these, "Resilience in interior architecture education: Distance universal design learning in the COVID-19 pandemic" (Dinç Uyaroğlu, 2021) addresses the

concept of resilience by means of the resilience of the education system itself, as like does this study. The study shares the view of that the pandemic experience provides the opportunity to investigate the resilience of the education system. Therefore, it discusses the concept of resilience through the experiences, limitations, and potentials experienced in the distance education process in order to contribute to the development of resilient education. However, differently from this study, it deals with the resilience in interior architecture and specifically dwells on experiences of the Universal Design (UD) course and focuses on the two dimensions of resilience that are "adaptation" and "transformation".

Additionally, there are studies that implicitly refer to the resilience concept and utilize the core terms, concepts, and approaches used within resilience without directly mentioning the term. For example, "Dealing with Change: For a dynamic, responsive, adaptive and engaged architectural education" (Spiridonidis & Voyatzaki, 2014) implicitly refers to the resilience concept while investigating the need for a dynamic architectural education that transforms in order to deal with change. It is argued that architectural education systems have significant resistance to the fast changes occurring in the real world; they appear relatively passive and unable to follow these changes at a social, financial and cultural level. Thus, the publication focuses on different ways for architecture schools to deal with the change alongside with the possible strategies, processes, tools and means for the adaptation of academic programs. In this manner, the study is very close to the understanding of resilience which emphasizes the capacity of systems to deal with disturbances. Additionally, publications such as "Learning for the Future: New Priorities of Schools of Architecture in the Era of Uncertainty" (Spiridonidis & Voyatzaki, 2011a); "Education for uncertainty" (Farrelly & Samuel, 2016) and "Doing more with less: Architectural Education in challenging times" (Spiridonidis & Voyatzaki, 2011b) reflects the growing interest of international organizations such as ENHSA and EAAE on the transformation of architectural education in the face of disturbances. Although there are studies discussing resilience intentionally or explicitly, the resilience debate

remains in a more general context. In this manner, there is a need to discuss resilience in architectural education systematically in terms of knowledge building.

It had mentioned that this study draws on the original conceptualization of resilience in ecological systems, particularly in Holling's works. Resilience thinking in Holling's studies claims that ecosystems are constantly changing and focuses on these renewal and reorganization processes rather than on stable states (Holling 1973, 2001, 2004). In this process, alongside with inner mechanisms, response to the disturbances also relies on the features of disturbances such as type, amplitude, frequency, and predictability (Davis et. al, 2021). The significance of the disturbances in studying resilience highlighted as follows: "To assess a system's resilience, one must specify which system configuration and which disturbances are of interest." (Carpenter et. al, 2001). Therefore, the fields of disturbances that lead to the change in architectural education are one of the main focuses of this study. Changing the emphasis of the study to focus on the disturbances and transformation of education helps to limit the study. Thus, this study prioritizes the renewal and reorganization processes of the architectural education system alongside with accompanying disturbances.

Moreover, the resilience perspective acknowledges complex, multi-equilibrium and open systems that cannot be analyzed at one level alone (Bekres,2007). Holling's (1973) discussion on Lake Huron experiment simulates this, where the whitefish population continues to decline even though hunting is over. This is because the fish population is not dependent only on hunting but a complex system that is influenced by multiple factors. In this manner, after the harvest, another element that was not harmful previously could affect whitefish as the dynamics of the lake changed. For example, the whitefish could lose its advantage over a competitive specie that was not harmful before, resulting in a population decrease. Architectural education is also an open and complex system that is open to multiple disturbances. Accordingly, this study adopts a holistic view and discusses the areas of disturbances holistically from multiple perspectives that include changes in the areas such as technology, socio-economic, and

architectural practice. It also admits that these challenges affect architectural education collectively, on different scales, and influence different elements of education.

Thorogood et al. indicate for ecosystems, ”if we can uncover how elements of the system have responded to past perturbations, then this information will become useful for predicting current and future change.” (2020). The investigation of the past is essential as the resilience capacity in living systems is highly provided by evolutionary genetics (Davis et al., 2021). Similarly, to be able to make predictions in the context of the future of the architectural education system, it is important to address the past areas of disturbances and identify the past transformations of architectural education have had.

Many of the current uses of resilience acknowledge the necessity to learn from past events (Bekres,2007). It is argued that the resilience of biological systems is highly based on evolutionary mechanisms triggered by stresses (Holling, 1973; Thorogood et al., 2020). Past disturbances leave their imprint on biological entities, forming ecological and evolutionary “memories” that impact future reactions to similar disturbances (Thorogood et al., 2020). Similarly, the “memory gene” created by pandemic experience would affect future reactions to similar situations, thus providing context for future responses. In this manner, this study aims to unfold the response of architectural education to the pandemic in an attempt to understand the resilience of architectural education. In addition to the pandemic, the past responses of architectural education to the past disturbances could also provide context for present and future responses. The development patterns of architectural education regarding disruptive events hold a significant role in understanding the adaptive capacity of architectural education. In this manner, the development of architectural education from a cause-and-effect relationship would be studied.

Lastly, as Berkes noted: “Social and ecological systems are sufficiently complex that our knowledge of them, and our ability to predict their future dynamics, will never be complete. “(2007). Similarly, the architectural education and dynamics that influence it are extremely complex. Thus, the understanding of the whole process of the

development of architectural education, all characteristics of it, as well as the knowledge on all factors shaping it will never be complete. Change is a very complex situation, and the disturbances architectural education faces are so large and complex to solve that resilience cannot solve all but could bring a perspective. Accordingly, this study does not claim to define all the transformations that architectural education has undergone, with all of its characteristics and disturbances. Rather, it identifies and discusses featured disturbances aiming to understand the ability of architectural education to adapt to future disturbances.

2.2 Characteristics of Architectural Education

The organisms in nature are consisted of genetic characteristics and metabolism. They reflect on external factors and adapt based on these two aspects. In this sense, their genetic characteristics are defining the dynamics of the system and thus very important for their resilience capacity. An example of resilience from nature is the reassembling of the ant colonies after a disturbance. Ants live in colonies, and they accomplish tasks such as finding food, building bridges, building homes, and protecting the colony collectively by labor division. In the face of a major colony disturbance, division of labor is maintained, and workers return to their relative spatial places. When some colony members fail, others can continue to carry out their functions. Even in the absence of the colony's main components, including the queen, the brood, or a large number of the workers, the system continues as individual workers are returned to their familiar tasks or tasks in close to their familiar tasks. This ability to re-arrangement the colony's components in the face of disturbance or change represent its resiliency (Chandra, 2010). In this context, resilience depends on the dynamics of the systems and requires knowledge of the components as well as the interaction between them (Chandra, 2010).

To understand the behavior of an ecosystem in the changing environment and disturbances, the knowledge of its components and their interactions is needed (Thorogood et.al., 2020). Similarly, the transformation of the educational structures is

enabled by its components and their interactions (Özersay, 2004); thus, to understand the behavior of the architectural education system, there is a need to understand its characteristics. Cummingham et al. noted that system components can be thought of as the system's pieces, depending upon both the knowledge base and the questions of interest (2005). As the ant colonies reorganize tasks to adapt, it is suggested that the characteristics of architectural education are rearranged and transformed to adapt to changing conditions. The characteristics to examine within this study are determined as curriculum, tools, learning environment and interaction. These characteristics of architectural education are used as a tool to discuss resilience in architectural education in a systematic and detailed way and form the framework of the study. To study resilience, it is crucial to clearly identify the components, component boundaries and relationships (how to interact or fit together) between these components (Cummingham et al., 2005). In this section, the determined characteristics of architectural education are discussed in detail in order to be able to discuss resilience in a systematic and detailed way.

Before discussing these characteristics separately, it is important to clarify the position of characteristics within the resilience concept once again. As mentioned before, variety and adaptation are the key elements of resilience thinking in the ecological domain. For instance, the adaptation and evolution of some species regarding different climatic conditions allow them to survive in disreputable events of their own environment. For example, two species from the same genus of Vulpes (fox); the Arctic Fox and the Fennex Fox, are differentiated according to their environments. While the Arctic Fox has small bodies that minimalize body surface and heat loss, short facial features, short limbs and a thick fur coat helping to keep the heat and stay warm; The Fennec Foxes (which lives in the desert) have large ears helping cool down, and sandy color helping to camouflage (Figure 2.5). While both have similar features of foxes, their characteristics are transformed in order to adapt to environmental conditions. They both represent similar physical attitudes of their family but in a specialized way. They both have fur coats, ears, noses, and tail, but these characteristics vary in scale, color, and behavior (Table 2.4).

Figure 2.5 : Arctic Fox and Fennec Fox. Source: Url-1 & Url-2

Table 2.3 : Similar and different characteristics of Arctic Fox and Fennec Fox. Source: Author's archive

Arctic Fox	**Characteristics**	**Fennec Fox**
Fur changes color with the seasons	Fur	Sand-colored fur
Thick bushy tail	Tail(similar)	Thick bushy tail
Small ears	Ears	Extra-large ears
Extra fur on its feet	Feet fur(similar)	Extra fur on its feet

Just like in nature, architectural education too responds to the changes around it, and transforms in order to adapt. And just like nature, architectural education has some common genes, or characteristics, that could be found in every department of

architecture but also differ by conditions and context such as region, sources, capital, facility, school culture etc. In this analogy, if architectural education represents the genus (Fox), the institutions with specialized characteristics represents species (Arctic Fox or Fennec Fox) and the characteristics of architectural education represent the characteristics of living systems (fur, tail etc.). For example, two prominent schools of architecture; École des Beaux-Arts and Bauhaus differentiate in these four characteristics (Table 2.4). Although every architecture department has a curriculum, these could differ in accordance with the context including the country of institution, dominant building materials, accessible technology, or school culture[5]. For example, while environmental studies and wood as a local material would stand out in an architectural department in Finland, technology education could come first in an architectural department in Germany. In this manner an architectural department in south Africa, in middle Europe or in a Nordic country; as well as institutions from the same country would differentiate and have different school culture. For example, Mimar Sinan Fine Arts University (MSGSÜ) is derived from French Beaux-Arts model, Istanbul Technical University (ITU) is derived from German Technische Hochshule model; and Middle East Technical University (METU) is derived from

[5] Culture in this context refers to the true character of an architecture school, both explicitly or implicitly manifested features embody the school's culture and identity (Roth-Čerina & Cavallo 2020). It is apparent by different substances of architectural education including curriculum, educators and students that generate the culture of school, the learning environment, and learning approaches (Roth-Čerina & Cavallo 2020). Most programs find it appropriate to promote a set of ideologies to their students, publicly or implicitly that often hinder individual inquiry, intellectual and artistic development (Glasser, 2000). For example, Louis I. Kahn's influence is still felt today in University of Pennsylvania where students mostly uncritically accepted his position on materiality and geometry. On the other hand at Cooper Union, students are implicitly expected to deconstruct or reconstruct the world in accordance with the visions of Eisenman and Liebeskind (Glasser, 2000).

American model (Sey, Y. & Tapan,1983). This shows that different universities even from the same country could be significantly different in terms of their characteristics.

Table 2.4 : Comparing four characteristics of École des Beaux-Arts and Bauhaus. Source: Author's archive

École des Beaux-Arts	**Characteristics**	**Bauhaus**
Ateliers Lectures competitions	Curriculum	craft (workshop training) fine art (drawing and painting) science (analytical methods)
drawing tools	Tools	different materials (sculpture, carpentry, metalworking)
Student limited with permitted forms and means of expression based on examining historical buildings	Learning Environment	learning by doing gives freedom to students Workshops practical experimentation
one way, from instructor to student teacher-centered	Interaction	student-centered two-way interaction between Instructors and students strong connection with industry and public life

2.2.1 Curriculum

The word Curriculum originally has roots in Greek which refers to “running”, and since then, different definitions have been developed based on what will be included concerning education. Today, the curriculum in education simply refers to the course of study or track, but some definitions expand to include a set of experiences that students must encounter and intended learning outcomes (Özersay, 2004). In terms of architectural education, it is suggested that the curriculum defines what knowledge-skills fields the architect will have “proficiency” in (Balamir, 1985). Moreover, it is argued that curriculum cannot be limited by “what to teach” and suggested that it is a process encompassing both implicit curriculum and the explicit curriculum (Hoadley & Jansen 2002). Architectural education has a powerful implicit curriculum, also named as the hidden curriculum, which refers to not planned, unofficial and not intended lessons, values, and perspectives that students learn. The hidden curriculum of architectural education equips students with the aesthetic, motivational and ethical values; unspoken academic, social, and cultural knowledge; and practices of the discipline, including language, deportment, and dress, in addition to the knowledge, skills and abilities outlined in the course documents (Dutton, 1991 in Helena Webster, 2008).

From this point of view, this study approaches curriculum from a broad view beyond traditional understanding, which refers to knowledge fields intended to teach. It approaches curriculum in an expanded form that encompasses educational objectives, architectural knowledge boundary, academic requirements for graduation, the content of the subjects, research areas, given problems in design courses, subjects of the competitions, the implicit (hidden) curriculum, and knowledge, skills and abilities earned through architectural education. The curriculum also represents the priorities of architecture departments with the presented subjects and the distribution of them. The amount of time devoted to various subjects, or theoretical and practical subjects, demonstrates that certain types of information are valued more than others. For example, although the design studio comes forward as the backbone of architectural

education in general, its integration with other courses or the weekly course hours could vary. Thus, institutional objectives are also discussed within this character alongside with unspoken meanings hidden between the lines of the syllabus.

Factors such as institutional backgrounds, intellectual, social, cultural, and environmental context results in a great variety of the curriculum. There are too many variations of the curriculum for cover here, but some following examples will help to demonstrate. For example, a study comparing eleven undergraduate architecture programs from different countries (America, England, Australia, Turkey, Iran, etc.) reveals that the length, goals, and syllabus of basic design education vary alongside the topics followed. Moreover, the objective of architecture education so does the curriculum is influenced by historical, cultural, geographical, and economic factors in each country (Gharibpour & Toutounchi Moghaddam, 2016). Accordingly, schools in eastern countries tend to follow political and ethical-based curricula with a traditional approach to learning that focuses on the rational acquisition of knowledge. However, schools in western countries tend to follow the constructivist approach of learning in the curriculum that is based on the construction of knowledge by the student with the practical experience.

Another study comparing architectural curricula in Iran and Australia argues that the number of subjects and lecture hours in Australia is nearly half that in Iran, which includes students in active learning and emphasizes self-learning (Saghafi & Sanders,2020). Moreover, it argues that the curriculum of architectural departments in Australia and New Zealand regards contemporary challenges and future needs and emphasizes social and ecological responsibilities such as a sustainable environment. The study also reveals that the courses are more specific at Queensland University of Technology (QUT) in Australia. The ratio of elective course numbers to total course numbers is higher, reflecting the higher opportunity for transdisciplinary study and the flexibility of the curriculum (Saghafi & Sanders,2020).

It is also clear that institutions with different priorities, facilities and resources would end up with different curriculum. For example, the harsh environmental conditions,

availability of wood as a construction material, and the characteristics of regional architecture in Finland also reflected in architectural education curriculum. In this manner the undergraduate courses such as “Integrated Interior Wooden”, “Industrial Wood Construction”, The Wood Program [6], student workshops and projects such as wooden pavilion[7], post-graduate research projects including “Wood Life”, the establishment of Aalto Wood [8] are some efforts of Aalto university that demonstrate the focus on wood in the curriculum (Cronhjort, Vahtikari, & Takano, 2016). Moreover, the given design problems vary in accordance with the cultural, environmental, economic context. Even in the same institution the given design problem could vary alongside with the contemporary issues, instructor, or the grade of the student.

The examples above demonstrate the influence of the curriculum on resilience in different scales and with different ways. While the variety in curriculum of different institutions contributes to the resilience of architectural education in local and global scale, local variations and specializations enhance adaptability to local disturbances. Similarly, flexibility in curriculum, variations in covered subjects, adaptability of given problems in design courses, or subjects of the competitions support the resilience in institutional scale by enhancing the adaptability. This points out to the second attribute of building resilience which was “nurturing various types of diversity for increasing options and reducing risks” (Berkes, 2007). Moreover, specialized course

[6] The Wood Program is a one-year study program that focuses on wood architecture and industrial construction.(https://www.aalto.fi/en/wood-program)

[7]https://www.aalto.fi/en/news/architecture-students-designed-a-wooden-pavilion-in-front-of-the-design-museum

[8] Aalto Wood is a hub for research, education, and information on wood construction and wood architecture s(Cronhjort, Vahtikari, & Takano, 2016).

content and elective courses allow personalized path for students and bring greater flexibility. From a resilience perspective, a more adaptable and integrated curriculum that addresses real-world issues would serve to the adaptability of architectural education. It is also important to develop a unique and independent program with specific content suitable to contemporary needs and the context of the school. Further, curriculum should consider the multidisciplinary nature of architectural education. In this manner the curriculum should respond to the "unpredictable local, national and global challenges and opportunities" (Moore, 2012).

2.2.2 Tools

The tools utilized in architectural education plays a significant role going beyond a simple instrument for teaching and used for different purposes including communication, designing, representation. As the profession is also a part of the architectural education setting, tools used in practice are also integrated in learning tools. Moreover, tools are not only utilized for the materialization of design ideas but they are also an integral part of the creative process. The tools allow interaction between design and people (both students and instructor), help developing design solutions, producing design variations, and direct thinking.

In terms of the design process, tools are utilized to generate, develop and represent design beginning from the moment architectural design comes to mind until the final outcome including presentation. The features and limits of the tools utilized have a direct impact on the design and they vary in different stages of design process. In terms of the early stages of the design process, tools used to generate ideas and to explore different design options. In this stage, tools are needed to set down immediate technical and physical limits to allow the discovery of possibilities and enhance the variations. Examples of tools includes sketches, physical/working models, computer aided design (CAD) software, virtual reality tools etc.

In terms of developing process, tools are used to communicate with the design, see different dimensions of designs, test technical and physical limits which provides an

opportunity to improve the design. Tools utilized here could direct the designers to different designs. In the final stage, tools are used to materialize and reflect/represent the design. In terms of representation, different physical and virtual tools including scaled models, virtual models, drawings such as plan-section-view, visualization tools, render, animation, 3d printed models etc. could be used. The variety of tools demonstrate different perspectives of the design and offers different experiences. For example, while drawings and renders visually represent the design object in two dimensions, a scaled model allows exploration of design in three dimensions. Moreover, while animations represent the design from designer perspective, a digital model alongside with technologies such as VR allow virtual walk and independent exploration of three-dimensional space in real proportion.

In this context, drawing, model making, utilizing digital technologies and computer-aided environments are some of the effective mechanisms that used in the design processes. All tools have different characteristics and serve different purposes in each stage of design. For example, as a freehand drawing technique, sketching is both a method to express thoughts as well as a design tool. It could be used to discover potential design solutions, to explain a design idea, to understand existing built environment and design within it.

As learning by doing is a key element of architectural studio, model making commonly used as a tool in design process. Constructing a physical model could foster experimentation of material, structure, and form in three dimensions. Moreover, model making out of different materials such as plaster or clay allows to experience different materials with different properties. In general, models are also used as a way of thinking in architectural design studios. German architect Frei Otto used experimental working models as a form finding design tool, which serves to design in many ways including to experience resistances of the materials, to understand complex surface geometries, to simulate a construction method (Goldsmith, 2016). He used physical models including tensile fabric models made of stretch fabrics, hanging chain models, soap film models as ultimate design tool which unfolds the form, allowing exploration

on the form, scale, and proportion. In a similar manner, well-known architect Antoni Gaudi also used hanging models as design tools before digital modeling has emerged. The hanging models of Gaudi defined as a "designing machine", which help to embraces different facets of the design, provide a deep structural insight, and allow to carry out quick calculations and alter the design (Santiago Huerta, 2006).

Alongside developing designs by experimenting with physical models, digital tools of today allow to design with much more parameters together and experience more variations. Today, with the increasing spatial and technical complexity of buildings, need for coordination with other industries, and designs with very complex installations increases the use of digital tools. For example, projects of Frank Gehry and Zaha Hadid's could not have been made without the utilization of digital tools.

A great variety of digital technologies with different features are used in different stages of design process and with different purposes including to design, analyze, materialization and presentation. For example, while digital sketching could utilize in concept design; computer-aided design (CAD) tools such as AutoCAD could be employed in design process generally; parametric design programs such as Grasshopper could be utilized to experience different design solutions; programs including Autodesk Revit, Rhino or SketchUp could be used for digital modelling; analyzing tools and simulation programs such as Green Building Studio could use to analyze performance of the building; and visualization and rendering software such as Lumion or Blender could be used in presentation phase.

In addition to these, the tools that are employed to continue education, tools used for research and tools that foster communication and interaction between students and instructors and between students are included in this characteristic. It is clear that tools used to support learning such as written, audio or visual materials and the medium have direct influence on learning process. In this manner, tools utilized by instructors in learning process could offer different learning experiences. For example, learning architectural history from text, visuals, watching a video or in a site trip differs in terms of learning experience. Or the tools utilized to communicate and lecturing such as

Zoom have different features from for example, Google Classroom which drive different learning experiences. Moreover, various tools could be vary depending on the grade, subject, course content, or the given project. For example, while architectural history courses are more verbal, and accordingly, the necessary materials are written and visual; architectural design courses require three-dimensional thinking and accordingly tools allow three-dimensional thinking.

In this respect, any tool utilized both by instructors or students in architectural education context for support learning, teaching, communication, and design discussed within this element. This encompass the combination of both the pedagogical tools and design tools including modelling, sketching, and digital technologies that are used in design process to understanding/ analyze the given design problem, generate design ideas, developing them, materialization, and presentation. It is also important to note that the term "tools" represent a board cluster including any instrument that is used in design process and architectural education including software, devices, equipment, learning materials etc.

The variety in tools and having different tools serving for the same purpose enhance the resilience as like in other characteristics. Although there is huge variety of design tools and continue to develop, adopting these tools in architectural education and use of them by architecture students is questionable. Although in many institutions, students are taught hand drawing and the use of digital tools, flat drawings on paper or their digital equivalent continue to dominate architectural design (Taraszkiewicz, 2021). There is a need for following up and benefit from new technologies in order to adapt contemporary world. The digital transformation of today requires a fundamental metamorphosis beyond incorporating new technologies into the traditional educational approaches. In terms of resilience, the adaptation capacity of learners and educators to the new technologies and tools, as well as pace of learning and ability to using a new tool is featured. Moreover, the proper and common use of communication tools would open new possibilities, enhance the interaction in different scale: student/instructor/institutions, does enhance resilience.

2.2.3 Learning environment

In terms of architectural education, the learning environment refers to a wide meaning. Environment in the dictionary defined as the surrounding circumstances, objects, or conditions (environment, 2022). Accordingly, the learning environment refers to all conditions, and both tangible and intangible forces surrounding a learning activity in a broader, less physical sense. Coherently, The Glossary of Educational Reform embrace all different settings that students may learn in including outside of the school or classes. It defines Learning environment as "the diverse physical locations, contexts, and cultures in which students learn." (Learning environment, 2013). It recognizes the culture of class or studio, its guiding ethos and features, as well as the various methods to facilitate learning and organization of educational setting which are enfold by educational approaches. Moreover, it is argued that learning experiences and learning activities formed the core of the learning environment (Kurt, 2011).

This study acknowledges learning environment in architectural education as a broad concept which encompasses spaces, places and strategies that measure and drive learning alongside with educational approaches, design studio implementations, activities supporting learning, resources used, and settings learning inhabits including formal/informal and spatial/virtual ones. In architectural education, learning activities are not limited to lecturing and school. In the core of architectural education there is the design studio where design processes are realized and it involves tutorials, presentations, and critiques, juries.

In terms of formal learning environments, special areas devoted to educational activities within the school included such as studio, lecture theatres, tutorial rooms, library, laboratories included alongside with virtual environments that formal learning

occurs such as virtual studio or learning management systems (LMS)[9]. Informal learning environments cover a variety of virtual and spatial settings such as public areas in university including, canteen, corridor, library, exhibition areas, studio; and virtual environments such as web. Internet itself is a huge virtual learning environment, with unlimited source of knowledge in different forms including text, visual, audio and video. For example, an architecture student could research their study topic on web, benefit from countless videos on video sharing platforms (such as YouTube), attend one of massive open online courses (MOOC) [10], examine the study area from online mapping (such as google earth), virtually visit a museum, explore artworks and buildings, attend conferences and exhibitions around the world. As learning occurs in multiple contexts and the options are limitless, there is no boundary of virtual learning environment in this manner. In terms of activities supporting learning, settings including workshops, student communities, internship, site visit, competitions, exchange programs such as Erasmus are also included. The instructional environments encompass strategies that measure and drive learning including assessment methods, crit, juries, instructional techniques, feedback mechanisms, lecturing duration, workload, and resources.

2.2.4 Interaction

Interaction is one of the vital elements in architectural education. Habermas defines interaction as the communicative action (1970), which is also referred the reaction or

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[9] Learning management system (LMS) is a software application or web-based technology provides administration, documentation, management, implementation, tracking, and reporting of distanced learning programs; provide medium for delivery of educational courses, assessment and interaction between educator-student and student-student.

[10] massive open online courses (MOOC) are online courses aiming for broad participation and open accessibility via the Web and by using providers such as Coursera, Udemy etc.

communication between people or things. In this study, the interaction characteristic refers to a variety of relations among the stakeholders of the architectural education including the interaction of architectural education with other domains such as architectural practice, other disciplines, or between institutions; interactions between actors of architectural education including student-student, student-instructor, instructor-instructor; interaction of student with elements in architectural education including lecture, courses, projects, homework, and with the design itself.

In terms of the relation of architectural education with profession, they both influence each other: while education leads research in innovations and brought new applications to the practice, the profession determines the requirements for graduates and direct the education. The interaction between actors covers the communication both during the lecture and outside the lecture. Moreover, the mutual relationship between student and instructor has two facets, from instructor to student and vice-versa. The interaction between students is one of the main elements discussed under the character of interaction as it plays a crucial role in learning experience in architectural programs, and peer learning is one of main element especially in design courses. In terms of the interaction of student with courses, status and perception of the student also referred such as involvement to the lecture, sense of belonging, individuality, focus, motivation.

Multiplicity and diversity in communication channels would increase resilience. Communication and interaction between institutions and around the globe will contribute the creation and sharing of knowledge. By this way, institutions would increase the range of knowledge and could benefit from experiences of other institutions. Besides, they would expand their course diversity and students could learn from different instructions from different fields of expertise. And lastly, they could build new networks. These points out three different resilience attributes that are; nurturing various types of diversity, increasing the range of knowledge for learning; and creating opportunities for self-organization by building networks (Berkes, 2007).

2.2.5 Relationships between characteristics

Additional to these characters, this study also values the strong relationship between all the characteristics. In terms of curriculum, it is clear that educational methods, level of needed interaction, and educational tools are identified by the features of the subject and the content. Curriculum may also directly involve the use of some tools, as there could be some courses aiming to teach a specific software such as Autocad, Revit etc. Similarly, the tools utilized in educational purposes directly influence the interaction and learning environment. In this manner, for example using traditional tools such as presentation board significantly differ from utilizing virtual environment in terms of learning environment and student-instructor interaction. Moreover, education approaches studied under learning environment largely organizing the interaction between student and instructors. Approaching within different pedagogical notions results in different hierarchies and relations between students and instructors. For example, while in the behaviorist notion the learning is teacher-centered and students are passive actors that absorb knowledge simply given by teachers; in the constructivist notion the learning is student-centered and it approaches students as active actors that construct knowledge by their own experience while teachers guide them in this process (Harasim, 2017).

It should be also noted that the mutual relationship between the mentioned characteristics (curriculum, tools, environment, interaction) and the culture of the school holds significant value. The culture of the school reflected within curriculum, diffuse between the lines of the syllabus and could be apparent by the tools utilized. Moreover, the spirit created by students contribute to the culture and educators personify it. The culture inhabits in learning environment, shaping learning settings and reflecting in educational approaches. Accordingly, the culture of the school develops with the support of faculty members promoting some ideologies and students adopting them as well as curriculum and tools accompanies to it. Together the characteristics embody the school's culture. Thus, although not mentioned as a

characteristics, culture of the school regarded as an accompanying dimension that effects architectural education.

2.3 Discussion on the Section 2

The aim of this chapter was to establish a framework for the thesis which enables approaching architectural education within a resilience perspective in a detailed way. Thus, this chapter provides a background study which helps to set the limits of the research.

The examination of the concept of resilience reveals that studies adapt the term regarding the field of the study, the nature of it, the disturbances it faces, the definition of the system. In this manner, regarding the architectural education system, this study adapted the adaptive resilience framework and highly benefit from the prominent studies on resilience. These studies that examines resilience in ecological systems highlighted the need for understanding the past and the disturbances. Thus, it is decided to study resilience of architectural education through the disturbances and transformation of system both in the past and during the disturbance of pandemic. Moreover, the importance to clearly determine the characteristics of the system indicated.

In this manner four characteristics of architectural education identified alongside with their scope which are: curriculum, tools, environment and interaction (Figure 2.6). The development of architectural education, disturbances and the pandemic experience are studied within these characteristics.

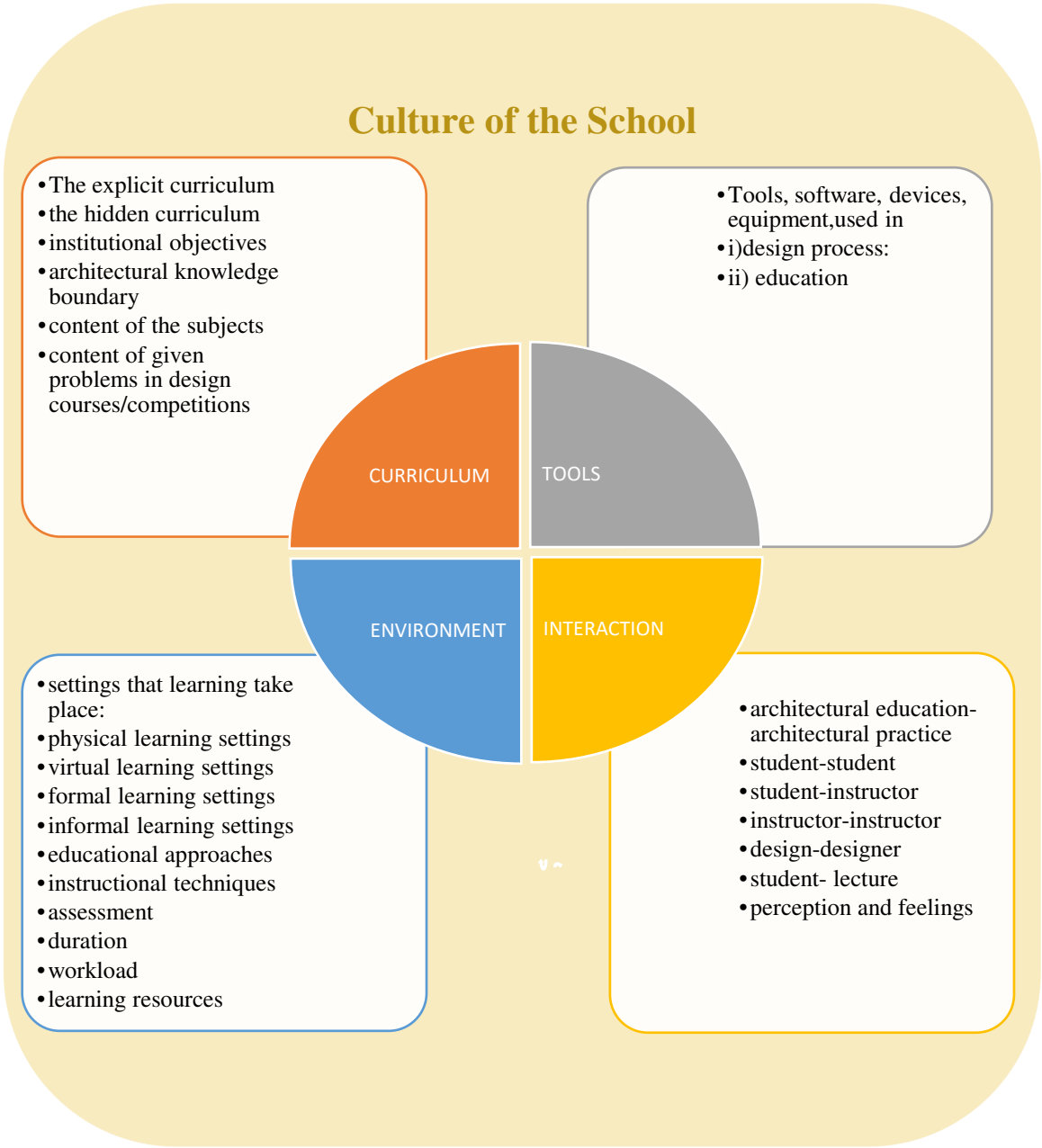


Figure 2.6 : Characteristics of architectural education. Source: Author's archive

3. ARCHITECTURAL EDUCATION FROM A RESILIENT LENS: LEARNING FROM THE PAST

This chapter focuses on the transformation of architectural education within the evolution of characteristics mentioned above (Curriculum, Tools, Environment, Interaction) and the fields of adaptation that triggered this change. The history of architectural education is a broad subject that has been discussed many times, but in this study, it is focused on development patterns of architectural education within specific characteristics and regarding disturbances. While examining the evolution of architectural education, the major transformations are discussed through the changes in the main characteristics. A discussion was held on the reaction of architectural education in the face of the disturbances and these disturbances from different contexts.

It is impossible to cover the extensive number of architecture schools, and all disturbances to the education system within the limits of this study. Moreover, the aim is not to make a historical journey, but to understand the transformations in relation with disturbances. In this manner, some of the schools that are transforming the architectural education landscape examined first. These are Academie Royal d'Architecture which is first school for formal architectural education, its successor Beaux-Arts, and Bauhaus. This examination through architectural institutions covers the period between 1671 – 1932. After the Bauhaus, architectural education presents a broad range of undertakings and diversity, which is impossible to cover all within the limits of this study. For the period after 1930 until today, the disturbances and developments in characteristics examined from an upper perspective. There are also

studies examine architectural education with similar approaches[11]. Understand the transformations that architectural education goes through from an upper perspective and by concerning disturbances will help to understand future alterations in architectural education against future disturbances. The events that forced architectural education to transform are mainly a part of the long-term changes, which categorized under five fields: technological developments, advancements in building technology, change in educational settings, social and political changes, and changing of architectural profession.

It is aimed to understand two main things at the end of this chapter: The transformation of architectural education within its characteristics and the fields of adaptation that triggered the change.

3.1 Development of Architectural Education from Institutions

3.1.1 The Academie Royale d'Architecture

The beginning of the development of architectural education can be traced to the Academie Royale d'Architecture, founded in France on the 3rd December 1671. It was the first institution solely dedicated to studying architecture and training architectural students, which can be called the first formal architectural education system (Griffin, 2019). Previous to this time, the primary source of architectural training was the apprenticeship method in many countries. Masters or craftsmen offered educational facilities in their workshops or residences. With the establishment of the Academie,

[11] For example, Ozersay identifies four primary forms of architectural education regarding the development of architectural education throughout history that includes Beaux-Arts education, Bauhaus and the present-day era (2003).

theoretical instruction was introduced to education with the implementation of the lectures.

When the history of the Academie Royale d'Architecture is examined, two critical factors stand out in its establishment and development of it; one is the ruling power of the time that is the King; the other is the director of the school. The political and social changes of the period can also be included as a third factor, as they led to the closure of all Royal Academies. We can clearly see the influence of the King on the school in many terms. Above all, the Academy was established at the request of King Louis XIV to strengthen his power and the country's prestige. Academy's basic responsibility assigned by the King is to provide expertise for royal projects. Later developments in architectural education, such as the establishment of the Grand Prix, the new implementations, and the establishment of private architecture schools, also took place within the King's approval. The Academy of Architecture was gradually extended and shaped into a highly structured body through a series of royal orders (Armstrong, 2017).

The evolution of the Academy's curriculum and education could be examined in two phases under the influence of two directors. The school was formed within the vision of the first director Nicolas-François Blondel and re-shaped under the directorship of Jacques-François Blondel. N.F. Blondel outlined two main functions of the Academy: i) to research architectural history, historical survey of buildings, and establish the most correct form of Classicism and ii) to pass on this knowledge to the students (Griffin, 2019). Depending on the first purpose, academicians were responsible of close reading of major theoretical works and careful analysis of ancient and modern buildings. They were preparing periodical reports on materials, building techniques, and new technologies and advising French Royal Works (the authority responsible for building in Paris) on problems related to building. The second task of transforming knowledge is performed in open public lectures, given two days each week for two hours each. The two facets of the Academy, doing research and training students, have

preserved their importance and these functions continue in today's higher education institutions. However, the task of advising the King on buildings ended in time.

The content of the lectures in the Academie where highly dependent on the professor's point of view and background. While N.F Blondel was in charge, his Platonist approach and background in mathematics and engineering were reflected in his academic studies and lectures. In line with N.F. Blondel's expertise, topics on architectural design, mathematics, mechanics, construction, perspective, and the science of fortifications were covered in his lectures, and the lectures began with a discussion of the orders. However, his successor Philippe de La Hire (1687-1718), focused on construction and domestic design for people of various social classes and occupations. His lectures included general principles of site planning, information about materials, construction techniques, the planning of discrete spatial units (such as galleries and staircases), and the design of building components (such as chimneys, windows, and roof trusses) (Chafee, 1977). In addition, Antoine Desgodetz (1719-1728) was interested different types of structures, both public and private, including churches and chapels; city halls, commercial buildings, palaces, houses, markets, fortifications, roads, fountains, canals, bridges, parks, and other kinds of buildings and monuments. Accordingly, He gives lectures on a wide range of subjects, including perspective drawing, stonecutting, and the building code of Paris (Chafee, 1977). It can be claimed that subjects highly varied depending on the teachers, and this system of lectures given by one professor created a monopoly, which is not preferable in terms of resilience. The Academy's system stayed the same till the end of 17. th century and many changes occurred after that. First, the ideology adopted by N.F. Blondel of 'good architecture is defined by its adherence to correct Classical principles', replaced by the new view emerged: 'good architecture is that which is suitable for the purpose it is designed to perform' by the end of the seventeenth century (Griffin, 2019). The Academy's early interest in the proportions and values of classical architecture left its place to interest in practical questions on construction such as ways of building, the behavior of materials, plumbing, heating, and lighting (Chafee, 1977).

In 1717, competitions, which are one of the essential measures of a student's ability, were organized for the first time with the name le Prix (and later, called Grand Prix). The establishment of monthly Prix d'émulation in 1763 was another major invention. The programs of these monthly competitions were entirely up to the professor alone. The change in the curriculum characteristic of the Academie could be understood over the programs of the annual Grand Prix. While Blondel proposed military subjects linked to the army, such as barracks, arsenals, and fortifications, Leroy introduced a whole new category of building types of maritime commerce and navigation. Leroy was responsible alone for design problems given to students from 1774 to 1793, and parallel to his vision, programs were aimed to align Academy's teaching with the contemporary needs and the ideals of Enlightenment society. For example, in 1790, the competition problem was the design of the National Assembly, and in 1792 a program was given for the design of the National Convention 1792 (Armstrong, 2017). Moreover, The proposed program for an observatory in 1776 and a school of navigation in 1786 shows the larger interest in science and education. It is said that "the competition programs from the end of the Ancient Régime reveal the progressive nature of the Academy and its willingness to embrace change. "(Armstrong, 2017, p.21).

The transformations in competition programs demonstrate great flexibility, and the introduction of more innovative building types reflects the high adaptation capacity. This adaptation capacity in project subjects is still continuing both in competitions and studio projects. Today, most of the competitions deal with the needs of the period and focus on contemporary issues such as new building types, new problems, and new technologies. For example, most of the studios heavily studied topics such as social distance during the pandemic.

The opening of the first private school by Jacques Francois Blondel in 1740 was a turning point in architectural education. The École des Arts broke the Academy's education monopoly and brought its own system (Armstrong, 2017). J.F. Blondel gathered several specialized teachers to teach various subjects in one place. Unlike the

Academie, studies in the École des Arts were full-time, eight hours per day, six days of the week. The program covers a wide variety of subjects, including studio work, architectural theory, copying details of well-known buildings, stereotomy, carpentry, history of art, sketching, mathematics, descriptive geometry, conic sections, mechanics, water supply, drainage, perspective, experimental physics. The study environment could be described as follows:

> "One room was used by the junior students designing projects; in both of these rooms, sets of finished drawings to large scale were exhibited. Next to it was a room used to display various techniques of drawing, including a number of originals, with specimens of sculpture in the round and low relief. The fourth room was for lectures in mathematics, perspective, fortifications, quantity surveying and theoretical stereotomy. Finally, there was a large room which contained books, instruments, all kinds of models and a fine collection of framed drawings. It was here that lessons were given in experimental physics."(Collins, 1979).

Moreover, The examination of existing buildings was an important educational tool for J.F. Blondel. He organized visits to domestic buildings, workshops and building sites in Paris. He continued this attitude when he was appointed Professor of the Academy.

J.F. Blondel was appointed as director of the Academy in 1762 and radically renewed the teaching structure of the Academy based on the educational method used in his private school. Accordingly, lectures are arranged and become two or three-year full-time courses given from November to September (Chafee, 1977). Another invention was separating education into two-stage: a six-month elementary course for beginners and further a two-year education for serious artists. The curriculum was extended by including lectures on calculus, geometry, decoration, facades of buildings, and construction covering materials, economy, and rapidity. In addition to the oral teaching, demonstration from models and practical observations on building sites are used to facilitate learning. In this manner, the learning environment character expanded. Moreover, the Academy accepts relative values that depend on climate, materials, and other factors regarding Enlightenment thinking (Griffin, 2019). Some of the educational methods and tools that J.F Blondel applied have survived to the

present day and have preserved their importance. These include, for example, the use of physical models, the exhibition of student works, site visits, and visiting architectural offices and construction sites (today, this is in the form of internship).

With the rise of Enlightenment Philosophy, many began to dislike the institutional approaches that were perceived as religious and royal. Academy's Classical approach that emphasized "God had created the universe based on geometrical laws and these laws could be understood and applied to architecture" radically contradicted with the rationalistic ideology of the era. In the eighteenth century, many things happened in France: the wars with neighbor states enhanced the tension countrywide, the divine authority of royalty destroyed, the republican Assemblée Nationale established, and the monarchic governance ended. As a result, Critics of students gained momentum and became an assault against the French academies, which were seen as a clear symbol of royal superiority. The student outrage toward its staff leads to the Académie's demise. During the French Revolution, the Académie suffered significant disturbances, and it was abolished in 1793. Despite the radical changes made in the architecture department by J.F. Blondel, The Academie Royale d'Architecture also closed along with all French academic institutions because of its monarchical roots (Griffin, 2019). This reflects the potential of disturbances such as student outrage and the social context of the French Revolution to close the institutions.

The academic architectural legacy persisted with a series of institutions that, at first, have a close similarity to the former Académie. After the abolishment, two distinct organizations carried out the functions of the Académie d'Architecture, which united in 1819 and formed the École des Beaux-Arts.

3.1.2 École des Beaux-Arts

École des Beaux-Arts demonstrated a similar development under similar forces to its ancestor, The Academie Royale d'Architecture. These forces are the ruling power and political and social developments of the period. However, the influence of directors on the characteristics of the school was minor, maybe due to its sophisticated structure of

it. Like Academy, Ecole des Beaux-Arts was established with the royal order in 1819, after the restoration of the monarchy. The administration and curriculum were entirely determined by the regulations of King Louis XVIII (Chafee, 1977).

During its period, the structure of Beaux-Arts was based on freedom, competition and variety. Students could determine the order, sequence and tempo of the lessons, the design instructor, and the duration to complete their studies. This freedom also brings flexibility to the studies of students. Moreover, The Ecole was open to anyone between fifteen to thirty years old, of any nationality or race, and there was no tuition fee. On the contrary to the flexibility provided to the students, the school was outlined strictly by the regulations in terms of structure, the selection and tenure of teachers, the type and content of courses, the number and kind of exercises and their sequence (Weismehl, 1967). Beaux-Arts's architectural education was based on three groups that are ateliers, lectures and competitions. Competitions were creating a competitive environment that are encouraging students. Ateliers were independent of the school's administrative scheme and could be opened when twenty students got together and requested an architect to open one. In terms of variety, the Ecole offered various assignments and technical courses, alongside with design exercises, both long-term architectural projects and sketch problems. In short, different from the monocentric and rigid education of the Academy, Beaux-Arts has a multi-layered system of lectures, ateliers, and competitions; and has a variety in terms of lectures, student profiles, design exercises and ateliers. In other words, there were variations in the characteristic of the curriculum as there are different courses with different contents and different options for competitions and ateliers. The dual system of ateliers and lectures also increases variety in learning environments. Moreover, independent Ateliers under different patrons with different perspectives were contributed to the variety in the Ecole. In this manner, It is argued that these varieties enhance the resilience of the Beaus Art. Additionally, this multi-layered, complex, student-dependent system increased resilience and reduced the direct influence of the individuals as was in the Academy.

The structure of the Ecole consisted of four-stage. The first stage was the admission; then came the second class; after it, there was the first class; and the last stage was the competition for the Grand Prix. The duration of these steps and until which step to reach was up to the student. Candidates who passed the entrance exam were moved from the admission stage to the second class and earned the student title. Progression in other levels was achieved through a set of values on architectural design, science, and construction. The lectures, Concours and ateliers were educational tools of the Ecole. But only two of them, Concours and lectures, were provided by the school and included in the curriculum. However, none of the lectures were mandatory, and attendance was optional. Moving to another stage was based on the Concours, which is at the heart of the Ecole education system.

Concours[12] were the terms used for regular exercises given by school which were also a kind of examinations because they were graded and they required for passing classes. For example, concours d'admission[13], consist of a set of tests on mathematics, descriptive geometry, history; a drawing of an ornament; and a set of design exercises. In terms of evaluation, on scientific subjects there were written and oral examinations, while architectural design were judged by a jury (Chafee, 1977).

The majority of Concours were in architectural composition, separated under esquisses (sketches) and projets rendus (rendered projects). Esquisses was a 12-hour sketch problem such as designing a public building or a village fountain, while project rendus was a design problem lasting two months that could be a school, an assembly hall, or a small railroad station. What was expected from students was proper reading of the

[12] The translation of "concour" means to "competition" in French, and some sources mention it as competition such (Chafee, 1977) and (Carlhian, 1979).

[13] Carlhian (1979) refers as "the entrance competition" , on the other hand Chafee(1977) refers as "Entrance exam"

program and arriving with a solution in the plan, section, elevation and presentation. Allowed tools were included T-square, 45’ triangle, 30’/60’ triangle and a pair of dividers, but any addition to paper such as photographs, collages, or glued-on paper were forbidden. Judgments were not an educational experience as only jury members attended. However, assessments were followed by an exhibition where all projects were exhibited in a large room and opened to students’ discussion. Construction Concours were also critical that includes concours on stone, iron, wood, and general construction (Table 3.1).

Table 3.1 : The curriculum of the Ecole Beaux-Art. Source: Adapted from Weatherhead, 1941

Entrance requirements	**The course of study for the second class.**	**The course of study for the first class**	**The Diplome** **(added in 1867)**
1. Architectural Design: A 12-hour sketch	1. Architectural Design a. Order Problems and Details(Doorways, cornices, etc.) b. Analytiques and Projets. c. Twelve-hour Sketch Problems. d. Archaeology Projets-Given by the history of architecture instructor.	1. Architectural Design: a. Advanced Projets. b. Sketch Problems. c. Archaeology Projets. d. Composition in Ornament.	The Thesis consisted of a lengthy oral examination by a prominent jury accompanying the complete presentation of a building including all necessary plans, sections and elevations, duly dimensioned and indicated in the manner of working drawings featuring construction details, structural diagrams and computations, as well as outline specifications and cost estimate

Table 3.1 : The curriculum of the Ecole Beaux-Art. (continued)

▪ Drawing from a Cast: An architectural fragment. ▪ Modeling from Ornament in Relief (added in 1883) ▪ Mathematics-Arithmetic, algebra, and geometry. ▪ Descriptive Geometry-General problems in Jines, planes and developments. ▪ General History-Ancient and modern European.	2. Lectures, accompanied by drawings and examinations in the following subjects: a. Mathematics, Trigonometry and analytical geometry and theoretical mechanics. b. Descriptive Geometry-Theoretical shades and shadows, tangent planes, intersection of surfaces, surfaces of revolution, conic sections, etc. e. Stereotomy-Stone-cutting and wood-framing and surveying. d. Perspective. e. Construction: Lectures on geology, physics and chemistry as applied to construction. Studies in stone, wood and iron construction, with working drawings and pecifications for a complete building. These projects were completed in the ateliers. f. Lectures in History of Architecture—Ancient, medieval and modern.	2. Drawing and Modeling: a. Drawing from the Human Figure—Nude. b. Modeling of Ornament-In the round. These courses in advanced drawing and modeling were collaborative with the departments of Painting and Sculpture and were not a definite requirement for architects.	
	3. Freehand Drawing and Modeling- Twelve Hour Studies: a. Freehand Drawing from Casts—Fragments of ornament. b. Drawing from the Antique Figure. c. Modeling from Cast of relief	3. Lectures in Building and Professional Practice.	

Ecole was provided lectures and Concours, including the programs and juries to evaluate submitted projects. However, design education takes place in private ateliers. The atelier system was at the core of architectural education, where students prepared for the entrance exam, studied all the architectural Concours and took design instructions (Carlhian, 1979). There were two main benefits of the ateliers, which are i) the guidance of an experienced master who is named patron and ii) assistance of other students that share knowledge, advice, help and criticism. In this manner, the learning environment transformed from including only lectures to including both lectures and the atelier system. Moreover, the interaction characteristic of Ecole also differs from the Academy as it includes the mutual relationship between the patron of the atelier and student and among students.

One of the significant disruptions to the Ecole was the reforms of Napoleon III made in 1863. The school shape largely remained the same (as explained above) till this. In order to increase the power of government on Ecole des Beaux-Arts, some changes were made, such as the discharge of most professors, the establishment of Official ateliers, and taking away the control of competition from the Ecole. The reform initiative was unsuccessful in applying the changes as it was protested harshly by artists, academicians and students. The lectures could not be held due to the riots and protests, and professors assigned by Napoleon resigned. Reforms of 1863 did not affect the school at the begging much, but alongside with other factors such as economic problems, their influence on the school increased. Especially the official ateliers, which were not effective at the end of the 1800s, profoundly disrupted the independent and diverse structure of the school by the 1900s, which limited the flexibility and triggered the closure of the school indirectly. In this manner, the intervention of the ruling power and the decrease in the diversity of ateliers together decreases the resilience.

Moreover, in the early 1900s, the school faced with several disturbances, including psychological and economic destruction by The First World War. Then, another problem arose: the school was criticized for not leading new ideas anymore and

rejecting the new ideas and movements. Patrons' ideas and views shaped the ateliers, and most patrons were old, distant from the new modernism movement. Some patrons with a modern approach have to close their ateliers because of bad economic conditions, and official ateliers become a majority. In the Grand Prix, the jury accepted only designs based on old-fashioned classicism and students from independent ateliers did not have any chance to win it. After the Second World War, the gap between Ecole and architectural thought outside France got more significant due to the five years of occupation by Nazis. Economic problems due to wars also negatively affect the school in different ways. Independent Patrons could not afford ateliers, and they closed. Thus most students have to shift to the official ateliers. As the number of independent ateliers decreases, the variety of ateliers and diversity in design approaches also decrease. According to chifee; "The flexibility of the nineteenth-century system of architectural education was gone; economic necessity in the mid-twentieth century caused a more rigid centralization.". Student number nearly doubled from the 1920s to the 1960s, but the school's facilities were insufficient for so many students, and the school was experiencing a shortage of money. For example, students stay up in crowded ateliers when others need space for drawings. Moreover, most of the students were dissatisfied with the decreasing prices of competitions and the quality of winning projects which seem outdated. Insufficient study environments, economic problems, dissatisfaction in the Grand Prix, outdated approaches of instructors, and many other problems resulted in a student rebellion in 1968.

Following the 1968 student riots, the Ecole des Beaux-Arts was closed down by the Ministry of Culture, and architectural education in France was reorganized. In the new arrangement, the Grand Prix de Rome was abolished. Ecole des Beaux-Arts was replaced by Unites Pedagogiques, a series of autonomous units with their own curriculum and teaching methods. The admission exam was removed, and the entrance condition was replaced by holding a baccalauréat degree (the equivalent of the American high school). And the duration of studies is fixed at six years. Consequently, the centrality and integrity of education were lost and transformed into independent units which approached positively in terms of resilience.

3.1.3 Bauhaus

The Bauhaus school has had a significant influence on the development of design education globally (Cross, 1983). The school was a product of the social, cultural and intellectual environment of the period and it was a part of a broader innovative movement of educational reform.

The conditions leading to the Bauhaus's development can be traced back to the 19th century. The Industrial Revolution began in England in 1760, and as a result, traditional production methods were replaced with mass production, and a new industrial society emerged. After the Industrial Revolution, some issues emerged, including; radical change in society, a dichotomy between production and art, changed production conditions, and segregation in branches of art. The idea of "the Gesamtkunstwerk", which means "synthesis of the arts, unified work of art" emerged to reverse the effects of revolution and unite the areas of artistic and technical production. In 1907, "The German Werkbund" was established in Munich to establish a practical, effective link between craftsmanship, commerce, industry, and the designer (Siebenbrodt & Schöbe, 2012). It was an association of artists, architects, businessmen and experts, including Walter Gropius. In post-World War I Germany, The Werkbund and Art Nouveau artists were in an effort to unite art and industry. The industrial revolution, economic, social context of its time and ideas like "the Gesamtkunstwerk" and "The German Werkbund "led to the foundation of Bauhaus. Moreover, Bauhaus was engaged with the pedagogical thoughts of the twentieth century. For example, John Dewey conceptualizes school focusing on student freedom as an environment that provides activities for individuals to discover their capabilities, interests and habits. Bauhaus strongly adopted ideas from Dewey and from his Chicago experiment on the implications of the curriculum and methodology (Cross, 1983).

The Bauhaus was founded by Walter Gropius in 1919 in the city of Weimar, Germany (Siebenbrodt & Schöbe, 2012). Despite its short education life between 1919 to 1933, the ideology and applications of Bauhaus influenced various educational institutions, instructors and courses over for a hundred years.

In Bauhaus, architectural education was redesigned, and many innovations were introduced in design education. First, differently from the previous European academies that taught design disciplines separately, Bauhaus's goal was to encompass all types of art as well as integrate arts and crafts. The guiding principle was the unification of all creative effort, as Gropius indicated: "the Bauhaus's goal is to instruct students in a combination of craft (workshop training), fine art (drawing and painting), and science (analytical methods) "(Żychowska, 2019). The Bauhaus education values practical education and advocates the idea of 'learning by doing' in contrast with the theoretical education of academies where practical studies are held in ateliers. It opposes the theoretical and history-based education approaches of traditional European academies. It brings a new system that cares about practical education instead of theoretical and individual creativity instead of history teaching. Walter Gropius did not completely deny the importance of teaching history but promoted the creative works of students independent from the influence of the past (Żychowska, 2019). While previous academies restricted all freedom and limited students with permitted forms and means of expression, Bauhaus gives freedom to students and does not set any limitations for students' creativity. Cunningham describes the educational environment of Bauhaus as:" anti-academic, anti-history, mistrustful of theory, based on practical experiments and conscious of social need "(2005). Another prominent feature in Bauhaus is the student-centered strategy which aims to remove the barriers between faculty members and students. It gave importance to the relationship of the Masters, Journeymen and Apprentices, both outside of the classes and in lectures, alongside with their connection with industry and public life (Siebenbrodt & Schöbe, 2012). Moreover, Bauhaus was willing to adapt the innovations and necessities of the new industrial society with its new materials, technology and production capacities. It established a new educational system based on the culture of the period, technical and technological capabilities, and rapidly growing mass production (Żychowska, 2019).

Here are some prominent features of Bauhaus:

1- Unification of arts: It aimed to combine arts and merge technology and arts. In 18. century Europe, art education was separated, and academies taught design disciplines separately.

2- student-instructor relationship: There was a mutual relationship between student and instructor. On the contrary, the communication in Beaux-arts was one way, from instructor to student. The interaction was limited in Beaux-arts. For example, in Concours, students left their completed studies without interacting with jury members, and in lectures, they were passive listeners.

3- Including Practical education: Unlike the theoretical education of 18. century Europe, Bauhaus utilized learning-by-doing teaching methods. While The students of Bauhaus were experiencing materials and working processes in workshops in beaux-arts, the institutional education was theoretical and practical instruction was held in ateliers.

4- Student-centered approach: Bauhaus gives freedom to students and encourages them to discover their own abilities, expression methods, and creativity. Before this time, education was based on examining historical buildings and students were restricted by the rules and forms of classical architecture.

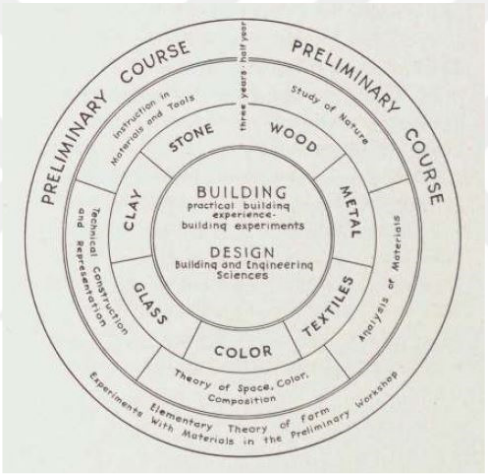
5- stay up-to-date: Bauhaus was reformist both in terms of its educational approaches and ideology. It aimed to adapt the innovations and necessities of the period and stay up to date. Moreover, the given design problems addressed challenges and the necessities of the time. For example, after the damage of World War, educational activities were focused on cheap and fast building methods and prefabricated houses to fulfill the housing demand. Moreover, the school's profile was modern, and students were educated in modern approaches that consider not only the ideal aesthetics but also techniques, technology and social elements of architecture (Żychowska, 2019).

6-Diversity: Tutors were selected from diverse artists with diverse aesthetic approaches. Developments were “a culmination, or synthesis, of a progression of ideas and activities which cannot be wholly credited to single individuals” (Cross, 1983). With this variety of tutors and directors, the school was changed, moved and evolved. Moreover, artists, architects, and designers work together in teams and share their creative ideas and efforts in an open environment that allows discussion and interdisciplinary debates. (Żychowska, 2019). Maybe because of this diversity and open environment, it stayed up to date throughout her education life and has remained effective until today.

Gropius modeled a three-level education for Bauhaus, which is shown in the figure 3.1. The outer ring symbolizes the first level of the studies, which is the preliminary course or “basic course” in design for one semester, which prepares students for regular studies in the Bauhaus. The development of the basic design course was one of Bauhaus’s most significant pedagogical inventions. The design course had an official curriculum that included exploring colors, forms, textures, structures, compositions, and materials and included applied work. The course was intended to free the creative powers of students, reveal their individual potential, and encourage them to develop and display their inherent abilities (Żychowska, 2019; Cunningham, 2005).

The two middle circles of the figure a symbolize the second level of education, which includes three-year instruction in crafts and form problems with the Journeyman exam. The instruction in crafts was the practical part, which consisted of studies of materials and working processes. In this part, students participate in specialized workshops, including sculpture, carpentry, metalworking, pottery, stained glass, wall painting and weaving (Bayer & Gropius, 1938). One of the distinguishing features of Bauhaus was these workshops which offered practical experimentation of materials, the experience of technical properties and the possibilities of application (Żychowska, 2019). Workshops evolved from the masters' specialties and identities, which were a diverse group of notable persons such as Vasily Kandinsky, Paul Klee, Maholy-Nagy, Josef

Albers, and Gropius, among others (Cunningham, 2005). The workshop works linked to the instruction in form problems which is technical courses on the artistic and natural science. These were divided into three sections: observation, which is the study of nature and materials; Representation which is the study of geometry, construction, craftsmanship and model-making; and composition, which is the study of volume, color and design (Figure 3.1). The student who succeeded in the Journeyman exam is qualified by the Journeyman's Diploma of the Chamber of Crafts. Lastly, the inner circle is dedicated to the third level, postgraduate studies. This level includes practical training in construction and independent architectural training in the Research Department. Master's Diploma of the Chamber of Crafts and, Diploma of the Bauhaus under special circumstances given as a result.



I. Instruction in crafts (Werklehre):

STONE	WOOD	METAL	CLAY	GLASS	COLOR	TEXTILES
Sculpture workshop	Carpentry workshop	Metal workshop	Pottery workshop	Stained glass workshop	Wall-painting workshop	Weaving workshop

A. Instruction in materials and tools
B. Elements of book-keeping, estimating, contracting

II. Instruction in form problems (Formlehre):

1. Observation	2. Representation	3. Composition
A. Study of nature	A. Descriptive geometry	A. Theory of space
B. Analysis of materials	B. Technique of construction	B. Theory of color
	C. Drawing of plans and building of models for all kinds of constructions	C. Theory of design

Figure 3.1 : a- Model of studies at the Bauhaus by Gropius, b- Curriculum of the Bauhaus. Source: Bayer & Gropius, 1938.

The school experienced several changes in location and leadership during its fourteen years of education. These two changes, alongside with politics, were the main forces that directed the evolution of the school. The directors with outstanding personalities, different objectives and talents made the school and its curriculum innovative without conflicting with the school's general educational approaches (Żychowska, 2019). They directed the school to modernity, added contemporary subjects to the curriculum while removing the obsolete ones, and emphasized the relationship between the architect and the contemporary world. The location of the school was also crucial since the setting was changing. All three cities (Weimar, Dessau, Berlin) had different states, rules, resources, characteristics and values. Moreover, the expectations of the public and the mayor of the school were changing, and so was the relationship between the city and the school.

The school was operated in State Bauhaus, Weimar, between 1919 and 1925, and the director was Walter Gropius until 1928. The curriculum was shaped under Gropius's ideology of combining arts and art and technology during this period. As indicated above, there were a series of workshops in different art venues that promoted practical work. But the bad economic conditions of the post-war years made Gropius' approach financially impractical. Thus, the Bauhaus' goals were updated to highlight the importance of designing for mass production alongside emphasizing craft. The school adopted the motto "Art into Industry" after the economic collapse of 1923, when there was hyperinflation in the Weimar Republic. Two years after, In 1925, the Bauhaus was politically forced to relocate. Dessau, the capital of Anhalt, was chosen to move due to its growing industry and the collaboration opportunity with the companies. Here, Gropius designed a new building for the school, and its international fame and reputation increased significantly following the opening of the new school building. The opportunities in Dessau were beyond Weimar; Bauhaus found outstanding support from the community. They approached this support as a driving force for cultural and structural growth and found more opportunities to collaborate with the industry. Here, Bauhaus's main interest was in the industry and urban construction, while the workshops evolved into "laboratories for the industry." The stone sculpture and

woodcarving workshops were replaced by plastic workshops, while the graphic printing department turned into the printing and advertising workshop and ceramics workshop removed in an attempt to adapt modern ideas (Siebenbrodt & Schöbe, 2012).

In 1928 Gropius resigned as director of the Bauhaus and was replaced by the Swiss architect Hannes Meyer. Due to economic and pedagogical considerations curriculum was reorganized, and structural changes were made. Meyer continued the emphasis on mass-producible design, but removed elements of the curriculum that he considered were too formalist. Furthermore, he emphasized the social function of architecture and design, giving more importance to the public good than private luxury (Griffith,2016). His motto was "Necessities, not luxuries" (Siebenbrodt & Schöbe, 2012). In order to prepare the school for the future, Meyer guided the school with a functional, constructive and collectivist approach. Moreover, he shifted the curriculum toward architecture and added engineering sciences lectures into the curriculum. These changes lead the school from "formal intuition to construction science education" (Siebenbrodt & Schöbe, 2012). Parallel to Meyer's support of realism and social context, workshop production was generally directed toward "people's home products," and production for real marked was merged with teaching and experimentation. Additional changes were implemented in workshops as the metal, furniture and mural-painting workshops were combined into the "Interior Furnishing Workshop", while the "Advertising and Marketing Workshop" added (Siebenbrodt & Schöbe, 2012, p.30).

Following 1929, increased unemployment and political context characterized the remaining years of Bauhaus. By that time, economic and thus political problems had deepened because of the spreading world economic crisis and the political instability of the Weimar Republic. In an agreement with the city, everything except the name and building of Bauhaus was changed: the budget, programmed constitution, content and structure. Some politically radical students were expelled, living studios closed, and school fees were increased. In 1930, Meyer resigned from directorship due to political reasons and was succeeded by architect Ludwig Mies van der Rohe. Mies

underlines his approach as “I do not want marmalade, not workshop and school, but school.” (Siebenbrodt & Schöbe). Moreover, the curriculum was reconfigured with a greater emphasis on architecture.

The school moved to Berlin in 1932 due to the unstable political situation and financial condition of the Bauhaus. Under the pressure of Hitler, who was gaining strength, Mies shuttered the Bauhaus in 1933. Numerous important figures of the Bauhaus immigrated to the United States during World War II’s chaotic and dangerous years. They impact generations of young architects and designers in the US with their work and teaching philosophies. As a result of the disturbance of the Nazis, educators immigrated to different countries, especially the Us, and spread Bauhaus thought all over the world.

The Bauhaus education model remained valid for hundred years. It is still remarkably influencing today’s design education, and contemporary architectural institutions include many elements from its curriculum. Above all, the education approach of the basic design course created in Bauhaus became a model used by many architecture schools. It is also possible to note many timeless elements from Bauhaus’s curriculum that are still necessary for the education of the architects, including art classes, courses in drawing, color theory and modeling (Żychowska, 2019). In terms of resilience, some efforts of the Bauhaus were approached positively, such as; adapting to the different contexts of three different cities, including contemporary issues that emerged due to the industrial revolution, and considering the contemporary educational approaches in the structuring of the school.

3.2 Fields of Disturbances

It could be inferred that architectural education has undergone some alterations and transformations from past to present in line with the changes in social, political, economic, and technological contexts and major events in world history. In this manner, architectural education is adapted to different disturbances, including developments in technology, changing architectural practices, social and political

changes and shifting paradigms in pedagogy. In this section, the events that forced architectural education to transform in order to adapt are examined. These events are mainly a part of the long-term changes defined as fields of disturbances.

3.2.1 Technological developments

In the last few decades, the rapid development of technologies, devices, and applications revolutionized nearly every part of human life, from daily habits to social or professional life. It significantly changed how people shop, socialize, work and are educated. The new opportunities afforded by digital technologies re-shaped both architectural education and practice (Salama & Amir, 2005). The inclusion of the internet, computers, visualization tools, and software are prominent examples of how the digital revolution has impacted architectural education (Al-Matarneh & Fethi, 2017). However, Katja Fleischmann noted that "Technology was identifying as a continuing significant impact on design education and was subliminally noted as a threat, rather than an enabler." (2015).

Developments in technology resulted in significant changes in educational settings, including architectural education. For example,

- There has been a paradigm shift in Higher education as new technologies globally democratize knowledge (Blessinger, Reshef and Sengupta, 2018). The information has become easy to access and globally accessible by the masses, especially with the establishment of the internet and MOOCs (Massive Open Online Courses).
- With the establishment of the internet, a digital age began with a new society, new demands and skills. These transformed the learning culture and brought new concepts to education, such as digital literacy.
- New technologies were introduced into the teaching and learning process, brought new tools to educational settings, and made a significant contribution to distance education by detaching the education from time and place.

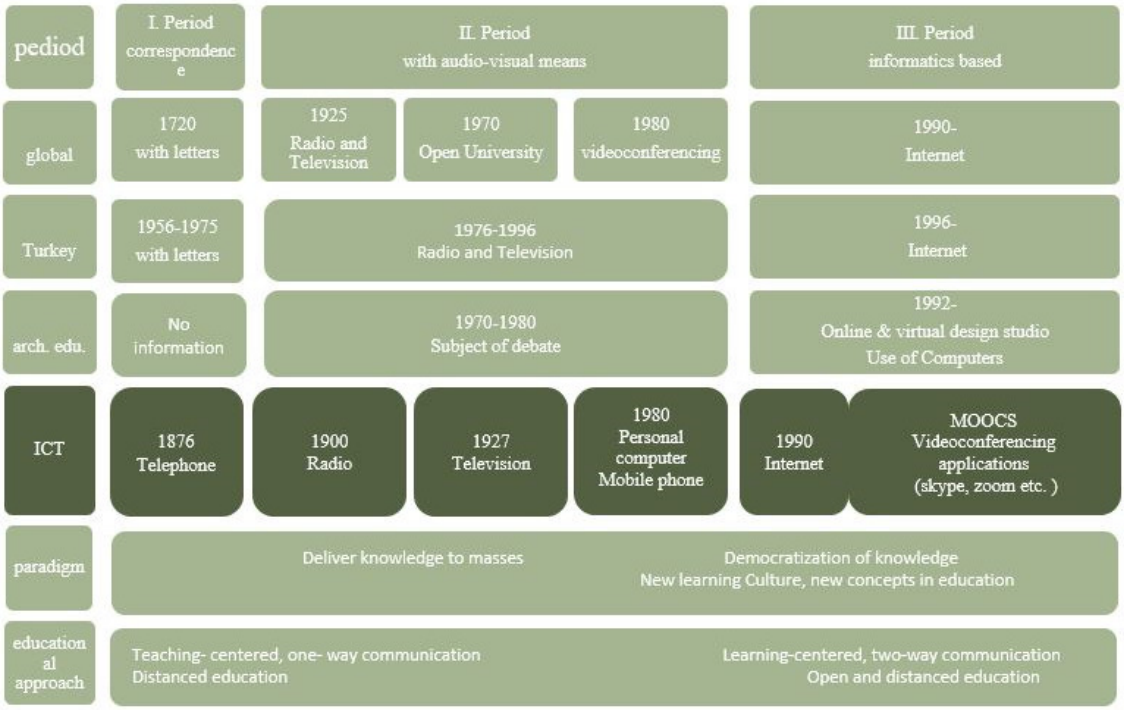
- Distance education gained new features and became able to fulfill the needs of design education.

The development of new technologies also influenced architectural education indirectly by transforming the building industry and architectural profession. The latest innovations in technology, including the internet, computer, CAD, BIM, and virtual environment technologies, remarkably changed design conception and application, resulting in the transformation of architectural design education through methods, curriculum, learning environment, and interactions.

In terms of distance education, even though it has become more popular with the pandemic, its implementation dates back to the 18th century when correspondence education systems were applied with letters. The ICT (Information and communications technology) plays a decisive role in the development of distance education. Teaching methods and approaches utilized in distance education transformed parallel to the available technologies such as radio, television, computer, and the internet. Moreover, these technologies determine the features of distance education as it evolved from one-way non-interactive to two-way interactive education. Radio and television were used widely for audio and visualizing of course materials which can be named the One-Way Communication Period. On the other hand, the utilization of videoconferencing tools added a new dimension to distance education by providing interaction. The invention of the internet transformed distance education again, alongside with the integration of the computer combining systems. (Demiray & Işman, 2003; Saba, 2011; Bozkurt, 2016). The development of distance education in Turkey represents a similar pattern as the world, but with a delay. In Turkey, the use of letters in distance education is followed by the utilization of radio and television. And In 1982, Anadolu University established Open University, which is the first online education program in Turkey (Bozkurt, 2016). The development of distance education in Turkey is behind from the global, partly due to the country's social and economic conditions (Samur, Akgün, & Duman, 2011). In this respect, factors such as access to new technologies, cost, internet access opportunities, internet quality, and speed directly affect the development of distance education (Table 3.2).

The integration of information and communications technologies into the creative areas, including architecture, is problematic (Gushchin & Divakova, 2017). Distant architectural education is viewed as a challenge as it has a design-based structure with a greater emphasis on applied courses and requires face-to-face activities such as peer learning (Unver, & Sungur, 2022; Silva & Lima, 2008). In this sense, the development of online architectural education was facilitated by the invention of the internet and the development of appropriate technologies. In this manner, online architectural education developed following new technologies that allow two-way communication and enhance interaction (Table 3.2).

Table 3.2 Periods and phases of distance education in the global context, in Turkey and in architectural education context. Source: adapted from Bozkurt, 2016 and Donath et. al., 1998.



The pedagogical and technological potentials of using ICT in the design studio have been discussed since the late 1970s and 1980 (Erdem & Pak, 2005). In this manner, there are different examples of adapting online educational tools within different

educational contexts. These include numerous experiments such as joint distance studio experiences (Matthews & Weigand, 2001); undergraduate design studio course experiences, use of education technologies to support studio instruction (Diane et al.,2006), and use of online tools for virtual design studio (Öztoprak, 2004). Despite some experimental and particular attempts at virtual design studios, the application of distance education in the field of architecture is still relatively new due to the dominant view that online or blended learning environments are inadequate for design education (Unver, & Sungur, 2022; Fleischmann, 2015; Senyapili & Karokaya, 2009).

Moreover, the change in design education is slower compared to other disciplines which go towards online courses, particularly during the last five years (Fleischmann, 2020). For example, about 46% of the top-ranked higher education institutes were offered online degrees in the United States in 2012, while this number raised to 75% by 2016 (Priceonomics Data Studio, 2016). There is also a similar increase in the number of online courses in Europe and Australia (Fleischmann, 2020). Although the transformation of architectural education is slower, today, there are numerous precedents of online architecture accredited degrees, both in graduate and undergraduate, and open online courses (Unver & Sungur, 2022). Some examples of online design education programs include the RMIT University Master of Design (online) program and the COFA Online unit, established in 2002 by the College of Fine Arts (Bennet & McIntyre, 2004).

It should also be noted that the pandemic has accelerated the development of online architectural education by introducing online education to many architecture departments by making distance education compulsory (Buldan, 2021; Ahmad et al., 2020; Unver & Sungur, 2022). It is also argued that the use of online methodologies in architectural education boosted significantly after the pandemic. However, many architecture departments still lack to use the full potential of communication technologies and merely bring traditional educational approaches to digital environments. It is also argued that although many new technologies have developed, there is not much change in educational approaches and methods. It is criticized that

educators have merely added technology into traditional ways of teaching and adopted the new technologies to serve traditional practices (Şentürk &Baş, 2020).

In the mid-1990s, with the increasing popularity and accessibility of personal computers, computers began to dominate architectural design studios. Design studios have become more computer-aided design-oriented, and related issues like collaborative solutions in design, virtual design studios, and some experimental design approaches have been implemented (Toprak & Hacihasanoglu, 2019). Today, computers play a fundamental role in nearly all phases of the architectural educational process, and every student of architecture utilizes computers within their education. However, the computer itself is just a vehicle that allows using other digital tools. In architectural education, the integration of developed technologies manifests itself with the implementation of computational design tools such as CAD and BIM applications, visualization tools and digital models. It could be seen that digital tools are mainly used in architectural education for a variety of purposes, including information processing, communication, design, visualization, and decision support.

Computational design started as a tool to make precise drawings with CAD tools (computer-aided design) and developed into more intelligent tools such as BIM (building information modeling) generating information 3D models. The CAD and BIM technologies rapidly transformed both the architectural offices and schools. Today these technologies are more than tools that create a medium within the architectural design process (Sariyildiz, et. a., 1998). Advancements in Computer-aided design (CAD), visualization, and digital modeling introduced virtual dimensions in the studio instruction and allowed the investigation of design ideas in three dimensions. They also fulfill the increasing need for efficient communication between project partners and cope with the increasing complexity of design (Sariyildiz, et. a., 1998). The computational design tools and digital models offer a virtual environment that enables a different interaction with the design, including exploring different components and systems of the project, such as the structure, mechanical features etc. Other than transforming interaction between the student and design, digital tools serve

the interaction in architectural education by involving different partners in the design process, which changes the interaction of students in the group projects.

Moreover, developments in such digital tools significantly impacted many key pedagogical aspects of architectural education and curriculum (Al-Matarneh & Fethi, 2017). Many architecture schools update their curricula to include new software and digital technologies. For example, in Jordan, while architecture schools included obligatory CAD courses by the end of the 1990s, software such as "Revit" and "Introduction to BIM" was installed into the curriculum by 2014 (Al-Matarneh & Fethi, 2017).

With the inclusion of digital tools into the design process, new design methods developed such as parametric design, generative design, and performance-based design. Today, alongside attempts to integrate building-performance simulation tools in the studio[14], there are courses[15] introducing both the new design process and tools, as well as master's degrees devoted to specialized areas such as parametric design.[16]

There has been a tremendous increase in visualization with the developments in advanced 3D visualization tools and improvements in Virtual Reality (VR) technologies. The potential of digital technologies extended beyond the inclusion of CAD courses in architectural curricula to include virtual design practices in the studio

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[14] Such as Charles, P, & Thomas, C. R. (2010). Integrating Building Performance Simulation in Studio teaching: a multidisciplinary consultancy based model. In Proceedings of 98th ACSA Annual Meeting (pp. 178-188).

[15] for example, "generative design in architecture" in Middle East Technical University. https://catalog.metu.edu.tr/course.php?prog=854&course_code=1200450

[16] For example, Master's Degree In Parametric Design In Architecture in Universitat Politècnica De Catalunya (UPC). https://www.mpda.upc.edu/

instruction with the efforts of prominent academics from MIT and the University of Sidney (Salama & Amir, 2005). Since 1990, several universities worldwide have been experimenting with Virtual Design Studio. Early examples include the "Virtual Village Project", a joint two-week design experiment conducted over the internet by students and tutors from five different universities in different locations in 1993 (Wojtowicz, 1995). Another example is a one-week design workshop experiment: "Place2Wait" held in 1998 (Donath et.a., 1999). In the Virtual village project, mostly asynchronous methods, including e-mails, shared CAD files, and video conferencing are utilized (Wojtowicz, 1995). Similarly, tools utilized in Place2Wait, include modeling tools, video-conferencing software and rendering programs (Donath et.a., 1999).

Since the 1990s, technologies that enable human-computer interaction in a virtual environment have been rapidly developed. Applications including AR (Augmented reality), VR (Virtual Reality) and, MR (Mixed Reality) and accompanied devices such as the headset, hand-controllers, immersive rooms, joypads brought a new dimension to education. Virtual reality applications in architectural education include uses in the architectural design studio to improve learning, remote design collaboration, visualization, alternative data representation, collaboration and communication that is implemented with the combination of VR, BIM and AR technologies (Gębczyńska-Janowicz, 2020; Milovanovic et al.,2017). Parallel to the developments in Virtual reality technologies, a series of courses have emerged, attempting to enrich traditional architectural education with computer-related design issues, including virtual reality (Bourdakis & Charitos,1999). These are mainly independent institutional experiments on using VR technology in courses. For example, Penn State University used an immersive space for a semester for a specific course to enrich the design process. In this experiment, students utilized the platform for design or communication (Milovanovic et al.,2017). Besides creating new environments for interaction and education, it is believed that virtual realities could bring a new dimension to design education (Bourdakis & Charitos,1999). These tools changed many characteristics of architectural education, including interaction. In this manner, interaction with the

project and the communication between students and teacher-student interaction altered.

It is argued that architectural education is still lacking in applying innovative technologies. It is into question the inclusion of some future technologies such as IoT (internet of things), Digital twins and Digital as-builts, or AI (Artificial intelligence) in the architectural education settings. Architecture schools must keep pace with the newest advances in technology in this era of rapid technological growth. However, the main problem is our ability to adapt and use new technologies when they advance rapidly (Chukwunonso & Oguike, 2013). In this manner, even if it is difficult to adapt and follow a particular technology, a certain perspective can be gained.

Advances in digital fabrication such as rapid prototyping, additive manufacturing, CNC, and 3d printing technologies opened new possibilities for students. While developments in technologies such as laser-cut had made model making easier and faster; 3D printing technology fundamentally changed the design process, allowed producing complex forms, supported experimental designs, gave students more flexibility, and enhanced visual perception. In this manner, these developments added new tools to the design process, especially in the materialization stage. In addition to utilization in the design process, there are also experiments on integrating 3D printing in design teaching methods (such as Boumaraf & İnceoğlu, 2020) which argue that 3D printing could enhance learners' spatial cognition and perception and could be a helpful teaching tool. There are experimental examples of engaging digital fabrication with architectural education by means of workshops, elective courses[17] and graduate programs[18]. However, a complete adaptation of digital fabrication tools into

[17] For example, MIT Advanced Design Projects in Digital Fabrication, a restrictive elective course.

[18] For example Master of Advanced Studies in Architecture and Digital Fabrication at ETH Zurich.

architectural education as an inner part of the design is still questionable. As the utilization of digital fabrication tools requires digital design skills and the knowledge to use technology, such an adaptation in architectural education requires offering of available digital fabrication technologies to students and a comprehensive education that empowers students with related skills and knowledge.

3.2.2 Advancements in building technology

In the 20th century, several innovations in materials and building processes occurred: some materials, including concrete, iron, steel and glass, improved and became stronger; and new materials such as reinforced concrete, steel frames and plastics were invented. These inventions have facilitated the construction of many skyscrapers, bridges, and dams. By the 1930s, the number of skyscrapers had exploded, and the use of reinforced concrete became widespread. Methods of producing traditional materials also changed; mass-production of glass became possible, precast concrete blocks were manufactured, and prefabrication techniques developed. While improvements in building materials allow more free structural forms in buildings, innovative architectural styles emerged accordingly. There is a strong relationship between pioneered architectural movements and developing building technologies. For example, modernism, the prevailing style of the 1950s, was enabled by the developments in building technology, such as the invention of reinforced concrete that enabled flexibility in plan, wide interior spaces and free facades. Moreover, with the development of building technologies, buildings have become more sophisticated. The need to consider new elements arose for architects, such as elevators or the design of service systems. These changing needs of the time were reflected especially in design problems by including new building types and in the curriculum by adding relevant courses as it was in Ecole de beaux arts or Bauhaus (see 3.1).

In addition to the immersive development of the building's technologies, innovations in materials also contributed to the transformation of architectural practice. For example, Immersive developments in plastic production opened new areas in construction. For example, with the new materials, the construction of plastic tensile

structures becomes possible. Another example is that The ETFE, a plastic found in the 1980s, allows to build the Eden project. Innovations in advanced materials such as smart materials, nanotechnologies, bioplastic, and Self-Healing Materials also open new possibilities for architects. However, the adaptation of characteristics of architectural education to these innovations in materials is questionable.

Over the last decade, significant relationships between design and making have been redefined by integrated and automated digital technologies (Sheil, 2014). Today, the construction industry is undergoing a significant technological transformation alongside with the inclusion of computer design software, computerized techniques, robotics and automation. Today, the building process can be fully controlled by computers with new technologies such as 3D concrete printing (additive manufacturing), built-in situ technologies, and robotics. In this manner, architecture schools must give the students the tools and confidence to adapt to these technologies, especially those connected to building production (Sheil, 2014).

Although advanced fabrication laboratories in some schools, specialized courses in graduate degrees[19], research projects[20] and workshops [21] are promising; the holistic integration of the contemporary building technologies in architectural education in terms of educational approaches, educational tools, and curriculum is not complete

[19] For example, "Advancements in Rapid Design and Fabrication of Small Homes" in MIT https://architecture.mit.edu/subject/spring-2022-4501

[20] For example, "rock print pavilion" built within the ETH research project "design and robotic fabrication of jammed architectural structures" focuses on the robot-based assembly of simple, loose, and granular base materials. (https://www.designboom.com/architecture/eth-zurich-rock-print-pavilion-gewerbemuseum-winterthur-10-03-2018/)

[21] For example, Technical workshop on robotic fabrication in timber construction. https://intelligent-city.com/presentations/robotic-fabrication-workshop-at-ubc/

yet. It is clear that architectural schools need to adapt to the developments in building technologies by including applied learning, the proper knowledge and multidisciplinary skills in manufacturing, design, craft, programming and materials that prepare students for contemporary building practice.

3.2.3 Change in educational settings

The education systems, learning and teaching hypotheses and approaches are products of their time and reflect transformations in society, economy and technology (Şentürk &Baş, 2020). Parallel to the social and technological developments, teaching and learning approaches have also undergone alterations and transformations. In the last century, there has been a shift from traditional learning-teaching theories, which approach learners as passive receivers, to theories that acknowledge student responsibility and promote lifelong learning. The teaching approaches also altered following the shift in teaching approaches. These teaching approaches could be divided in two in general: the traditional and modern (Constructivist) (Şentürk &Baş, 2020). The traditional teaching approaches are based on behaviorist theory which developed in the first quarter of the 1900s and approached learners as an empty jar. In this view, learners are passive receivers who memorize information that comes from teachers. Moreover, teachers are at the center of all activities and are responsible for transferring information. Individuality and active participation of learners are ignored while the whole learning process is directed by teachers (Harasim, 2017; Şentürk &Baş, 2020). The contemporary teaching approaches are based on the cognitive and constructive learning theory that emerged after 1960. In this approach, learners are active contributors of the learning process and their past experiences and past knowledge of learner matters. Learners construct knowledge rather than passively absorbing it, and teachers are guiders instead of those who simply put the knowledge in the head of students (Harasim, 2017; Şentürk &Baş, 2020). Moreover, The individual differences and different interests, needs and skills of learners are considered. Thus, the teacher-centered approach of traditional teaching was replaced by student-centered approaches (Şentürk &Baş, 2020).

It could be seen that architectural education was also influenced by the prevailing educational approach of the time. As Dovey argued for architectural education:

> "We are seeing a pedagogical transformation from teacher-centered to student-centered learning. This is part of a change taking place across all levels of education as we understand that learning outcomes in terms of creative and critical thinking are more important than a simple consumption of knowledge and acquisition of skill. We move from the passive learning of facts to interactive and debate-centered learning; from individual to collaborative learning." (2014)

This shift in educational approaches could be observed in the Academie Royal and Bauhaus. In the academy, the theoretical lectures with a passive student understanding were dominant, while in the Bauhaus, the view of the "learning by doing" idea is superior, and the creativity of the students gains importance from a student-centered view (section 3.1). Moreover, process-oriented design approaches emerged in design studios in the 1990s, parallel to the developing teaching approaches (Toprak & Hacihasanoglu, 2019). It is also argued that although different studio approaches emerged in the last decade, such as the case problem model, the interactional model, and process-oriented design pedagogy; current approaches to teaching architectural design still rely on concepts developed by the traditional Beaux-Arts and Bauhaus models (Salama, 2015).

In Today's rapidly changing environment, it is said that bringing some 21st-century skills, including self-learning, innovation, problem-solving, critical thinking, communication and collaboration, cultural and universal awareness, entrepreneurship, and leadership, has become critical (Şentürk &Baş, 2020). Accordingly, a shift in design projects with a more social focus was recognizable in all institutions (Fleischmann, 2015). Moreover, instructors from design education also noticed the need for critical and creative thinking skills, mentioning them as "master skills" that students need to develop (Fleischmann, 2015). According to Welch, "creative thinking skills are essential (for design students) in developing resilience... " (2011). Moreover, integrating multidisciplinary approaches and considering the social responsibility of architects in design projects and activities have gained importance recently in

architectural education (Toprak & Hacihasanoglu, 2019). As required skills rapidly changed, leading schools of architecture aimed to bring skills to the students such as collaborative working methods, interdisciplinary approach, and mastering communication and sharing skills (Rodic et al., 2013).

Not only teaching approaches but the culture of education also transformed. According to Blessinger and his colleagues, the higher education culture changed with the forces including globalization, internationalization, political-legal educational reforms, changes in the socio-economic landscape, and technological innovations. As a result, lifelong learning developed as a human right, the knowledge was democratized worldwide, and a global knowledge society developed (Blessinger, Reshef and Sengupta, 2018). New technologies in communication have transformed learning culture by making knowledge free, open and accessible to anyone with an internet connection (Fleischmann, 2015). The universal access to knowledge contributed to education equity, especially with the MOOCs. In this manner, while in 2015, design education was absent from online courses (Fleischmann, 2015), parallel to the shift in education culture, architectural education was also incorporated into online courses. Today, architecture faculties offer many online courses at a cost or free of charge (Unver & Sungur, 2022). Additionally, developments in transportation trigger both student and instructor mobility. With developing communication technologies and student exchange programs such as ERASMUS, more channels of communication and interaction opened, and knowledge sharing and partnership between architecture institutions took a new dimension.

Bologna agreement was another threshold in higher education that directly influenced educational settings, including architectural education. It emerged in 1999, aiming to establish the European Higher Education Area (EHEA) and to ensure coherence in the standards and quality in higher education systems across Europe (url-3). Turkey became a full member of the Bologna Process and European Higher Education Area in 2001 (url-4). Following the participation in Bologna, a global perspective has developed in the Turkish Higher Education System, and the structure and priorities of

architectural education programs are transformed. Both in Turkey and around the globe, there have been large-scale implications on the education of architects, which leads to changes in many areas, including learning periods, qualifications, teaching, student mobility, the structure of courses and the contents of the curriculum.

3.2.4 Social and political changes

In the twentieth century, there were significant political and social shifts related to developments in technology. Nationalism has risen as a major political issue after WWI, and then globalism became dominant with the advancements in transportation and communications technology. In the 20th century, popular culture spread and new trends in art, culture and politics led the intellectual environment towards pluralism. The world became more culturally homogenized, and a new social consciousness emerged. Moreover, discrimination based on race and gender dissolved. While women had gained equal rights with men, racism had become unacceptable, and attitudes against homosexuality began to change. On the other hand, it was the era of social movements, where movements such as the New Left and New Humanism emphasized, resistance against colonialism, racism, and the bourgeoisie enhanced. After 1960 the influence of Bauhaus decreased, and belief and enthusiasm for modernism began to dissolve (Balamir, 1985).

These shifts in the social and cultural structure are reflected in educational settings by considering new issues. By the 1970s, many countries, including Turkey, were shaken by student activism. The youth in Turkey and globally announced their demands for social and economic equality, justice, self-government, participation, personal freedom, and peace with various protests. In Turkey, the student riots resulted in political violence, and education was mainly delayed. These movements were reflected in architectural education as the adoption of new issues into architectural discourse, including social responsibility, social justice, social relevance, public benefit, and accountability in design. As Sancar summarizes it, architecture students of 1968 discovered, adopted and applied concepts such as social justice, publicity, social benefit, knowledge-based design, collective work, equality, self-management and

participation, the importance of practice, and locality (2018). Moreover, Political awareness and the sprawling student movements forced education policies to target broader masses (Balamir, 1985).

The concept of the socially responsible and active architecture of the 1950s, 1960s and 1970s resulted in several socially and environmentally sensitive movements. This transformation in society affected architecture schools in many areas. One of them is that the architectural knowledge boundary expanded significantly. Accordingly, fields such as sociology, politics, and philosophy are heavily involved in the programs. After the 1970s, architectural education was influenced by multiple paradigms; programs included courses such as systems Approach, Cybernetics, Operations Research, and Semiotics; local architecture was glorified; participatory approaches were tried; utopian cities were designed; and issues including Ecology, Politics, Social and Behavioral Sciences enters the design studio (Balamir, 1985).

In the last two decades, issues such as global warming, climate change, and energy efficiency have been present in professional and educational settings in architecture (Rodic et al., 2013). While sustainability has become increasingly important in many scientific domains, architectural discourse also confronts environmental issues. In practice, certificates such as Green Led introduced and Building-performance simulation tools boost. A transformation process has also started in the education of architects regarding these topics (Rodic et al., 2013). Additionally, the issues of inequalities gain importance with the global economic crises. A growing movement of similar ideologies among architects can be recognized under different names such as ”architecture for humanity”, ”public (interest) architecture”, ”emergency architecture”, ”architecture as activism,” and ”architecture for the other 90%” (Rodic et al., 2013). Consequently, many architecture schools included these issues in their programs (Rodic et al., 2013). The contemporary global problems required new modes of learning and thinking, which shifted design studios from ” knowledge-based design” to “interdisciplinary and collaborative design” (Rodic et al., 2013).

Lastly, technological developments create a new digital generation. The new generation of digital natives thinks and learns differently from the former generation of digital immigrants (Öztoprak, Sipahioğlu, & Çağlar, 2021). Architectural education should also consider this language gap and establish proper communication with students to develop resilience.

3.2.5 Changing of architectural profession

Architectural education should also adapt to the ever-changing building industry that is transforming the nature of the architectural profession. Today, the building industry is increasingly global, diversified and connected, and the role of the architects has become more complex. Before everything else, the field of architecture has undergone an extraordinary expansion with new social, environmental, and economic considerations. Accordingly, both the complexity of the role and responsibilities of the architect increased rapidly (Rodic et al.,2013). Today architecture students need a broader knowledge and skill base to respond to problems with increasing complexity. In this manner, architecture schools include more subjects in their curricula and encompass contemporary skills.

Moreover, the development of building technology created a direct link between architecture and construction, which also fundamentally transformed the discipline. The designer's scope and potential have been exposed, especially with the digital fabrication technologies, which allow the direct engagement and control of the architect in fabrication processes (Sheil, 2014). Accordingly, new areas of expertise arose within the design and building facets where some architects redefined their role as hybrid disciplinarians (Sheil, 2014). In this manner, there is a need for architecture schools to alter their approaches toward multidisciplinary.

Design has evolved has evolved into a broad, collaborative process. Accordingly, teamwork has become an essential part of design education, remarkably as it improves student flexibility, understanding of the significance of collaboration and the limitations of an individual (Fleischmann, 2015). As Sheil indicates, “the architectural

school has become a testing ground for what architecture could be, and what architects could do," which also defines this as "a profoundly liberating and positive condition, and a forward-looking and progressive educational environment that can offer new opportunities and rewards." (2014).

3.3 Transformation of Architectural Education in Turkey

From the foundation of the Republic (1923) to the present, Sociological breaks with civil and military interventions have caused structural transformations and legal regulations in Turkish higher education. In this context, five basic laws on higher education were introduced in 1933, 1946, 1960, 1973, and 1981. In addition, after the 1971 military coup, a change made in constitution law allowed foreign intervention in universities. Within the scope of the reform of 1933, the university system completely transferred from the West in terms of model, structure and terminology. Unfortunately, the legal regulations did not provide systematic integrity in theoretical infrastructure and conceptual schemes. One of the shifts in higher education in turkey is caused by the establishment of the "Higher Education Board" (YÖK) in 1981, which aim is to give direction to higher education, to carry out the necessary examinations, research and evaluations and to ensure coordination among higher education institutions. The fact that three educational reforms (1960, 1973 and 1981) took place after the military interventions and changes in the constitution law after the military coup demonstrates that higher education in Turkey is particularly affected by the political environment.

Architectural education has shown parallel developments with higher education. It was affected by political developments, including the establishment of the republic, government policies, and architectural movements of its period both in Turkey and Globally. The institutionalization of architectural education in Turkey started with engineering schools, while significant changes occurred in all institutions regarding the modernization process of the late Ottoman period. The first formal architecture school was established in 1882 with the name "Sanayi-i Nefise Mektebi" (Sey & Tapan,1983). The school's pedagogical method was established in accordance with

the Ecole des Beaux-Arts model. Students were selected by a drawing exam, and architecture education was four years. Design studies were applied together with lectures on drawing, history, mathematics and anatomy (Kulaksızoğlu, 1966). The other school providing official architectural education was the "Hendese-i Mülkiye". It was established in 1883 as a civil engineering school and turned into the "Engineering School" in 1928. Over time, more hours had been given to architecture lectures, but the architecture was not a field of study. The architecture was a specialization field that could be selected after three years of education. This school's system was based on the German Technische Hochschule (German Technical University model), and the focus was on the technical dimension of the design process.

With the establishment of the Turkish Republic in the early twentieth century, a significant shift in architectural education happened. In 1927, "Sanayi-i Nefise Mektebi", became Academy of Fine Arts (Güzel Sanatlar Akademisi) regarding the renovations in the language. Moreover, the curriculum of the architecture department was revised to modernize architectural education. The school remained under the influence of the first National Architectural movement and was then influenced by the functionalist movement in 1930. The appointment of Austrian architect Ernst Egli as the head of the school and German architect Bruno Taut came after was tried to rationalize education. Egli brings some of the concerns of the Bauhaus approach to the Turkish architectural education system. In this manner, some changes were made in the curriculum, design classes were taught with a contemporary perspective, and contemporary design and construction concepts were included.

Following the declaration of the Republic in 1923, one of the most critical problems was the need for new buildings, accompanied by the need to train great numbers of architects. Many steps have been taken to solve this problem, such as pacts for interchange university instructors across countries, laws allowing the Ministry of Education to hire foreign specialists in universities, and sending students to Europe. Both the foreign experts who came to Turkey and the students sent abroad greatly influenced architectural context and architectural education. Architectural movements

of the time were also reflected in education. After the great economic depression of 1929, the Second National Architectural movement emerged as a reflection of Turkey's economy, politics and ideology. The outstanding architects of the movement, Emin Onat from Engineering School, and Sedat Hakki Eldem from Academy of Fine Arts, directed their schools towards the Second National Architectural movement. Thus, It could be observed that the directors and professors of architecture schools highly influenced the academic environment. Outstanding architects and professors directed architectural education through their ideology, which was also observed in other schools worldwide (such as Beaux-arts or Bauhaus). Throughout the 1930s, students were influenced by the modernist approach of Egli and Taut, but by the end of 1930, schools were dominated by the Second National Architectural movement under the influence of Onat and Eldem. Austrian Professor Holzmeister and German Professor Paul Bonatz, who came in the 1940s, also greatly impacted architectural education. They bring questioning aesthetical dimensions of architecture together with engineering issues. In 1942, another department of architecture was established under the Technical School, which is known as the Faculty of Architecture of Yıldız Technical University today. In 1944, Engineering School was renamed as the Istanbul Technical University (İ.T.Ü.), and the Faculty of Architecture was formed under it.

The architectural environment in Turkey, and therefore architectural education, has also been affected by movements in the world, especially in Europe, in addition to the national ones. After the effects of World War II decreased, the country started to open up to the world again. As a result, The National Architecture Movement loses its impact on education, and International Style becomes dominant at the beginning of the 1950s. Additionally, new courses such as acoustics and solar control were introduced in ITU. At the end of the 1950s, the idea of regionalist Architecture was introduced by some guest instructors at ITU, such as Richard Neutra, Bruno Zevi, and Rolf Gutbrod. Another essential academic development in Turkey was the meeting of the First Building Congress in 1948. This congress was the first significant meeting where issues related to architecture, urbanism and the building fields were discussed collectively. Thus, an important step has been taken in seeking solutions to

architectural problems with scientific methods and collectively (SAĞSÖZ et al., 2014). The influence of foreign architects in education has decreased dramatically after leaving of P.Bonatz and Holzmeister in 1955. This marks an essential break in architectural education as the lack of authority opens an area for developing personal views and personal practices in architectural education (SAĞSÖZ et al., 2014).

University-level architectural education began to spread out of Istanbul to Anatolia with the opening of the Middle East Technical University (METU) Faculty of Architecture in 1956. It opened after of close military and economic relationship between Turkey and the United States of America, and it adopted the American model. METU brought the two-level system of studies: four years of undergraduate level and two years of graduate level. The other two universities (GSA and ITU) that had five-year programs also shifted to a four-year system later. Both GSA and ITU were based on European models: while the GSA adopted the Beaux-Arts model of French and ITU adopted the German Technische Hochschule model. METU had contributed to the architectural education system by bringing American models (Sey, Y. & Tapan,1983). These three separate approaches of French, German, and American systems enriched architectural education in Turkey. Turkey's architectural education system is shaped by the unique synthesis of these separate approaches alongside regional impacts.

Between 1960 and 1980, there was a series of revisions to existing architecture schools as well as there was an increase in the number of architecture schools. The scientific approach to architecture was adopted under the influence of the empirical and positivist architectural research developed in British and American universities. Moreover, Regarding the aims of the National Plan and the new ideals of the State, the new generation advocated more scientific educational programs. German Technische Hochschule and French Beaux-Arts were replaced by new structures based on the socioeconomic context of Turkey. And lastly, new concepts such as "scientific-analytical studies and systematic design; objective methods for environmental control and architectural science; energy, environment and energy conscious designs;

cybernetic and semiotic approaches to architecture" were introduced into the curriculum (Sey, Y. & Tapan,1983).

It is difficult to speak about a particular influence or model in today's architectural education in Turkey. There are many architecture departments and a great diversity in the pedagogical approaches in architectural education. From 1990 to the present, there has been a tremendous increase in the number of universities and the number of architecture departments. In this manner, the number of architecture department has increased eightfold (11 to 83) from 1990 to 2013, and today there is more than one hundred architecture program (Url-5; Url6). This variety and multiplicity in the number of architecture schools are approached positively in terms of resilience. However, this situation is criticized as architecture departments opened without sufficient spatial infrastructure and education staff, which is adverse in terms of flexibility.

3.4 Discussion on Section 3

Architectural education is in a constant state of change from past to present. In this sense, architectural education transformed regarding the technological, social and political context of the period and the changes in architectural practice and educational approaches. In order to understand the transformation in the characteristics of architectural education in relation with disturbances, the information from the text is organized. The disturbances are listed regarding the year, disturbance field, disturbance type (long-term/ Shock), affected characteristics and the total number of affected characteristics (Appendix A). These are visualized using tableau public, which is a data visualization software. In Figure 3.2, the disturbances from different fields are represented by a cluster, and the size of the cluster represents the higher number of disturbances in this field and the higher number of affected characteristics. It could be said that long-term changes such as developments in technology and changing social-economical contexts are more prone to challenge architectural

education compared with the shocks such as war and disturbances of ruling power (labeled as political) (Figure 3.2).

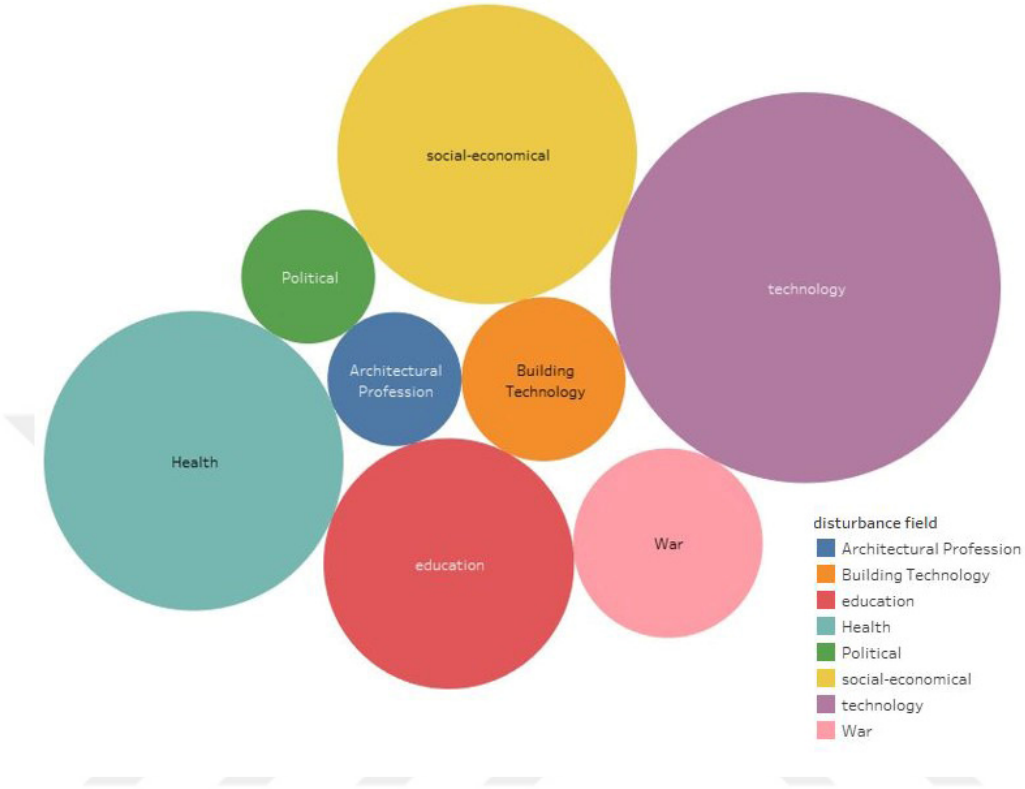

Figure 3.2: Disturbance fields and their impact on architectural education. Source: Author's archive

It is observed that the architecture schools of Academie Royal d'Architecture, Beaux-Arts, and Bauhaus are particularly affected by political forces and social developments. Even the closing and opening of the Academie Royal d'Architecture and Beaux-Arts were directly up to the ruling power of the time, that is the king, Assemblée Nationale, or the government. In addition to the ruling power, it has been observed that the individual efforts of the school principals direct the change of the school. In this sense, the different personalities, objectives, and approaches of the different directors is directly effective in shaping and changing architectural characteristics. Thus, the change of the school director was shifting points for the architectural education at the institutional level.

While the changes in these characteristics before 1900s period were especially seen in the curriculum characteristics, with the rapid change in technology in 1900s, transformations were observed in all of the characteristics (Figure 3.3), especially in the tools. In the architectural institutions, the transformations in the characteristic of curriculum include the changes in the given design problems in design course, changes in the design problems of competitions, and adding courses. New courses have been added to the curriculum based on expanding architectural knowledge or the principal's approach to architecture. For example, École des Beaux-Arts added the course "Godeboeuf" in 1881, designing special elements such as elevator cabins (Chafee, 1977). Another example is the inclusion of engineering sciences lectures into the curriculum of Bauhaus under the direction of Hannes Meyer (Siebenbrodt & Schöbe, 2012). The building typologies studied in design problems and given design problems in competitions reflect the building models of the time. For example, Leroy transformed the architectural programs of the Grand Prix to include new public buildings. In cases where the institution could not adapt to its time, the students rebelled, and the school was closed. In this sense, both the Academie Royal d'Architecture and Beaux-Arts were closed after the students' revolt, which started due to not being in line with the developments of the period.

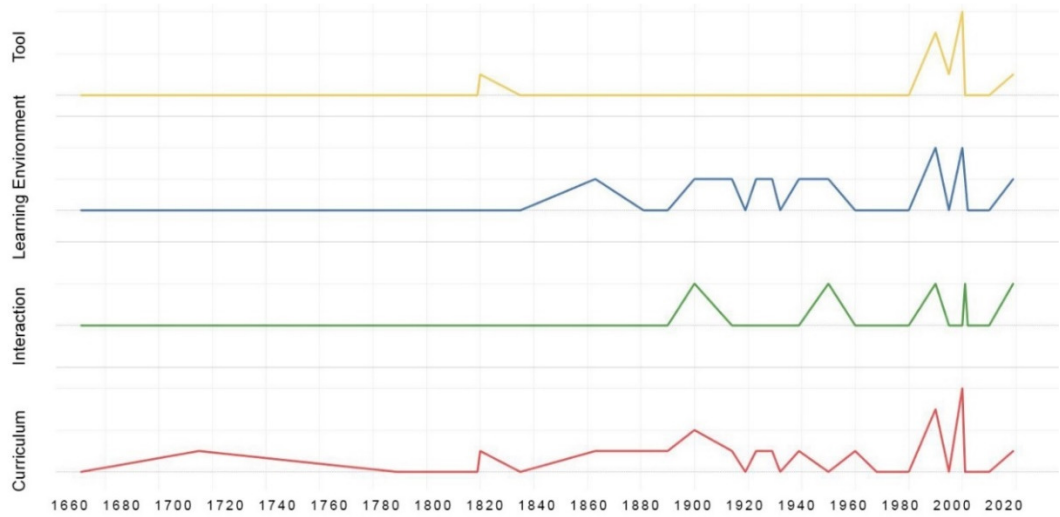

Figure 3.3: Moments of change in characteristics by year. Source: Author's archive

However, as in the case of the Bauhaus shows, it is also not always enough to be in line with the developments of the period to survive. Bauhaus, which adapted to the changing world order with the industrial revolution and technological developments, was closed due to political issues. Nevertheless, the Bauhaus educational culture has spread worldwide and is still alive with its innovative educational approaches. In this respect, the system has collapsed from the engineering resilience approach with the physical closure of the Bauhaus. However, within the resilience perspective of this study, the Bauhaus resisted with its educational culture which can be seen in many characteristics of the current design institutions.

It is possible to observe a more frequent pattern of change in architecture education for the 1930s and beyond. It is seen that the direct influence of the ruling power (King, government etc.) has decreased over time, and changes in various areas, especially in technological development, have been more effective in the development of architectural education. In other words, instant disturbances such as sudden decisions coming from King, and Wars, are replaced by the disturbance of long-term contextual changes such as developments in technology and related social, cultural and intellectual changes (Figure 3.4). Additionally, there are transformations in different characteristics, not only in the curriculum but also in tools, learning environment, and interaction. In this context, the developments in technology that include building technology, devices, and software directly influence educational tools, design tools, and interaction. On the other hand, changes in educational settings affect both the educational environment and the interaction characteristics as new approaches are adopted, such as student-centered education. Additionally, the changes in the social and cultural context influenced the curriculum characteristics and learning environment. In this manner, as the boundaries between disciplines blurred and awareness on environmental issues increased, more subjects from other disciplines were included in the architectural curriculum. It is also observed that architectural education follows these changes instead of being a pioneer. Moreover, the adaptation to the process consists of experimental and singular efforts, far from being collective

systematic. Lastly, the disturbance of the pandemic affected all four characteristics, which is discussed in the following section.

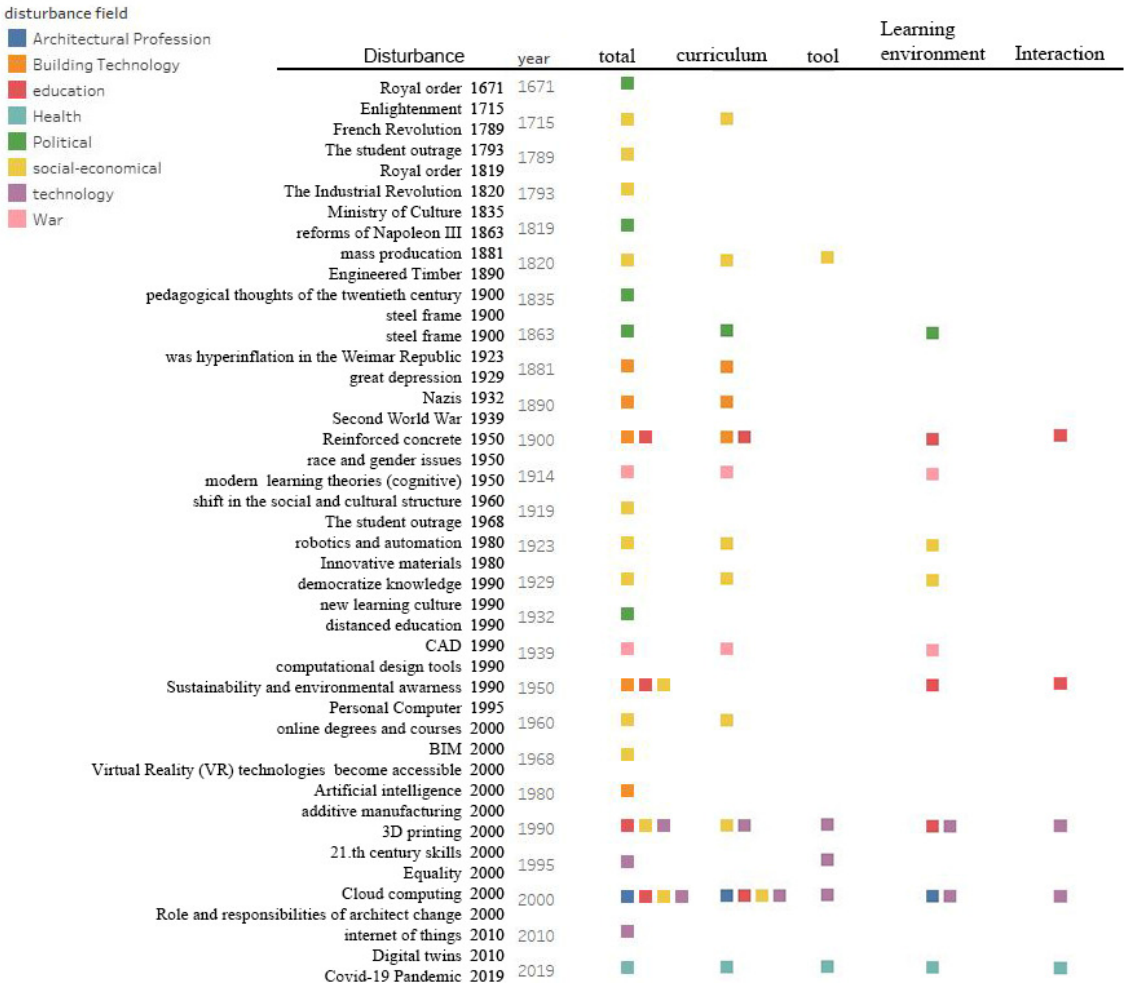

Figure 3.4 : Disturbances, affected characteristics and disturbance fields. Source: Author's archive

Lastly, it can be said that both the developments in the world and Turkey have influenced architectural education in Turkey. In this context, especially the characteristic of the curriculum is directly influenced by global and national movements. For example, Architectural design problems and student projects of the design studio directly reflect the movement of its time, such as the second national architectural movement in the 1930s and International Style in the 1950s. Moreover,

individuals also had a significant impact on the transformation of architectural education. In this sense, we can say that architects such as Emin Onat, Sedat Hakki Eldem, Clemens Holzmeister, and Paul Bonatz direct the change in the architectural environment and education in Turkey. Another event that triggered the change in architectural education in Turkey was the establishment of the republic and accompanying changes in the cultural, political and architectural context. It is observed that architectural education in Turkey and the world has been transformed following the long-term changes in technological, educational, social, and cultural contexts.

4. TOBB ETU DEPARTMENT OF ARCHİTECTURE'S RESPONSE TO THE PANDEMIC

The global public health crisis, the COVID-19 pandemic, has affected many areas worldwide, including the economic and social domains, daily life, and education. World Health Organization (WHO) reported almost one and a half million deaths and more than sixteen cases by the end of November 2020 (Coronavirus disease (COVID-19) – World Health Organization, 2020). Therefore, to prevent the spread of the pandemic, many measures were taken by governments, including nationwide lockdowns, social distancing measures, and school closures.

Education, and more specifically, higher education, is one of the sectors highly disrupted by the pandemic. Within the strategies to contain the spread of the virus, most governments have temporarily closed educational institutions, which impacts hundreds of millions of learners at all levels, from pre-primary to tertiary education levels. By the end of April 2020, school closures in 151 countries have affected more than one billion children and youth, which means 81.8% of total enrolled learners (UNESCO, 2020). Pandemic measures have been reduced in most countries after vaccination and immunity, and most schools have back to face-to-face education. Millions of children and youth are affected by school and university closures. In particular, 85% of classes in higher education have been totally or partially replaced by online methodologies during the pandemic (Gabriels & Benke-Aberg, 2020; Marinoni et al., 2020). Accordingly, the temporary break of the face-to-face activities is defined as a "huge disruptor of their (HEIs) functioning" (IESALC, 2020). At the beginning of 2022, the number of closed schools reduced to 12 (on January 15), but it is uncertain when this kind of disruption will happen again. As Bill Gates noted, the COVID-19 might not be the last pandemic, and it is very likely to face different kinds of infectious-disease outbreaks (MSNBC, 2021). In this manner, there is a need to be prepared for the potential disturbances of the future.

Besides being a significant disruption, the pandemic also allowed to rethink higher education and revealed emerging vulnerabilities in education systems (Schulte et al., 2020; Recio & Colella, 2020). Universities rethought and redesigned their education models due to the COVID-19 crisis, which brought into question the current system and demonstrated higher education's capacity for change (Recio & Colella, 2020). During emergency remote teaching, the potential of new technologies is being explored; new applications are found, and alternative ways of teaching models are experienced. This emergent type of digitalization opened a new era in education as universities radically transformed their systems in terms of teaching, learning, collaborations and international mobilities (Recio & Colella, 2020). The current situation also leads to the understanding that some of the activities that were done physically could also be held in a virtual format with appropriate digital infrastructure, methods, and skills. In line with all these, the University of the Future Network argues that the current transformation will affect the ways and methods used to access and acquire knowledge in the future (University of the Future Network, 2020).

From time to time, higher education needed an examination of new ideas to align itself with society's needs and demands (Cox, 2019). In this manner, the pandemic is one of these events that lead to examining new methods, approaches, and tools by triggering the digital transformation. Although it occurs due to an emergency, it is predicted that the effects of emergency remote teaching will be permanent (Recio & Colella, 2020; Marinoni, Van't Land & Jensen, 2020; Schulte et al., 2020).

In this chapter, the pandemic experience at TOBB ETU Department of Architecture will be given as a case study. First, a broader overview of the pandemic and its effects on higher education will be explored. Then, the effects of the pandemic specifically on architectural education will be discussed. Finally, the experience at TOBB ETU will be explored with a field study. It is believed that the results of this field study will provide important insights to improve the resilience capacity of architectural education. Further, these results will illuminate which effects of the pandemic were positive and needed and thus will be permanent in the future.future.

4.1 Literature Review on Pandemic and Higher Education

Before everything else, it is crucial to clearly define the terminology used to refer to the specific mode of teaching/learning delivered during the pandemic. The studies that focus on education during the pandemic use a variety of terminology, including distance learning, online learning, online education, or online teaching. However, it is essential to note that the current online mode of education in response to the pandemic is different from well-planned online learning experiences. In an attempt to end the terminology conflict and to draw a clear contrast between high-quality online education and online education during an emergency; researchers and professional practitioners propose to use the term emergency remote teaching (ERT) for the type of instruction being delivered during a crisis or disaster (Hodges et al., 2020). ERT differs from online education as it is implemented suddenly, without any preparation and as a necessity. It could take months to plan, prepare, and develop a fully online university course. However, faculties had to move their courses online within weeks and without a careful design process. As Doğan noted, the process we go through in the means of both psychology and infrastructure is a situation of resilience, not distance education". Similarly, another research highlighted that one of the most important issues is that our experience should be called Emergency Education instead of Distance Education. (Acar, 2020). This study approached the pandemic as a disturbance from the very beginning and clearly distinct the present mode of education from online education.

In terms of the studies on the pandemic and higher education, large-scale efforts evolved quickly. In this manner, a significant number of studies hold to share information, understand the impact, collect data, develop solutions, and develop future insights. These include several studies on different scales (international, regional, national and institutional); providing different perspectives (institutional, instructor, student); and focusing on different dimensions (academic life, student life, communication, used tools, psychological impact etc.); and hold by different agents (international organizations, independent researchers). Some featured studies include published reports of international organizations such as UNESCO, Association of

Universities, Erasmus Student Network (ESN), European Students' Union (ESU) (IESALC, 2020; Marinoni, Van't Land & Jensen, 2020; Gabriels & Benke-Aberg, 2020). The variety of the pandemic-related studies in the educational settings reflects the richness of the topic. However, it is observed that there are some repeated patterns in terms of the challenges and benefits of distance education during the pandemic. Moreover, there are repeated general remarks on the future of higher education and opportunities opened up by the pandemic.

In terms of the challenges of education during the pandemic, the digital gap and the increasing inequalities, as a result, are some of the most featured issues (World Bank, 2020; Recio & Colella, 2020; Barada et al., 2020; Schulte et al., 2020). The digital gap appears in two ways; one is on inadequate infrastructure, which refers to access to the internet, and the other is access to equipment and devices. In this manner, the impact of the pandemic is not the same, as the infrastructure, access to technology, and available resources differ both at the regional level and individual level. In this manner, access to devices, the internet, and equipment ownership is crucial (Schulte et al., 2020). While some students have to share the equipment or only have one device such as smartphones; others have a couple of devices, such as computers and printers, that both types of equipment provide different types of learning experiences (Schulte et al., 2020). Moreover, as the Institutions in Africa has lower access to facilities, electricity, network and computers for implementing online education, the percentage of HEIs completely canceled teaching and exams in Africa is significantly higher than in Europe (Marinoni et al., 2020).

The adverse effects of the pandemic on the mental health of the students and instructors are another issue that is commonly mentioned. In this manner, it is noted that many students faced mental health issues, such as anxiety and isolation during the pandemic, which also affected their academic life. In this manner, students also face psychological challenges such as lack of motivation, difficulty in concentration, and missing face-to-face interaction (Barada et al., 2020). It is also noted that although the pandemic has had a negative impact on international student mobility, most of HEIs

overcome this by increasing virtual mobility and/or collaborative online learning as alternatives (Marinoni et al., 2020). Additionally, inadequate studying conditions at home, increase in workload, cancelation of practical classes, access to laboratories, access to study materials, and the difficulties in the assessment are also issues that are frequently addressed as negative features of online education during the pandemic (Barada et al., 2020; Gabriels & Benke-Aberg, 2020; Schulte et al., 2020; Recio & Colella, 2020; Marinoni et al., 2020; Aristovnik et al., 2020; IAU,2020). It is noted that "older students, students who had a quiet place to study, a good Internet connection and material for studying at their disposal, as well as students with higher levels of digital and social bonding capital, consistently reported greater adjustment during the COVID-19 pandemic." (Barada et al., 2020)

On the other hand, some benefits of distance education are commonly mentioned, such as the sharing of the resources online, flexibility in terms of time and place, lower living costs, expansion in international collaborations and increasing networks between universities. One of the most referred positive aspects of online education is in the means of eliminating the need for transportation. In most of the studies, students referred to the advantage does not have to travel to the school. This had different benefits; one is in the means of time and money consumption, and another is in flexibility. As there is no need to travel to the institution, this saves both money and time. Moreover, the opportunity to attend classes from any place increases the flexibility. Moreover, the open share of the resources increases the accessibility to the learning resources to anyone with an internet connection, which also opens new opportunities for learners to access lifelong learning. Additionally, international collaborations and university networks contributed to the exchanges of experience, sharing advice, and conducting research, alongside with pooling resources and providing support. In this manner, new ways to work together are discovered.

Above all, one of the most referred advantages of the emergency distance is that pandemic experience has led to tested new tools and systems and triggered the digital transformation of higher education (Barada et al., 2020; Gabriels & Benke-Aberg,

2020; Schulte et al., 2020; Recio & Colella, 2020; Marinoni et al., 2020; Aristovnik et al., 2020; IAU,2020). Especially in developing countries like India, where online education was not very common, the pandemic forced people to learn and test new tools and systems, which has opened a new horizon of teaching and learning (IAU, 2020). This led to an increase in innovation in teaching pedagogies, as well as created space for more flexible learning possibilities such as blended learning (Marinoni et al., 2020; IAU, 2020; University of the Future Network, 2020).

In addition to the examination of the challenges and benefits of emergency distance education, there are attempts to develop future insights for higher education. In this manner, the University of the Future Network (UFN) argues that the current transformation will have a permanent impact on the ways and methods used to access and acquire knowledge (University of the Future Network, 2020). It is also argued that the current situation provides the opportunity to rethink higher education (Schulte et al., 2020). As Recio & Colella noted, “the COVID-19 crisis questioned the status quo and showed the potential for change of higher institutions” (2020). Accordingly, it is foreseen that higher education institutions will radically transform the way in which they offer teaching, learning, international mobilities and collaborations (University of the Future Network, 2020; Recio & Colella, 2020; Schulte et al., 2020). In this manner, the future insight on education includes “hybridization of the system” that is coupling campus-based education with distance education and synchronous with asynchronous learning. More diversified ways of teaching and learning alongside with the online components would offer flexibility to learners (IUA COVID19, Recio & Colella, 2020; Schulte et al., 2020). Accordingly, “The overall educational offer will be a perfect blend of formal, informal, physical and virtual elements.” (Recio & Colella, 2020)

4.2 Pandemic and Architectural Education

It is essential to understand the current situation within specific contexts such as the university, region, or discipline. As IESALC underlined, "Every HEI, and probably

every discipline, must find the most appropriate combination of technologies and resources to improve the pedagogical impact." (IESALC, 2020). It is argued that the fields that have the most challenging process are; the fields with special needs, the creative areas, fields requiring access to laboratories and fields depending on specific technical equipment (Marinoni et al., 2020; IAU, 2020). This is also reflected in the applied courses, as nearly all lectures are replaced by online methods, there are fewer replacements in practical ones (Barada et al., 2020). Similarly, in Turkey, while almost all of the theoretical lectures moved to online teaching methods (99.2%), this rate is lower in practical classes (75%) (YÖK, 2020). Therefore, the situation becomes more special in architectural education, where practical education stands out. In this manner, the studies on architectural education during the pandemic are examined in this chapter.

It is observed that some of the comments on the distance architectural education during the pandemic coincide with the ones on higher education. In this sense repeating arguments in terms of challenges includes the inadequate infrastructure, inequality, access to technology, inadequate studying conditions at home, access to study materials, and psychological issues. In terms of the advantages of pandemic experience, it is mentioned the flexibility in time and place, testing new tools and methods, and experiencing distance education. However, these issues gain a different dimension and meaning in the context of architectural education due to their particular structure. For example, as the physical model is one of the inherent parts of architectural education, not being able to access study materials affects the learning process differently than the other fields. Moreover, in architectural education, the studio and university environment provides specific technical equipment for architecture students, such as drafting boards, laser cutters, and 3D printers. The loss of these environments also affects the learning process negatively as it limits access to this equipment. Moreover, the loss of the studio environment, which facilitates socialization, is one of the main challenges that negatively impact peer learning, which is essential for architectural education (Grover & Wright, 2020).

Similar to the studies in higher education, one of the biggest challenges faced during emergency architectural education is the inadequacies in digital infrastructure. In this manner, the process was challenging, especially in the courses where there was a need for excessive data and file sharing. For example, in the design studio courses or group projects, different types of files are shared, such as visuals, digital drawings, and digital models, which are highly influenced by the quality and speed of the internet. Challenges due to insufficient infrastructure differ by country. The inadequate digital infrastructure is mentioned as the top problem faced in architectural education in Turkey (Bala, 2020) and India (Varma, Jafri,2020). However, in the UK, it is mentioned in the lower ranks and comes later than challenges such as "seeing the work of other students" and "working in a team" (Grover & Wright, 2020). Moreover, the adverse psychological impact of the pandemic on architecture students includes increased loneliness, and depression, anxiety (Gokhale and Vaze, 2021). Students' sense of being part of a community, interacting with other year groups, motivation, and support from others were also negatively impacted by the studio environment's loss (Grover & Wright, 2020).

Most comments on the adverse impact of the pandemic were centered on design courses considering the social dimension of the studio environment. While most of the students and instructors (%90) prefer face-face education in a design studio (Grover & Wright, 2020), educators draw considerable satisfaction in teaching the theoretical subjects online (Varma & Jafri, 2020). In studio classes, disadvantages were experienced, especially due to the adverse effect of the pandemic on peer learning and communication, which is crucial in architectural education (Bala, 2020; Grover & Wright, 2020). In this manner, the loss of interaction between students is highlighted as a big challenge. It is also noted by the instructors that the ability to observe the students was significantly disrupted during the pandemic (Acar, 2020). In this manner, instructors noted that they were able to provide more support to students in face-to-face education, even in situations where the students had difficulty in expressing themselves (Acar, 2020).

In terms of the benefits, emergency architectural education brought flexibility in time and space. It became normal to go anywhere in the virtual environment and participate in lectures, critics and other learning activities. The access to the experts and academicians from different schools, from abroad, strengthened as they easily participated in the juries and studio sessions (Yorgancioglu, 2020). The virtual environment removed the limits; distances have decreased, time-independent education opportunities have been offered, and the doors of unlimited education opened (Bala, 2020). The disappearance of physical conditions also provided a rich content environment for students to access information both easier and with broader content as more schools openly share their sources online.

Another issue discussed specific to architectural education is the change in architectural representation tools. Drawing techniques and environments, and physical models either changed or disappeared. In this manner, students' lack of access to materials causes serious deficiencies. Various software is being learned to compensate for this gap in the physical model, to explore the third dimension, material, and light (Acar, 2020).

One of the outstanding points is that the pandemic experience differs at the institutional level due to the differences in infrastructure, access to technology, available resources, school culture, and differences in the characteristics of architectural education. For example, there were departments where digital tools were not preferred in the first year, even until the 3rd grade before the pandemic. Both students and instructors in these schools quickly switched to digital tools. But it is observed that the adaptation process to the emergency is faster in schools that work with computer-aided design from the first year (Acar, 2020). Additionally, there are different experiences in adapting the lessons to the emergency situation (Acar, 2020). In this manner, while some schools have entirely switched to distance education, some schools wait for a while and gradually transition. In this manner, each department followed a strategy regarding the extent of its facilities. However, it is seen that almost all departments put

serious evaluations and changes on the functioning of the courses on their agenda and discuss them (Acar,2020).

In one way or another, this process of emergency education forced to re-think the architectural education system. It forced the rapid transition to digital delivery that most students and educators had little experience before the pandemic (Fleischmann, 2020). This rapid shift also broke academics' conservatism and forced them to test "new" tools and methods and rebuild the teaching and learning experience (Bala, 2020). The inertia and conservatism created by the long-standing habits in the architecture academy have been shaken to a great extent (Acar, 2020). Moreover, it leads to changes in the environment (space), tools and methods. As Yorgancıoğlu noted: "We should better consider it as an opportunity to reflect upon the challenges and potentials of both digital tools/platforms and traditions design studio model, and to initiate experiments for the development of a new approach that would support each other and move in parallel." (2020). In terms of future insights, it is noted that "This (pandemic) opens the doors of new hybrid systems. These hybrid systems will not only be among the components of courses, faculties, departments or universities. It will also occur between different schools, contents, and disciplines." (Acar, 2020). In this manner, the pandemic experience is defined as a breaking point where "Design education is at the crossroads of re-defining itself" (Fleischmann, 2020)

It is evident that all the attempts put into practice in emergency education during the pandemic cannot be completely permanent. However, there will certainly be permanent effects that are foreseen and unseen. These changes have not yet led to a systematic transformation in architecture education. In order to enable and enhance this transformation, there is a need to understand the changes during the pandemic with a comprehensive study.

4.3 TOBB ETU Department of Architecture

Turkish authorities announced that the schools and universities would be closed as of March 16, except for digital and remote education, due to the pandemic (Anadolu

Agency, 2020). Within the scope of distance education, the Ministry of National Education has decided to perform the courses via its online platform-EBA (Educational Informatics Network) and the national television channel TRT in primary and secondary education levels. Universities, on the other hand, used their own systems. In this manner, TOBB ETU also moved to distance education and took necessary precautions quickly.

Unlike other universities in Turkey, TOBB ETU implements 3-term in an educational year. After the announcements of the closures, TOBB ETU took the end of the spring semester one week ahead and updated it to March 14 (TOBB ETU, 2020a). Then it held final exams before all other universities from the teaching management system; uzak.etu.edu.tr, from 13 – 18 April. Then, the university senate announced that Summer Term courses would be conducted through distance education in the Emergency Education format.

The Summer Term started on April 27, 2020, and lessons are conducted in three categories: synchronous, asynchronous, and mixed. Course materials are shared on the Uzak.etu.edu.tr system, and synchronous lectures are generally conducted on the Zoom teleconference platform. The Cooperative Education Program, a part of education and training at TOBB ETU, is also carried out remotely in the 2019-2020 Summer Term. After the necessary arrangements were made in the system, 222 students were placed in companies and institutions that stated that they would accept students within the scope of distance co-education.

Within the scope of combating Covid-19, TOBB ETÜ regularly evaluated and updated the work done. Some of the activities carried out are:

- Establishment of Coronavirus Information Commission

- Establishment of Pandemic Disasters Prevention and Management Technological Research Centre (PDRC)

- Disinfection
- Hygiene and Social Distance Practices
- Information and Support Activities for Students
- Online trainings for Instructors (TOBB ETU, 2020b)

To understand the state of the TOBB ETU Department of Architecture during the pandemic, it is necessary to understand the department's original structure. As mentioned before, one of the distinctive features of TOBB ETU is that it implements 3-term education practices. In total, bachelor's education is comprised of 11 terms, 3 of which are reserved for cooperative education, that is only practiced in TOBB ETU in Turkey (Table 4.1). Cooperative education programs have many benefits such as providing a good amount of work experience to students, enabling students to discover what they want and what they are good at in their field and also introducing many companies to them.

Table 4.1 : Structure of 11 term education in TOBB ETU. Source: url-7

	1st grade	2nd Grade	3rd Grade	4th Grade
Autumn Term	1.Semester	4.Semester	6.Semester	cooperative education
Spring Term	2.Semester	5.Semester	cooperative education	8.Semester
Summer Term	3.Semester	cooperative education	7.Semester	

Under the Faculty of Architecture and Design, the Department of Architecture of TOBB ETU provides one of the most innovative academic and cultural environments. The Department establishes continuous innovative learning models and redefines architecture and design education according to changing conditions (Çağlar, 2022). It adopts an experimental structure different from conventional methods. It aims to raise

architectural intellectuals. The Department develops a unique architectural education model with an interdisciplinary working culture; a free school environment that enables experiments and differences; and close relationships with technology. Thus, it ensures academic staff development in academic and professional fields and the students benefit from the architectural education program with the highest performance and efficiency.

The curriculum is comprised of four modules that are Architectural Design; Building Technologies; Architectural Culture, History and Theories; and Expression Presentation Techniques. These modules constitute the original education program of the department since 2012 (url-8). These modules are integrated with each other rather than being autonomous parts of the curriculum. In this unique model, the focus is on the process and the student's progress, not on the end product. The department has no exam-based evaluation, based on the idea that architecture is a process-oriented field which does not necessarily focus on the end-product. Moreover, the vertical studio system is an integral part of the education model, which enhances peer learning, and strengthens the network and interaction between students[22].

Regarding the pandemic experience, there is a criticism that the current situation is mostly reduced to a question of student assessment and mainly could not go beyond applying existing approaches in online platforms. Different from this, TOBB ETU Department of Architecture extensively searched for new ways of teaching, evaluation and new content for the digital realm (Arkitera.com, 2020, min. 9.00). The education model could transform in such a way if only it is adaptive enough. Otherwise, the emergency remote teaching would only mean transmitting the same content with different tools without a structural transformation, which happens in the early periods of the pandemic (Arkitera.com, 2020). In this manner, it is noted that the flexible

[22] For more information please see: Öztoprak, Z., Sipahioğlu, I. R., Çağlar, N. (2021).

structure of the TOBB ETU Department of Architecture provides an advantage in the current situation as it is flexible enough to update and adapt according to the current needs and conditions (Arkitera.com, 2020, min. 19.00).

With the different options offered by the department for the cooperative education program in the summer 2020 term, the process is not only interrupted but also enriched in terms of experience. For example, the cooperative education term is enriched with the inclusion of different options. These options include joining an internship in an architectural firm as usual, participating in an international competition, participating in academic projects or taking online courses from the platform Coursera that are provided within the scope of the agreement made by TOBB ETU (Arkitera.com, 2020, min. 43.00). Moreover, the technological infrastructure offered by the university accelerated online meetings with students. This helped to buffer one of the main disadvantages of remote learning, which is to stay away from the cultural dialogue of the university environment and increase the mutual interaction.

The faculty reported that the student society of “architecture and design culture” organized online meetings to re-establish communication between students (Arkitera.com, 2020, min. 1.15.00). Moreover, because of the process-oriented education model, some of the main issues that other departments have experienced about the evaluation processes did not come into question at the architecture department. In this manner, evaluation is provided as usual, by project submissions, homework, presentations etc. By utilizing the innovative education model, new methods in design education were searched during the pandemic period, such as in basic design studio (mindcraft_architecture, 2020) or building technologies studio "yapım ekibi" (tobbetu_mimarlik, 2020).

Considering all these, TOBB ETU Department of Architecture is an important asset in exploring the pandemic experience as the department's experimental structure and its character, which is open to new possibilities, catalyze the adaptation to online education, especially in design courses.

4.4 Qualitative Study

In order to be able to understand the transformation of architectural education in the face of disturbances in detail, the pandemic experience of the TOBB ETU Department of Architecture is examined as an example of resilience of architectural education. In this manner, the study employs a qualitative method to reveal the changes in the Department. Semi-structured interviews are conducted with students and faculty members to collect qualitative data from different perspectives of different actors. Semi-structured interviews allow in-depth explorations and enable participants to express their views in their own words and have the potential to reveal unpredicted aspects. Thus, the research benefits from semi-structured interviews, which enabled the examination of the transformation of architectural education during the pandemic, specific to the context in depth. Besides interviews, the study also benefits from the extensive observations and documents such as official announcements, and faculty statements as supplementary data. The participants, data collection, and data analysis methods used in the qualitative part of the research are explained below.

Interviews were conducted with students, instructors, the head of the Department of Architecture, and the dean of the Faculty of Architecture and Design. In this context, a total of 17 participants, seven from the faculty members and ten from the students of the Department of Architecture of TOBB ETU were interviewed. Interviews were conducted with instructors who gave different courses from different modules, including the courses from the design studio and the theoretical courses, elective and compulsory courses and courses from the different grades. The dean of the Faculty of Architecture is also the founding head of The Department of Architecture and is represented as an instructor in the study. Similarly, one of the participants is the current head of the Department of Architecture. In terms of the students, undergraduate students from 4th grade had one year of emergency remote education experience by the time they were interviewed. Earlier grades were excluded as their lack of face-to-face architectural education experience could limit their analysis and reflection on the current situation. Moreover, student participants took different courses from different

modules that coincided with the ones that interviewed instructors gave. Thus, both the instructor and student experience of the pandemic in both practical and theoretical lectures were examined.

The interview instruments were built regarding the studies on architectural education and pandemic. Based on the literature review, the semi-structured interviews are guided by four main headings that focus on identifying changes in the TOBB ETU Department of Architecture (Appendix B). First, general remarks on the impact of the pandemic on architectural education were asked (guiding question 1). Then, remarks on the changes in the different courses asked regarding the feature of the course (such as its module or practical/theoretical) in terms of different aspects such as content, tool, learning environment, methods, duration, assessment (Guiding questions 2-4). Third, remarks on the impact of the pandemic on the interactions both in terms of between students and between student and instructor examined (Guiding question 5). Finally, it is requested to compare the different periods of the emergency remote teaching (Guiding question 6).

Same guiding questions are used both for students and instructors to ensure consistency. Interviews were conducted on the online meeting platform zoom in the spring term of the academic year 2020-2021, which is after three semesters (one year) of emergency remote education. The permission of the participants and approval from the human research evaluation board of the university were obtained (Appendix C). During the interviews, digital recordings were made using the recording feature of the Zoom platform with the consent of the participants. The interviews were then transcribed, titled (I for instructors and S for students; such as S1, S2...) and transferred to MAXQDA for qualitative data analysis. Depending on the answers of the participants, interviews with instructors lasted for about 30 to 60 minutes, and interviews with students lasted for about 15 to 30 minutes.

In order to analyze the collected data systematically, the interview transcripts were coded. Coding refers to assigning a label (code) to a text passage that assigns symbolic meaning to the descriptive or inferential information compiled during a study (Rädiker

& Kuckartz, 2020). Coding is an inherent part of the analytical process in grounded theory (Groat & Wang, 2013). In this manner, MAQDA software is utilized in the data analysis process to code, specify themes, identify relationships among the codes and visualize. The qualitative data was evaluated by performing content analysis. First, the interviews are read intensively and phrases with the same topics were labeled. After the encoding, codes with similar meanings or a relationship with each other clustered and formed some themes. Then, the data was re-examined and renewed regarding new observations and progress in the study.

After this step, considering the repeated themes and structure of the TOBB ETU Department of Architecture, the genetic characteristics of architectural education, which were mentioned before in chapter 2, were determined as the curriculum, tools, learning environment and interaction, that also form the four main themes in the coding system. Then, the category system developed further, and the second coding cycle (fine coding) developed. Lastly, emerging themes were discussed regarding the resilience concept. The process was an iterative and cyclical one which is as follows:

1. Interviews conducted

2. Transcription made

3. Intensive reading made

4. Coding: phrases with the same topics were labeled.

5. The themes developed: Codes clustered and formed themes

6. Analysis and visualize with Maxqda

7. The themes renewed: category system developed further and the coding process repeated (steps: 4-5-6)

8. Discussion held (Figure 4.1)

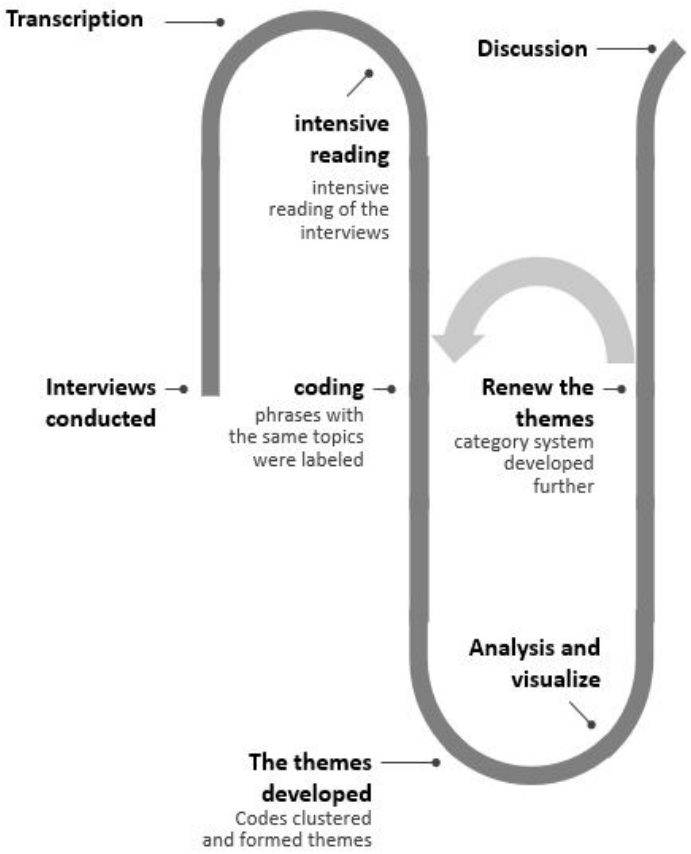

Figure 4.1 : Analysis process. Source: Author's archive

In the preliminary phase of coding, themes such as environment, interaction, methodology, perception and feelings have emerged. It is also observed that some positive effects of the pandemic repeated such as accessibility to knowledge, time efficiency, and participation of guest tutors, which are also mentioned in other pandemic-related studies. In terms of negative effects, the loss of randomness and spontaneity were prominent (Figure 4.2). Regarding the characteristics of architectural education and the concept of resilience the codes and themes are updated. For example, the themes of “negative” and “positive” were updated, and the codes under these themes that are related with resilience attributes are gathered under the theme ”resilience”. For example, the codes such as time efficiency, multitasking, and accessibility to knowledge related to flexibility and resilience, thus these phases are re-coded under the label “flexibility” in the renewing process (Figure 4.5).

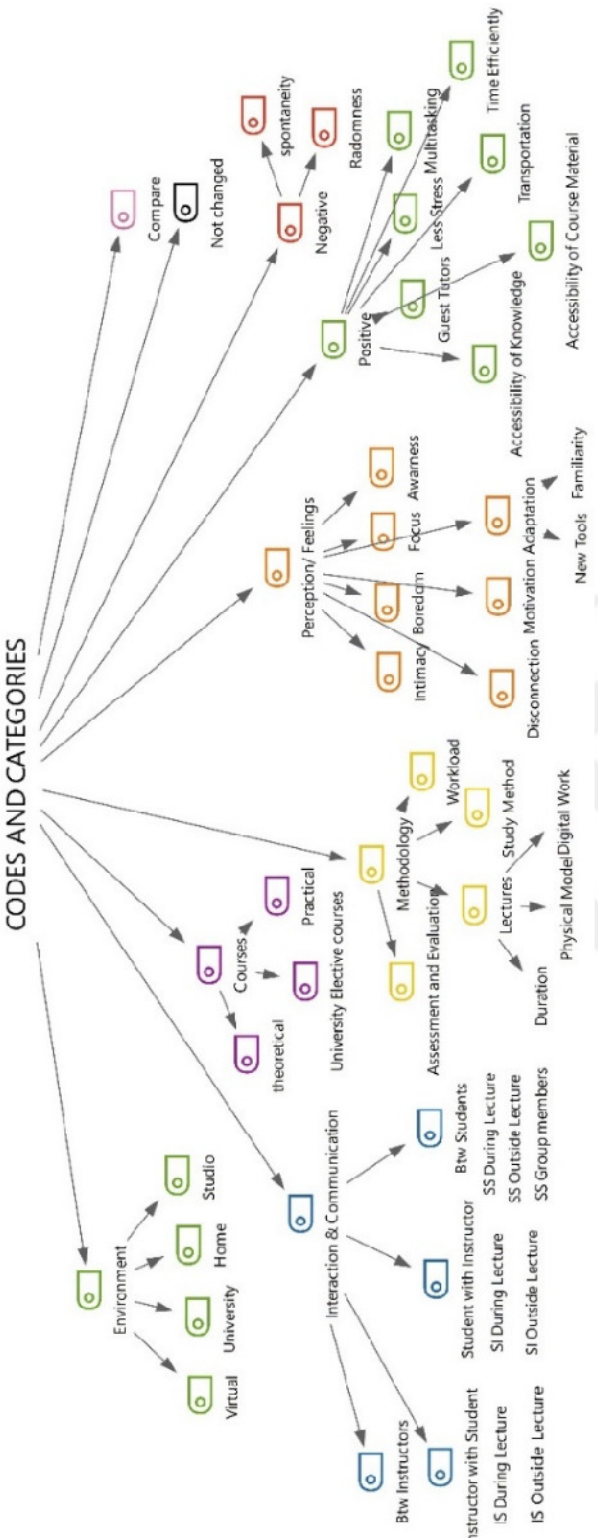

Figure 4.2 : Emerging themes and codes in the preliminary coding. Source: Author's archive

Moreover, it is observed that some codes are less mentioned, and some themes have secondary importance regarding characteristics. For example, both in students' and instructors' interviews the codes "Negative" and "Positive" came to the fore, which reflects that participants mainly focused on the challenges and advantages of the distance education (Figure 4.3). However, this study aims to understand the change in architectural education regarding the pandemic experience. Thus, the phases labeled with positive and negative codes were re-read focusing on resilience concepts. For example, transportation became unnecessary during the pandemic, which is mentioned as an advantage of the distance education frequently, but has no relation to resilience However, access to guest tutors from other cities and countries becomes easier by eliminating travel obligations, contributing to resilience by strengthening networks and increasing diversity. Thus, the theme of Negative and Positive are replaced by the theme of resilience and codes are renewed regarding resilience concepts.

Figure 4.3 : Code Cloud: Students (left), Instructors (right). Source: Author's archive

Moreover, there are a variety of codes on feelings such as boredom, motivation, focus under the theme of perception and feelings; that are mentioned separately (Figure 4.4). These feelings are in relation to resilience but are not a leading characteristic or a main feature in resilience concept, thus these are merged under the code "feelings", as a part of the theme "interaction" (Figure 4.5).

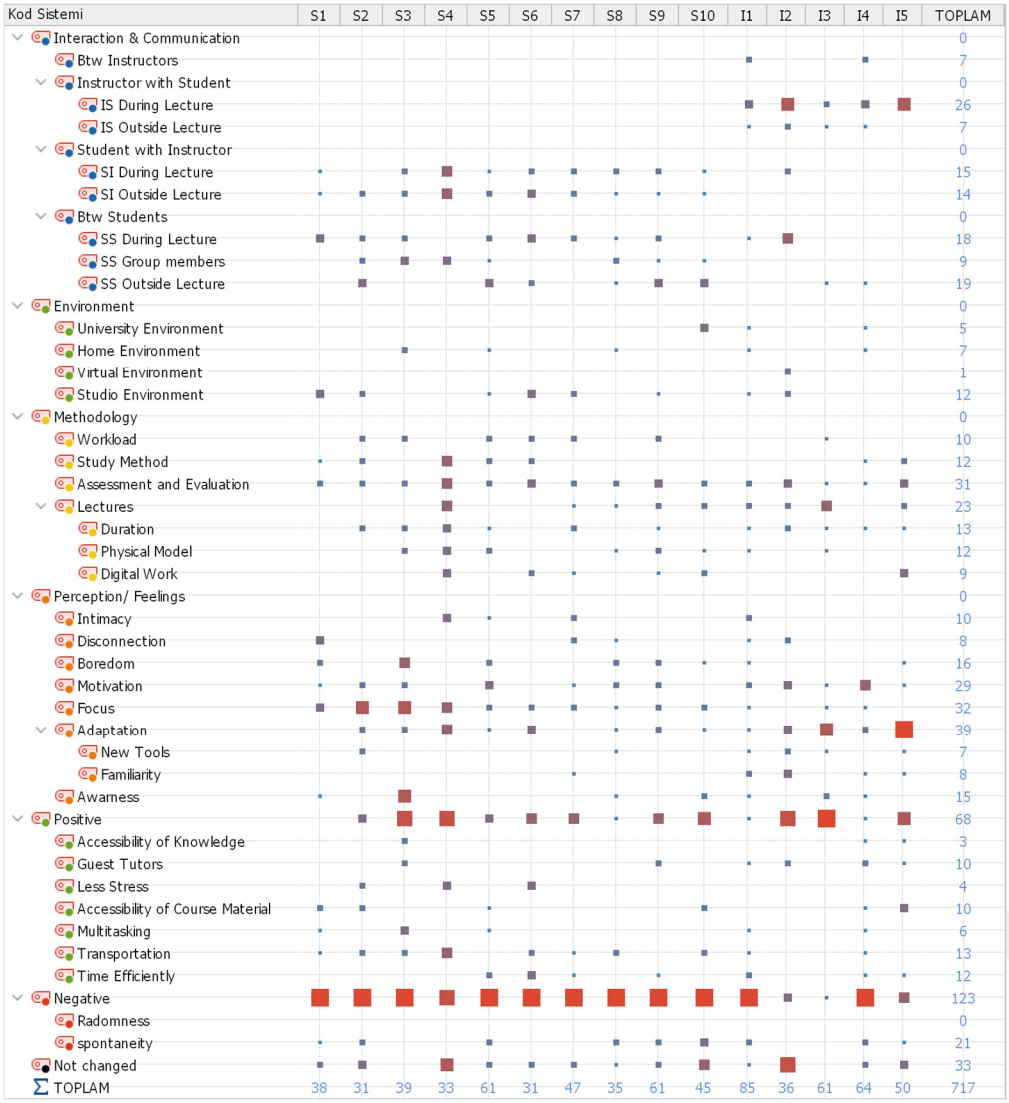

Figure 4.4 : Matrix of mentioned codes by each participant in in the preliminary coding. Source: Author's archive

Regarding the preliminary codes and themes, resilience concepts and characteristics of architectural education, the themes are re-arranged in the renewing process. The interviews are re-read and the coding process repeated. The emerging themes and codes after the renewing process are shown in figure 4.5. While the interaction, curriculum, learning environment and tools themes refer to the characteristics of architectural education, the resilience theme is not a characteristic but is emerged as a group of accompanied codes that helps to held discussion (Figure 4.5).

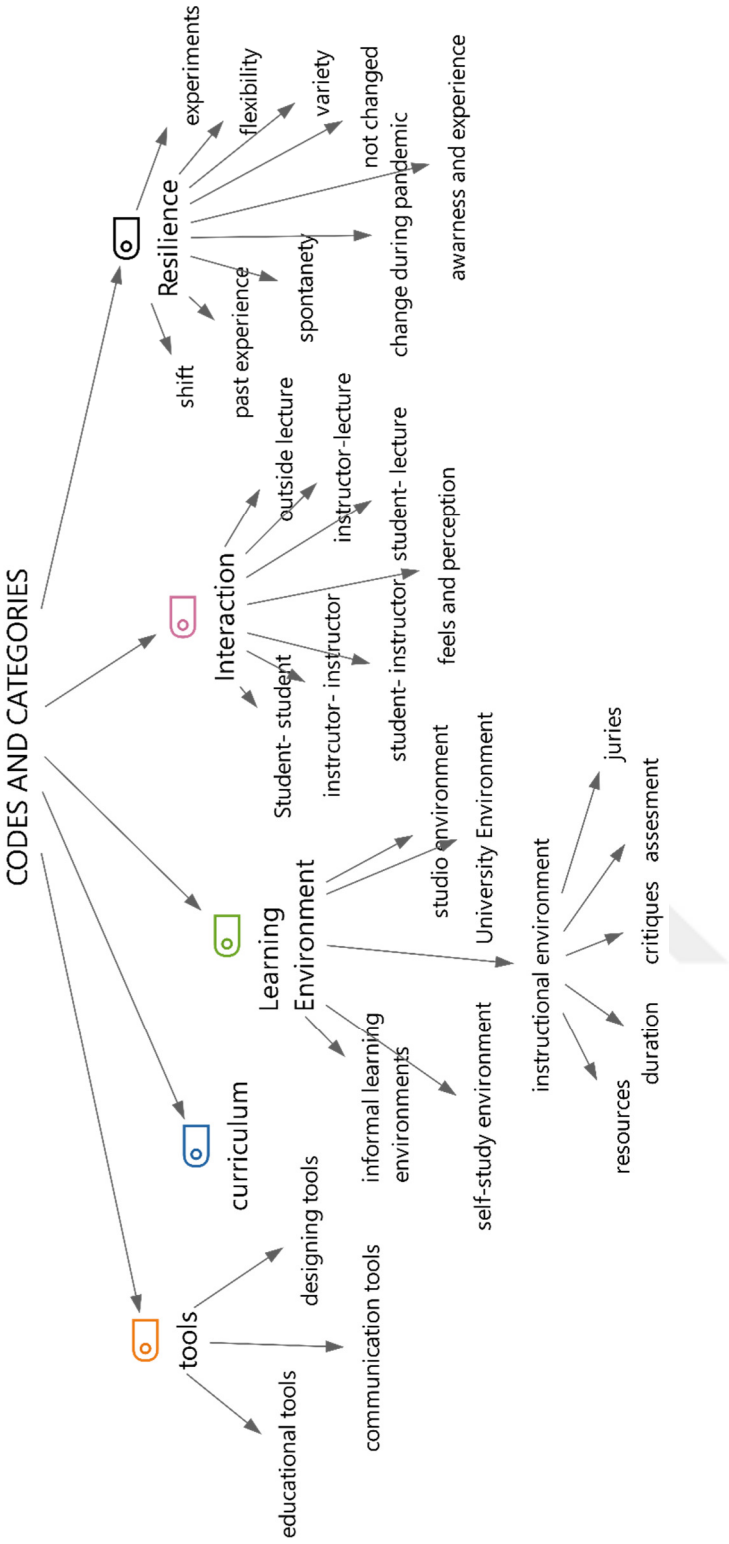

Figure 4.5 : Emerging themes and codes after the renewing process. Source: Author's archive

Figure 4.6 shows the co-occurrence of codes from characteristics (interaction, curriculum, learning environment and tools) and codes from the resilience theme. The thickness of the lines reflects the co-occurrence frequency, and the minimum co-occurrence number is selected as two, that means less than two intersections are not shown. It is argued that codes from the curriculum intersect mainly with the code “not changed”. Moreover, while other codes from the three characteristics of interaction, learning environment, and tools are mentioned together, the curriculum is mainly mentioned independently from other characteristics. It is seen that individual experiments are mentioned in each of the characteristics. Moreover, codes from tools and learning environment frequently intersect with the code flexibility. This is mainly due to the flexibility in time and place bring with the online methods. Both interaction and learning environment characteristics did not mention together with the code “not changed”.

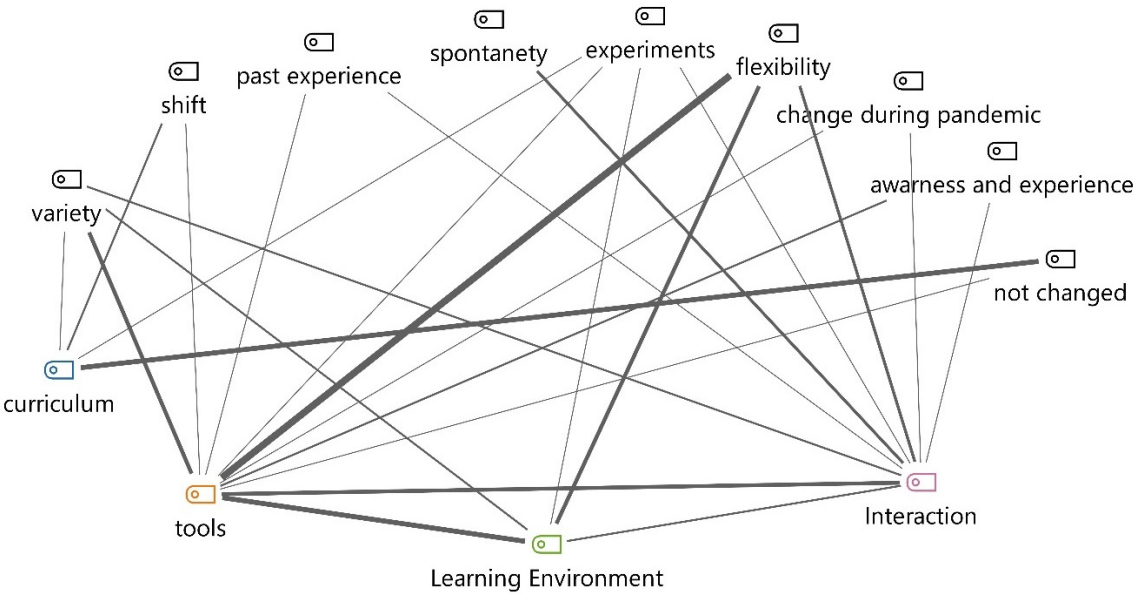

Figure 4.6 : Code intersections. Source: Author's archive

4.5 Discussion

The transformation of architectural education in the face of the pandemic is the major issue to be explored in this study. In this respect, changes in the TOBB ETU Department of Architecture regarding the disturbance of the pandemic have been examined in detail. The transformation discussed within the genetic characteristics of architectural education specifically from the resilience perspective as explored in chapter 2.

4.5.1 Curriculum

The interviews revealed that, it is believed that there was not a fundamental transformation in terms of the curriculum. While most of the respondents do not mention to any change in the content of subjects, two of them specifically criticized that pandemic do not have a significant impact on the architectural curricula. For example, an instructor noted:

> "I don't think anything has changed… The same content is transmitted, and the possibilities provided by the current technology are only used to implement the same content and the same method… The assignments given and the content of the assignments stay in the same place."(I2)

> "We did not update the content and method of our lessons… At the moment, we are trying to do the same courses only on the net. " (I7)

The dominant view was that there was no fundamental change in the curriculum regarding the pandemic and the same content was transferred with different tools. However, there were also some other views. One responded noted that s/he preferred not to open one of the elective course s/he given as it includes applicational parts where students were building some structural structures and testing their system behavior. It is thought that the course would not be productive as the practical part requires being in the class environment. As a consequence, this elective course did not open (I4). The

loss in the alternatives in elective courses is interpreted negatively from resilience perspective as it is expected to prevent its function and even grow in the face of the disturbances. In this context, a resilient education system is expected to continue existing studies with minimum damage and even develop the curriculum, for example by creating new elective course alternatives or developing course contents. The opening of Coursera Courses in the Department can be seen as a positive example of creating new alternatives for students. During the pandemic, TOBB ETU offered Coursera Campus membership that allows accessing many online courses and earning licenses. This opened an opportunity for students to attend various courses in their area of interest. By the end of 2020, 1553 students had taken 10902 lessons, and 1876 licenses were given, which shows high interest in these online courses (Öztoprak, A., personal communication, September 21, 2020). Adopting the vast course diversity on MOOCs promoted resilience as the course diversity increased and it gave more freedom to students to build their own learning paths. This also reflects the positive influence of networks in increasing resilience.

Additionally, one of the views suggested that there were developments in the curriculum on module basis. For example, it is noted that the "Architectural Design, Presentation, Research Methods and Techniques" module was developed due to the increasing need to improve students' self-expression during the pandemic. For this purpose, the density of the module tripled, and the teaching of more software was included in the curricula (I3). Another change was reported in the Building Technologies II class. In this case, the course content was reduced during the pandemic as it is seen in the early stages that the productivity of students decreased in distance education. As a result, I3 noted that "I s/he reduced the course content by one third, but I tripled my the efficiency. . I want a third of what I used to want in Building Technologies II class, and we had better results and reactions" (I3). These examples reflect the adaptation of course content and even the improvement regarding the pandemic as expected from a resilient system.

A remarkable insight from the interviews was that architectural education did not undergo a main transformation during the pandemic as expected due to the misunderstanding of the main challenge. In this interview, the state of architectural education in the pandemic is compared to that of a man having a heart attack. In the early semesters of the pandemic, emergent methods were applied in order to continue the lectures and to solve problems that needed to be solved urgently. This simulates firstly bringing a patient to life whose heart has stopped. For that moment, his heart beats, he breathes, and his brain is working, but coming back to life is another thing. Thus, there is a need to investigate the underlying causes of heart attack, the real reason, which is missing in this situation now (I7).

As in this example, there is a need in architectural education to identify the problems and challenges correctly. In this situation, the main problem is not the pandemic but the delay in the expected transformation of architectural education. Architectural education needs a transformation to keep up with the new digital world. It is argued that these tools were ready for a long time, and if architectural education was transformed alongside with technological developments, there would not be such an emergency. In this manner, if the needed transformation of tools, methods, and curriculum had already been done, maybe the pandemic would not have been such a disturbance. In this sense, as reported in the interview, the pandemic has actually created an opportunity to understand the real problem, rethink approaches to architectural education, and create a new awareness of technological developments.

It could be said that the pandemic experience led to increasing the resilience of education systems by triggering discussions on architectural curricula and revealed the need for transformation in line with the digital developments of our age. Moreover, it is observed that the transformations in the curriculum characteristic of architectural education are mostly course-based and highly depend on the instructor of the course. Particular efforts such as reducing course content and including more software to improve students' self-expression in distance education are some examples of adaptation. The course-based alterations in the content reflect that the pandemic

experience increases the awareness on the difference of distance education from face-to-face. It is believed that these attempts could contribute to the resilience as it creates a new version of courses that is more suitable for online education which could be beneficial in the future in the face of similar disturbances that online education is needed. Moreover, it is believed that the comment on the decrease of attention span is also valid in terms of the character of the new generation of students. Thus, it is suggested that there is a need of re-think and update the curriculum of architectural education not only in terms of pandemic, but in a wider perspective that includes the changing learning habits of new generation of students, the developments in technology, developments in architectural practice, and changing priority skills, knowledge, and abilities.

4.5.2 Tools

Adopting digital tools enabled maintaining teaching and learning activities online in this period. Without current technologies that made distance education possible, education could have been suspended completely. In this manner, it could be inferred that the facility of adopting new tools and software alongside with the ability of using them is a vital element of resilience in general as they reduced potential learning losses and enable online learning during the pandemic.

One of the repetitive comments was about the limitations of distance education in terms of communication and interaction. Especially in the architectural design studio, it was noted that losing the studio environment and design tools such as models negatively affected both the design processes and communication. The interaction loss and effects of the lack of environment will be examined further in the upcoming sections, but it is believed that the main reason underlying the criticism is the resistance to the change of the tools. There is a difference between being able to continue education in an emergency situation and providing a quality education that fully meets the requirements of architectural education. Architectural education requires a high level of interaction in multiple scales and facets, including the interaction between

different actors (students, instructors) and with the design. Moreover, active participation and continuous, mutual communication is essential in design courses.

It is observed that there is a lack of a comprehensive and radical transformation in terms of tools utilized both for educational purposes and in the design process. It is argued that there was not an essential change in the tools, except for the introduction of Zoom platform which is utilized merely for transmitting the same information over the internet. Moreover, some of these tools, including Zoom, were the same as those utilized in other disciplines. It is clear that as the educational needs, character and structure vary from discipline to discipline, the tools should also be varied accordingly. In this sense, there is a need for the utilization of more specialized tools suitable for the needs of architectural education. Architectural institutions should experiment with more diversified and specialized educational, communication and design tools in order to increase their adaptation to disruptive events. One of the respondents noted: “These digital communication tools need to be strengthened and transformed. Even the distance education tools which we can call the best at the moment are actually very primitive, too simple and inadequate.” (I5)

Moreover, there is also a need for variation in tools that are utilized in different courses. It is clear that the characteristics (content, environment, interaction) of, for instance, History of Architecture course is significantly different from Architectural Design Studio. Thus, while the use of Zoom could be appropriate for architectural history course, different tools are required in Architectural Design Studio. Some of the reviews also support the need of specialization in tools of different courses. Students evaluate the situation in accordance with the level of the needed interaction. The first group includes courses which are; more verbal, more technical, and where students only listen to the instructor and do not actively participate, don't produce anything with instructor or with other students, and one-to-one communication is not mandatory such as courses from module 2 (Architectural Culture, History and Theory), courses from module 3 (Architectural Design, Presentation, Research Methods and Techniques), or university electives such as foreign language courses. The second group include the

courses which are more practical; where students draw, made models and require to study together, and mutual communication and high level of interaction needed, such as Architectural Design Studios. The new facilities made possible by digital tools have been positively interpreted especially in the first group of courses where interaction between students and with instructor is not considered important. For these courses, the use of digital tools during the lectures brought some flexibility in architectural education in terms of resources, time, place, access to knowledge and dissemination of knowledge. However, the tools used in the second group of courses are considered inadequate as they limit the interaction.

One of the repetitive arguments by students and instructors was that they could attend to the lectures from everywhere which brought flexibility both in space. Moreover, lectures are saved and published alongside with the digitally shared class materials. This made participation and knowledge more accessible from everywhere and in anytime. While students found the opportunity to repeat the lecture and study better, the instructors found the opportunity to share documents faster. For example, a student noted: “In terms of history of architecture, it is better to be lecturing in this way because we are making presentations, and everyone sees the images well. Here we can look at the screen, record images, and we can remember better” (S9). And an instructor notes: “(this situation) enables a large number of people to access information (from the lecture) easily and of high quality.” (I5).

It is believed that the distance education process is more difficult in architectural design studio as the tools adopted do not provide the required level of interaction. For example, one student expressed that as: “having a computer in between makes communication difficult, it makes even a simple conversation very difficult, so this process is more difficult in practical courses.” (S1). In this manner, there is a need of tools that allow interaction in different levels, between different actors simultaneously and support both formal and informal interaction such as in the studio environment. As one of the instructors underlined; “..maybe we need to have a ground that can provide this interaction (informal and multiple) with students. I think that informal

grounds are not supported by online platforms in this sense. “(I1). It is believed that this issue is related to the tools that are utilized.

It is significant that there are more positive feedbacks in the courses where different tools are tried. For instance, the utilization of Minecraft education edition within the Basic Design Studio provides a good example. In this experiment, the first semester of the first grade completely moved to a video game platform, Minecraft Education Edition (MEE) and the exercises practiced both inside the platform and in the traditional sense (I2). It is remarkable that this is a game-based learning platform instead of a design platform which supports developing cooperation, communication, interaction, and creative problem-solving skills. In this manner, this experiment reveals the need for developing cognitive skills. It is also noted that MEE has been a very useful platform in terms of identifying the individual differences of the students, organizing the learning environment for these individual differences, and to construct a learning process that students can individualize. Supporting individual differences and creating new domains for interaction which are essential in architectural education, showed that this example is very positive in terms of increasing the capacity of resilience.

Additionally, it is claimed that although the technological innovations and tools are ready for a significant transformation in education, there is an update problem (I7). A number of tools have existed since the 60's and various studies have been carried out, but we are slow in developing methods accordingly and keeping the pace with the technology. One of the instructors noted: “I think that all kinds of systems and tools are ready in order to ensure that the course is not disrupted.” (I6). The tools utilized during the pandemic were actually there for years and it is believed that being familiar with them before such a disturbance would ease the adaptation process. It is claimed that for building resilience in architectural education, there is a need to follow technological developments regularly, and utilize new technologies before the disturbance occurs. It is also observed that in the courses that digital tools are already in use the adaptation process were easier. Moreover, both students and instructors

found the transition to distance education not as disruptive as the other disciplines as the digital design tools used during the pandemic were already in use before the pandemic. For example, some of the arguments from respondents are:

> "Whether I do it at school or at home, since I present the things that I need to do in my projects in digital environment anyway, I did not experience any difficulties in this process." (S4)

> "In fact, since we always produce digital things in our critics, apart from physical models, many of our criteria are successful… This is also true for the jury." (S7)

> "a large part of our application area is already in the digital environment. There is very little left that we physically produce. I took that little thing apart (such as physical model) but any work involving architectural presentation, expression and expression techniques is mostly in digital… (thus) I think that these digital distance education processes are positive." (I5)

As noted above, it was easier to continue the digital practices that are in use before the pandemic. Considering how digital tools that are already in use ease the transition to distance education during pandemic, it can be claimed that if more of the technologies and new tools were integrated into education, the adaptation process would be easier. Moreover, past experiences with different tools facilitated adaptation because the decision-making process was accelerated. While most of the courses goes through an adaptation and decision-making process in terms of what tools to utilize and understand the advantages and disadvantages of digital tools, the ones that already experienced with such tools had a smoother transition process. For example, I2 noted:

> "I am using OneNote classroom notebook, a platform of Microsoft, actively for 5 years. That's why we didn't have a problem in transferring the works to the digital environment… I was also doing online jury two years ago… As we

were already using the tools of this (digital) environment intensively, there wasn't much change for us in that sense" (I2).

Moreover, habits and awareness towards new tools were gained and different tools experienced. The experimentation of different tools with their limits and including them in the architectural education influence resilience positively in different ways. Firstly, in the case of a similar disturbance in which the education could not be continue face-to-face, the adaptation process would be easier as the limits and use of the different tools are learned. Secondly, the conservatism of academics through new tools and methods are mostly broken which enhance the flexibility. Most of the respondents noted that they have the opportunity to saw distanced education is possible in some of the lectures which would not be discovered without such an emergency. As it is noted:

> "We started to use digital platforms more effectively and competently. We have seen all the software, teams, zoom, WebEx, Meet, everything. (We have seen) which program should be used, what is advantageous and what is disadvantageous. In this sense, I can say that our knowledge of computer technology has improved." (I6)

> "(at the beginning) I really didn't know what to do, how to manage, and I had no faith, that such a thing was possible… And when we started, I saw that it could happen" (I1)

> "Positively, we saw that in emergency situations, for example, in case of a lecturer going to a congress or conference abroad, or in case of being physically unable to attend the class for his/her own project, we saw that this work can be done online like this" (I6)

There were also developments during the distance education period, and tools were transformed as the limits of them discovered and challenges experienced. To continue to experience different tools and utilize new ones through the pandemic situation

reflects that the adaptation is a continuous process. For example, in one of the architectural design studios, in early stages of pandemic, it is experienced that the Zoom platform is not allowing separated group working and the students could not continue their work during the critiques as it was in studio environment. This problem solved by utilizing a new system in Zoom called 'rooms'.

Moreover, it is also noted that both the students and instructors adapted to the use of digital tools throughout the pandemic which reflects the resilience capability of actors. Especially students have adapted to the situation faster and with more ease. Additionally, considering the wide variety of answers on tools, both differs on the course basis and by respondents, it is seen that there is no single tool that can solve everything. In this respect, diversification of the tools according to different orientations and profiles of students and instructors, and diversification according to the special needs of the courses, diversification even within the same course (for example in different design processes or in different learning activities within the same course) would help to enhance resilience. If different applications and tools had been tested and experienced before pandemic, it would have been much easier and fast to adapt to the distanced education process. In other words, if we have been equipped with a variety of tools that are tried and approved, we could have quickly switched to them. Still, it is believed that the pandemic took architectural education at a certain level against similar disturbances that could require distance education by forcing the use and testing of different tools. Moreover, it is seen that particular adaptations and individual efforts such as utilizing Minecraft education edition (MEE) have a significant role in enhancing resilience. Thus, it is believed that there is a need to promote such individual experiments more and encourage instructors in this manner.

4.5.3 Learning environment

In terms of learning environment, it is clear that the environment in which the education takes place has moved from physical to the virtual settings. With the loss of the physical environment, architectural education is influenced negatively in many aspects and one of major disruption was on interaction. As it is noted:

> "There is a spatial problem when there is no place for education, there is no interaction environment… If there is no space, there is no sociability, and if there is no space, there is no interaction… Therefore, education lost its place and gained a different kind of spatial content. *This is the most fundamental change*." (I3)

Apart from the transition to virtual environments, there have not been a fundamental transformation in learning environment in terms of instructional techniques, educational approaches, assessment, and course duration. For example, giving critics in architectural design studio were very similar to the conventional one. As it is noted: "For the design studio we follow a method in which we divide the students into digital rooms and walk around the rooms in a certain order… In the conventional one too, everyone was standing at the tables and we were walking around the tables in the physical environment. Now it's a digital version." (I5). Another example could be given from a theoretical based course: It is noted for architectural history course that not much has changed in the way the lesson is run, in the methods, and in the duration. It is continued to use PowerPoint presentations but instead of in the classroom environment, in the computer environment (I6). Similarly, it is noted for the presentation and expression techniques course that the method is very similar to the conventional one which occurs in the physical environment with slight differences. In this regard, the feedback processes occur asynchronously as it is not possible to walk around the desk and look at the projects of each of the students in virtual environment as there are 45 students. The lecturing, the implementation of student work and questions occur synchronously as it was in conventional one, but differently, the final works evaluated asynchronously (I5).

It can be clearly stated that there is not a fundamental transformation in instructional techniques and the change in feedback processes based on the shift to distance education. However, the virtual environment is significantly different from physical one such as in terms of facilities, features, and setup. Thus, there is a need for change in the educational practices accordingly. Moreover, pandemic is a unique emergency

situation that distinguish both from face-to face education and distance education and requires specific measurements accordingly. For example, due to the curfew many students faced difficulties to access supplies, equipment and materials that used for model making including cardboard, foamboards, laser cutter, 3d printer etc. It is expected from a resilient system to develop new approaches in line with the emergency situation and needs of online education and transform architectural education. Thus, the resistance to the change in learning environment is approached as an unfavorable situation from resilience perspective.

Although the conventional methods were replicated in the digital environments in general, there were some particular adaptations. For example, in Building Technologies I course, the kitchen was turned into a kind of architectural laboratory, a place of design. It is noted that, the kitchen provided a great infrastructure as this course is mainly based on concepts (I3). Students designed and cooked their own meals and, a cook listened to their meals one by one. Then all experience connected to the architecture. This attempt approached positively in terms of resilience as it adapts to the new setting by creating an alternative production environment (kitchen) that all students could access.

Moreover, it is believed that some elements of architectural education do not go through a transformation due to their pre-existing flexible structure. For example, there has not been a significant change in assessment methods, but it is believed that the existing process-based strategies to measure learning used in TOBB ETU Department of Architecture have the capacity to bend and is adaptable to the current situation. It is argued that the evaluation methods which are based on the regular submissions (homework) and presentations were more prone to distanced education compared to the exam method and they are adapted to the new situation more easily. Comments of students which are criticizing the exams of other departments while favoring assessment method of architecture department support this argument. For example, for the courses of the Department of Architecture it is noted:

> “the submissions are mostly online, and it was not like a visa and final exam for us. It's easier because I make online submissions every week. So not much has changed as architecture was already proceeding more on submissions. “(S9).

> “I don't think it's much different the assessment and evaluation in architecture since it was already over the submissions or the juries. I don't think architecture has changed much, but there are exams in other courses which is a very challenging process” (S1)

Moreover, the assessments in TOBB ETU department of architecture measure learning, instead of the knowledge and based on the process. For example, evaluation of projects in Architectural Design Studios is inherent in design and based on titles such as the way of expression, the depth of the design, how mature it is. Similarly, the evaluation in architectural history course based on the criteria such as the originality of the students’ own idea, the diversity of the sources they used, the reliability of the references they gave. This prevents the problem of cheating, and prevent instructors from taking extraordinary measures to prevent cheating. On the other hand, in some other schools or departments the exams are used as the assessment method, which is not suitable in online environment. The assessment methods in elective courses from other departments were extremely criticized by not being able to adapt to the new situation. This was challenging both for students and instructors. For example, it is noted:

> “we have moved to something new, we have moved to a digital environment, but they still send us a paper. They say print it out on a paper, write it down than take a picture and send it.”(S4)

> “ for the elective courses from other departments , we can say that it (the assessment process) was challenging… It is a digital environment that we are not used to and we are subjected to an exam on it, it's like two exams in a row”(S10).

Here “two exams in a row” refers to the required abilities for having exam in digital environment in addition to the management of the requirements such as using extra cameras, being in an isolated place, proper use of digital tools etc. This reflecting that the existing exam system of university electives failed to adapt to the new situation compared to the submission method of the Department of Architecture as they replicated the same methods in the digital environment. Moreover, it is remarkable that the assignments and submissions given in department of architecture vary according to the courses which contributes to enhance resilience. It is highlighted:

> “there is no written exam, a presentation sheet and animation may be required, and since this is a process that can change for each project, it remains more flexible. In that regard, I can say that I find it flexible in general and that we had more comfort on that subject. “ (S5)

In terms of the juries it could be inferred that they are not completely adapted to the pandemic situation. For example in the juries students reflect5 minutes -10 minutes records taken before. This disrupt the interactivity as a student noted: “During the presentation, maybe something comes to our mind at that moment, or we listen to the previous jury and want to add things, but we cannot reflect it directly because it is recorded” (S2). There are remarkable statements on the loss of flexibility in juries by the means of the communication, simultaneity, and spontaneity. For example another student noted: ““While we are talking, we improvise at that moment, and this can often affect it in a positive way…But I think that we did not go beyond what we wanted to tell in that sound recording so the teachers were limited there and made comments accordingly.” (S5). As the communication limited the with the screen, there have been a loss in means of communication such as nonverbal communication and interaction through physical model. With these limitations, the interaction become more vulnerable. Moreover, as the simultaneous and spontaneous activities disappeared, the juries partially lost their richness and became more rigid. The loss of flexibility, vulnerable interactions and became rigid are interpreted negatively in terms of resilience.

One of the instructors compared the loss of simultaneous and spontaneous activities as the loss of “whisper”. Accordingly, it is noted:

> “For example, if a professor says a word there, "introversion" for example during the jury, I can catch that whisper from there and say "you are right, look, we are doing this" at that point… that whisper is not there now, everyone has to wait for their turn, so that it does not overlap... *This situation prevents several parallel activities from running at the same time.* What I mean by parallelism is that someone's touch on the model there, or drawing something on the presentation sheet, but the other continues it through the presentation. Now the focus is on one place, only one point is spoken. Alongside it, we lost the work that went along, one after the other.” (I1)

In other words, it is criticized that while in the studio environment, the jury members have the facility to observe design simultaneously with the presentation by exploring presentation sheet and physical model, the current implementation of distanced juries dictate the uniform exploration of the design projects. it is clear that there is a need for the exploration of new tools and approaches to break this monotony and open up spaces for simultaneous and multiple exploration of projects in different dimensions.

Additionally, although the educational tools and design tools changed in order to be able to continue education online, these utilized tools were not enough to conduct some of the learning activities. When shifted to distance education, both the students and instructors noted they have made changes in terms of expressing the design, physical models, and presentations. For example, the physical models were extracted from learning environment in some design studios. Physical model is both a learning tool and a design tool, thus the learning process disrupted in many aspects in the absence of it and evaluated as a huge loss by many instructors. It is noted that with the loss of model, the sense of scale lost in students as they can't get the sense of scale on the screen (I1). Some other schools were continued to the model making and continued the learning process from the model. This were not possible in TOBB mainly it is noted:

> "We work as a group and when we give a big project, students need workforce, so two or more people are needed to complete that model. Maybe if it's were a smaller project that student could working alone, they probably continue to make models." (I1)

Here, it is mentioned that if the methods had changed, for example if the scale of the project were adjusted to be suitable for the work of a single student, the making of physical models could be continued in the pandemic. From this point of view, TOBB ETU could develop some solutions for model making to adapt to the situation. To abandon such an important element during the pandemic evaluated negatively from resilience perspective. Moreover, the loss of physical model interpreted negatively as it led to a limitation both in learning activities, design tools and interaction. It is expected from a resilient system not to abandon the existed methods, on the contrary include new ones in the face of disturbances. On the other hand, students demonstrate a level of adaptation to the loss of model. They covered the deficiency in expressing the design by developing their 3D presentation skills. It is noted:

> "This environment has greatly improved the language of architecture. So, they (students) draw very well and express themselves very well now… 3D expressions are much better than in the past. "(I3)

Additionally, the loss of physical environment influenced the instructional environment in different aspects, for example in the means of the educational practices, follow up the course, control of the class. Conducting all the activities in online disturbed some activities due to the limitations of devices and accessible technology. For example, even some courses students are doing various applications during the lecture. In conventional face-to-face practices, students have their computers in front of them and the instructor shares the presentation on another computer but during the pandemic students need to both following the slides, or instructor and working on in their computer. It is hard to carry on both practicing such as in Revit and following up the lecture from the video conference at the same time in one screen. It is also harder to carry on simultaneous activities in one device due to the capacity of computers. In

this sense students need dual screens (I1) and “computers of students could not carry on the process, overheat, and students cannot maintain both the presentation and their own simulation on two screens... They cannot follow the course content.” (I1). There is a need to change educational practices considering digital infrastructure that include the features of devices and the type of available devices (computers, screen, printer etc.).

In addition to some of the limitations in terms of learning environment that are mentioned above, some new possibilities which are provided by the digital technologies are also discovered such as multitasking, flexibility in time and place, flexibility in class arrangement, access to resources. Especially the flexibility in time and place alongside with multitasking positively influence both formal and informal learning environments. Flexibility in place refers to the opportunity to attend any lecture, symposium, interview etc. in everywhere without the physical limitations such as transportation, budget, accommodation both for students and lecturers. And flexibility in time indicated the opportunity to access any digital resource, recorded lectures, course content etc. in any time. In this manner, the number of online activities such as seminars, symposiums are increased. Not only the number of the activities but also the participation of students is increased (I1). This is probably because following something online is easier in terms of transportation and it allows to multitask. As it is noted: “when it is online, we see that people are listening, even if they are eating” (I1). Students also noted that they are more actively participated in these online activities. For example, students noted:

> “I can meet people who cannot come to the school in the juries... Normally this is not that popular, let's participate in such conversations from distance, from YouTube or zoom but now there are plenty of them, I come across with the interviews of excellent people. They also join in our juries and I get the opportunity to talk to him one-on-one.”(S3)

> "In my opinion, the best part of online education is that different teachers can participate in the lesson. Different teachers from different cities can attend the lesson and enlighten us on different subjects."(S9)

Moreover, some practices opened up to public. For example, TOBB ETU department of architecture broadcast juries live on YouTube[23]. Thus, both formal and informal learning environments expanded and become more accessible which triggers the sharing of knowledge and experience. Additionally, it becomes easier to invite lecturers to the courses and juries from different universities, cities and even countries. In other words, the students had the opportunity to benefit from the knowledge of a more diversified group of people due to the advantages of being online. The participation of different people to the lectures and juries evaluated as one the best practices brought during the pandemic. Actually, the tools and systems were ready and already in use, but they became more common during the pandemic. It is noted:

> "Because of the physical distance limitation, it used to be a big thing to invite a teacher from another city to a lecture… (Now, it is very easy) In that sense, this was an expansion..." (I4)

> "We have become able to invite members of the jury to the studios, who were never in our lives, from abroad or outside of Ankara, as invited speakers. I can't explain the plus of it."(I1)

The increase in informal learning environments and the opportunity to interact with different people is considered positively in terms of resilience as it increases the variety and number of learning resources.

[23] accessible from https://www.youtube.com/results?search_query=tobb+mimarl%C4%B1k

Moreover, the accessibility of resources increased as the knowledge is accessible from anywhere and anytime in the web including the access to course materials such as the lecture records. Actually, the accessibility of knowledge was increased since the invention of internet in 1990s but it become more common during the pandemic. In this manner pandemic led to an awareness of that there are numerous resources on the web. As it noted:

> "It's like the whole world is at your fingertips. Immediately, all conversations with the students were recorded. of course, in the past too, for example, a professor in Cambridge was giving a speech and record… (but) It was more restrained, limited. All of a sudden, those barriers were lifted." (I4)

Lastly, the virtual environment had the potential of renewing hierarchy and educational approaches which could be very revolutionary in terms of learning environment. The influence of online education on class arrangement is already observed by some of respondents :

> "everyone is sitting in the front row now... For example, in the Architectural Culture, History and Theory course, the instructor sees all the students in front of him/her which can't do that in class. In Architectural Design, Presentation, Research Methods and Techniques courses, the student was seeing what the teacher was talking about by looking at the slide screen all the way behind the table. now there is no such thing, the teacher can directly interfere with everyone's own screen." (I3)

> "I can bring the file I want in front of me at the computer. I can enlarge it as I want. I can manipulate it. I can draw new things... Of course, this also happens during the jury. This allows a lot of people to have a lot more control over the project presented in the jury because we are at the same distance to the projects."(I5)

One of the adaptations in learning environments was in terms of the lecture duration and group members. For example, in one of the design studios, the duration of the juries limited with 3 hours by increasing the number of groups and number of instructors (and decrease the number of students in each group). This new structuring made after experiencing the adversity of crowded groups in juries in the beginning of the pandemic (I3) which reflected the adaptation process to the pandemic situation and learning from it as expected from resilient systems.

In general, there was no fundamental change in learning environment in terms of instructional techniques, educational approaches, assessment, and duration. Besides, there are remarkable statements on the loss of flexibility in juries by the means of the communication, simultaneity, and spontaneity. And the physical model was lost, thus the learning environment was limited in some respects. However, it is expected from a resilience system to able to develop new practices and adapt to new situation. Moreover, the learning environment, methods, duration, learning activities, learning process, assessment varies in different courses, especially in the practical and theoretical basis in conventional architectural education. It is believed that this variation in methods and approaches between courses became limited during the distance education which leads to homogenization. It is argued that there is a need for diversification in distance education similar to the traditional face-to-face one in terms of learning environment (includes methods, assessment, learning activities etc.) in order to be more resilient.

On the other hand, it is believed that the pandemic positively impacted the resilience as it provided re-thinking of the approaches and methods of architectural education regarding the requirements of our age. It is argued that the existing process-based assessment method not changed as it already has a flexible structure and is applicable to the distance education. Moreover, the potential of open and online activities discovered and both formal and informal learning environments expanded in number and variety. In this respect, the increase in sources and the sharing of knowledge are valued in terms of resilience perspective. Some particular adaptations in course base

such as decrease in course duration d in order to adapt the decrease in the focus time are also evaluated positively in terms of resilience. Lastly, it is believed that the experience of distance education during the pandemic would be beneficial in the face of future disturbances. In a situation that fa-to-face education is not possible, the experience here will be used instead of constructing everything from scratch. In this manner the pandemic experience contributed to the resilience to similar disturbances.

4.5.4 Interaction

The lack studio and university environment negatively affected interaction in many aspects. Circumstances such as the decrease in the means of communication, in the domains that allow interaction, and in the chance of randomness alongside change in feelings such as commitment to the lesson, belonging, and motivation negatively affected the resilience by limiting the interaction and communication between the actors of architectural education. However, the flexibility in time and space brought by the digital tools allowed to make new connections, collaborations and to involve new actors which interpreted positively in terms of resilience.

Interaction is disrupted in different aspects including the decrease in the means of communication. The communication occurs in different ways including the verbal and nonverbal. Alongside with verbal communication, nonverbal communication occurs through facial expressions, body language and posture, gestures, eye contact, paralinguistics (loudness or tone of voice) , facial expressions, touch, personal space, appearance, are a part of the communication and form a whole. However, tools used during the pandemic mainly limit the communication and allowed only certain things to tansfer, such as only text, and even the camera open, most of the verbal communication is lost. In this manner, with the decrease in the means of communication, the flexibility of interaction also decreased. Many of the respondenents (Both students and teachers) noted that they lost nonverbal communication. For example it is noted by instructors:

> “When I was face-to-face with students, for example, because of the smallest gesture on her face, the smallest thing, which is when I turn my eyes lightly in a classroom, I could understand for example if s/he didn't understand the subject, or something else was on her/his mind at that moment, s/he wasn't here... (Now) I couldn't feel it.”(I1)

> “(Body language and eye contact) is important pedagogically. Because you can at least confirm whether it has passed on to the person in front of you with facial expressions, nodding, or laughing when you make a joke. I think this is one of the biggest problems we have (during the pandemic).” (I6)

Similar comments made by students, for example it is noted:

> “we could normally express ourselves much more easily... I think it's a little difficult when we don't use our body language.”(S7)

> “While we were talking in juries… I use hand gestures a lot. I think this is (communication) more effective when standing at the board. But I think, most of the things do not be reflected to the others in front of the camera”(S5)

One of the reasons for the disturbance of the interaction could be seen as the lack of creating a new environment that provides the communication ground similar to the the one provided by the studio and university environment. In this sense, what is expected from a flexible architectural education system is to include different tools that create alternative communication channels and allow different means of interaction even in the emergencies. As discussed above, different educational approaches such as the inclusion of the game in the education process and the use of different tools such as minecract education edition have gone beyond imitating the studio environment and established a different ground for communication and interaction. It was noted that: “Instead of looking at each other on Zoom, interacting with our avatars in the game allowed us to solve many issues very quickly.“(I2). Moreover it was observed that while walking around the places in the game, students give way to each other although

avatar is a virtual thing that can pass through each other. For example when a student comes across me or a friend when he is going through a door, he waits to other to pass which reflects the feeling of "being in there" (I2). There is also the change of choose the appearance of the avatar. In this manner, it is remarkable how a digital environment could open space for nonverbal communication such as body language, personal space, and appearance. Further, the use of Miro platform in TOBB ETU Department of Architecture Studios to store and present studio-process and outcomes, and to communicate, can be seen as another attempt to find an alternative interaction way.

Another reason that limits communication is the absence of physical model from design process. Physical models is one of the important means of communication in architectural education that allow to examine the design from different aspects and allow to communicate with the design. In this manner, it is remarklbe that how the physical models contrubited to the flexibility by ensuring random and open discovery of the design. It is noted that the absence of pyhsical models negatively affected the interaction in different stages of design and different parts of learning activities including the group work, critics, and juries. For example, it is noted that:

> "I think we have more time and more opportunities to express ourselves in face-to-face… because we express ourselves through the models. And the teachers examine the model, they turn it around and discover something (else), they have the opportunity to look from other directions than the perspective we showed."(S5)

> "I had the most difficulty in the design studio because I think it is a course that needs to be studied and take critics together. I don't think we can solve anything by writing with a pen like this. (for example, in group assignments and critiques) it is very different when an instructor show something to you on a model or by doing something on model near you. And It is very different when instructor says that you can do something just by drawing like this (in online)… This is why it is very difficult to undertsand and express … it is in the same

way in the jury, we do not understand enough what is being said because they try to draw it with a pencil" (S8)

Similar perspective also noted for sketching, for example:

> "I think that being one-to-one is more beneficial in design classes, in building classes, in classes where we draw and make models… (Now) I can't explain exactly what I want. Sometimes it takes an hour or so to agree on something that we can produce very quickly when we are together. (S3)

> "It is very difficult to carry out a project when we are a group and from a distance. When I could drew, we could draw together on a piece of paper in the same place at the same time we were able to develop our design together… (Now) since we can't draw on the same paper, everything moves much slower." (S9)

During the pandemic, other than the decrease in the means of communication, there have also been a decrease in the domains that allow interaction. In architectural education, information exchange does not occur only in class environment but also in studio and university environment, in corridor, library, canteen etc. The random encounters in such places form an important part in generating and transmitting school culture, and in the transition of non-verbal architectural knowledge. The decrease in these domains have limited the interaction between students and negatively affected the learning process as peer-learning is one of the fundamental elements in architectural education. However, it is expected from a resilient system to preserve different interaction domains and learning activities and even developing these in the face of disturbance. As one of the students noted:

> "At school, for example, there were models in the classroom and in the hallway. There were exhibitions of others, there were exhibitions of other classes. We were saw them and we were inspired by them. For example, we were saying, "We can make progress like this, how well they did it". I think

they are very few now. I think it is more difficult for us to see someone else's exhibition and interact it now." (S9)

Decrease in the interaction domains and in the chance of encounters also decreases resilience as it leads to vulnerable interaction. For example, it is more likely for a student to interact with others while there is more option such as canteen, corridor, studio etc., where students can share knowledge, motivate and inspire and advise each other. But this chance of interaction limited with the Zoom environment and limited within the lecture hours in the pandemic. Thus, in the face of a trouble in the lecture (for example the internet connection of student can be bad), the chance of communicate with others are less, compared to the university environment. In short, with the shift to the distance education, there have been loss of interaction especially in extracurricular domains. Students attempt to increase communication domains other than lectures by setting up digital chat groups (in different platforms such as WhatsApp, Telegram, discord etc.) which approached positively. A student noted:

"I'm really in great contact with all of them (peers). My phone has constant messages, it comes from groups… We are in constant contact with my friends, my group mates, etc. I feel like they are living in our house. Now their voices ring in my ears sometimes. We started talking so much." (S3)

Although students that took same courses and from the same grade continued their communication in a certain level, the pandemic especially disrupted the interaction between students from different grades. This negatively influenced the transmission of the unwritten architectural knowledge and school culture. To enhance interaction between students and transfer this knowledge, an alternative digital communication channel created by an instructor:

"The fact that the interaction between the students fell to zero had very bad results in terms of transferring the unwritten knowledge of that architecture to each other. I realized this one week after the semester started and I did something like this: I formed a group called Wolves and Lambs, that brings

> together our first, second, third and fourth year students… I wanted to create a kind of gossip environment. In the group, wolves taught the lambs topics like " this teacher wants that, this teacher does that… Professor X behaves like this, he teaches these..".(I3)

Another method applied in order to enable the transmission of the unwritten knowledge of architecture that normally transferred between students in university environments includes the direct sharing of previous student projects. The work done in the previous period were shared on purpose by instructor, which is never done before (I3). As it noted:

> "Previously the knowledge from the past, the inner knowledge of that course was transferred to transmitted to each other by students. Now as this interaction is broken, I consciously provided this to the students… in this crisis environment, it was important for me not to lose that information. "(I3)

It is observed that not only the interaction outside the lectures between students, but also between students and instructors are disrupted during the pandemic. However, in architectural education the informal communication has significant importance to be able to direct students in their projects. As it is noted by I1, as there is no truth in architecture and as it is endless the architectural education differs from other fields… Thus, there are courses that can be specific towards the student's interest. Losing the informal interaction with the students challenged instructors in this regard. It is noted that:

> "When I thought how the personal link was, it was through a meeting in a hallway, drinking a coffee, in workshops we were doing with these students face to face.. Since the education was not limited to only those lesson hours, I knew that student and could chat with him/her. I could know about his personality, who he was, what he had read… I lost that interaction and I don't know the student." (I1)

Although there are some experiments, it is believed that more effort should be taken in terms of domains of interaction to enhance the resilience. There is a need to develop alternative channels and practices that allows informal interaction between students and instructors

The loss of some domains of interaction also led to the decrease in simultaneous and spontaneous interaction. Being in the same environment enabled multiple communication at the same time and triggers the unplanned interactions. In this manner, the tools used during the pandemic do not allow simultaneous interaction, and the ability to carry on multiple interactions simultaneously with multiple stakeholders is lost. Moreover, the flexibility of communication is limited as the change of random encounter decreases and communications become more rigid that happen only in defined times and places. The lack of the accidental encounters/communications created by the university and studio environment are negatively affect the flexibility and resilience. From students perspective the interaction with instructors affected as:

> " We only meet with the teachers during class hours, or we will either send an e-mail or write on whatsapp... "(S1)

> "In our school, even a small activity that you will do after the lecture can take you to a different point with the teacher. Any conversation you will have can add a lot of different things to you. Unfortunately, it doesn't work in online. If you have something to say, you can have a conversation, but if you have nothing to say, you just hang up (zoom) and leave. But in school is not like that. Even after saying hello, we have the opportunity to have a talk, learn something or add something directly from a sentence that the teacher will give you, this is not provided online." (S10)

> "For example, when we were at school, when we went out into the corridor, we could encounter and chat with other friends. Sometimes we could talk about each other's projects or about our project, and when we found a teacher, we could get critiques. Now everything has to be planned." (S8)

Moreoever, similar comments made for the interaction between instructors. For example one said:

> "(In the university you encounter with) a person and tells you something or talks about a book, conference or something that he or she is interested in at that moment. So you are also interested. We lost that interaction. We lost those spontaneous encounters, that spontaneous interaction, because everyone started talking about defined topics at very defined times."(I4)

In this manner the interaction between studentds is one of the most impacted areas from the limitation in encountering. The studio and university environemnt offers opportunity to interact with other students' projects and saw for example different design solutions for the given problem. The lack of this interaction is negatively affect the peer-learning which is one of the main elements in architectural education. Students oftenly noted that noncirrucular activities are also indirectly influence their projects and creativity. Not only discussing projects but also daily activities and daily conversations are reflected in their projects, which is very limited during the pandemic. For example it is noted:

> "While we were side by side in the studios, at least we were seeing each other's project, or we can asking how someone was doing something while doing it. You were learning something, or we were able to explain and interpret our project to each other while walking on the corridor. We could say "Look, it would be better if you did that like this"... There was randomness there, so you could talk and argue with everyone as you walked down the hall."(S9)

> "Communication with friends has been reduced to the level of more planned and programmed interviews, now it is online and the randomness has decreased to almost non-existence. In fact, we, (me and my friends), think that we fuel on that randomness… for example, talking to someone while having a coffee at Starbucks, and we got distracted a bit, something could come out when it came

> to the problem, and we found it very enjoyable. we can't find it right now and we are missing it." (S5)

> "we do not get together specifically. During the school period, we didn't say, "let's get together", but we were getting together all of a sudden. This was making a huge difference." (S10)

Additionaly, it is noted that the lack of interaction also negatively impacted some feelings such as the motivation and commitment to the lecture and the sense of belonging. In this manner, some respondents compared lectures to uninteractive situations in which student- instructor relationship is absent such as youtube video (S4), or a newsreader (I4). One of the students noted: "The lack of the dialogue with instructors has somewhat changed my commitment to the studio. Normally, studio is a much more friendly environment, but now I feel like I'm a little further away when I enter from the computer." (S7)

Resilience carried on across scales, from individuals to systems (Davis et. al, 2021). More resilient individuals establish more resilient systems. Similarly, resilient actors help to build resilience in architectural education system. From this point of view, it is crucial to provide the necessary psychological support to the students and instructors during the emergency situations. Although there were comments on the adaptation to the tools and methods, this requirement was not expressed. However, it is noted that the feeling of isolation and solitude increased and there have been decrase in the motivation by time during the pandemic. For example students noted that:

> "I'm so bored right now. I constantly try to study in a different room of the house and change my desk so that at least my motivation will increase. We are both very bored and our days are starting to progress in a monotonous way. It is also very depressing and reduced our idea generation efficiency a lot compared to the beginning... There is nothing to feed me anymore although I try to fit anything I can into that screen: music, movies, TV shows." (S5)

> “Now that we have been at home for a year and a half, we see the lack of social life too much. For example, while I were studying more at first, I started to have more diffuculties in studing now. It is the same process, perhaps it is even progressed technologically. But for a year and a half, when you stay at home and do not have any social activities, you become more depressed and this make everything more difficult.” (S9)

Similar comments also noted by instructoes. For example:

> “There is no sincerity like in the classroom environment… We are deprived of things that can make the lesson a little more enjoyable, such as being in mutual dialog and saying, "Oh, your sweater is so beautiful". On the screen, I am teaching such a monotonous lesson as if I was teaching against a flat wall. I feel a lack of motivation rather than a loss of concentration in his narrative.”(I6)

> “We need a conversation without an agenda… This does not exist and it needs to be created as soon as possible because we are starting to become very mechanized and it is evolving towards losing our soul in this sense.. In this sense, I think there is a need for something like a meeting without an agenda, drink coffee and chocolate.. otherwise i break off (lost, i.e. in terms of motivation) “(I1)

It should be reminded that this is not a situation of distance education alone, but it should be handled together with the other facts brought by the pandemic such as isolation, anxiety, health concerns etc. To be prepared to the other emergency situations, the actors within the architectural educations should also be resilient and robust psychologically. As a benefical attempt, using MEE had also positively influence the students in terms of overcoming the feeling of isolation created by physical distance, the feeling of loneliness, and learned helplessness (I2).

Contrary to the arguments on the decrase of interaction that mentioned above, there are arguments on positive influence of distance education in interaction. The flexibility

in terms of time and place also brought a level of flexibility in terms of communication. In this regard, there had been some arguments on the fast communication, independent from place and time, and being able to interact with many people from other schools, cities and countries. Some arguments includes:

> "I think it increases socialization. In other words, we always call it social distance, but the necessity of traveling from one place to another, that is, we cannot travel because of necessity, but at the same time, the obligation to travel has disappeared… We can organize meetings with different people in different parts of Turkey or the world at the same time. This greatly increased communication and interaction. (I2)

> "(Now) We can reach the instructors and send a message at any time. But when we were at school, we were afraid to send a message if the teacher was not at school, we were thinking of asking the teacher the next day if we could not find the teacher at school at that moment. There was definitely a distance in that regard, but communication by phone increased more in online."(S5)

> "For example, our communication with the teachers started to become more comfortable, which is also positive. For example, when we send a message to the teacher and ask if our teacher can give a critique, they return more easily because they give critiques over the internet, they do not need to come to school."(S9)

Additionaly, the communication with the students in lecture were developed in some aspect regarding the features of the technologies. For example, communication become more efficient with features such as screen sharing, file sharing, preparing surveys or making quick quizzes, assignments, quick submissions and instoctors have the chance to receive digital delivery, especially over the "uzak" system of our university (I5).

It is believed that the architectural education could not adapt to the emergency distance education in terms of interaction and interviews supported that. There have been loss in tersms of means of interaction, domains of interaction and chance of randomness. There is a need to prevent such disruptions to interaction and strengthen communication between different actors in the times of adversity in order to be resilient. Different technologies could be examined and utilized in order to strengthen interaction and communication during such disturbances. Moreoever, adverse phycological affects seen such as decrease in the motivation and commitment to the lesson. There is a need to provide the necessary psychological support and promote indivudual resilience as it directly influences the system resilience. There have been also favorable developments from resilience perspective. The interaction with the experts and academicians from different schools, from abroad, strengthened which enhance the varity and number of interactions. Moreoever, particular experiments positively affect the interaction such as the use of avatar in Minecraft education edition, or the alternative digital communication channel created by instructor: Wolves and Lambs. These attemps were approached positively in terms of resilience as they set solid examples of adaptation that could be benefited.

5. EPILOGUE

This study examined architectural education from a resilience perspective, with the aim of providing insights to the transformation of architectural education in the face of disturbances. In this manner, previous and current (pandemic) disturbances as well as the evolution of architectural education within its genetic characteristics were examined. To this end, three interrelated processes are carried out within the study, which are; i) setting the framework, ii) architectural education from a resilience lens: learning from the past, iii) TOBB ETU Department of Architecture's response to the pandemic.

In the first part, the concept of resilience and characteristics of the architectural education (curriculum, tools, learning environment and interaction) are discussed, which forms a foundation for the study. An understanding of resilience developed in this section has been a guide throughout the study. It was also noticed that resilience is utilized enormously by numerous fields and with different approaches, but the conceptualization of the term in educational settings is not complete yet. In this manner, one of the unintended inferences of this study is that there is a need for the conceptualization of resilience in the context of education. Resilience should be clearly framed, especially in the field of architectural education, to avoid misunderstandings. There is a need for developing more studies in this respect.

In the second part, the transformation of architectural education in relation with the disturbances is examined. First, it is benefited from the developments of the Academie Royale d'Architecture, where Academic architectural education started, then its successor École des Beaux-Arts, and The Bauhaus. The examination of these leading institutions with a focus on the developments and disturbances that triggered their transformation helped to understand the adaptation potential of architectural education. For the period after 1930, the disturbances and the adaptation of

architectural education were examined in general with a broader perspective. It is seen that architectural education is in a constant change and transformation process parallel with the developments in the fields of technology, building technology, educational settings, social and political settings, and the architectural profession.

In the third part, pandemic experience of the TOBB ETU Department of Architecture is explored with the aim of providing a case and accessible data. The changes in architectural education are discussed in four characteristics with respect to the disruption of the pandemic. The results of the interviews can be summarized as follows:

Curriculum

- The curriculum needs to be designed in a way that supports individual paths. It should be designed and organized in a way that can be customized according to different interests different learning paces and ways. During the pandemic students have had the opportunity to focus more on their fields of interest. It can be seen that they developed themselves in the fields they want such as the language skills, attended the seminars they want from all over the world, and took courses from platforms such as Coursera.
- The curriculum and content of the lectures needs to be rethought and transformed according to the needs of the current age. They should be addressing contemporary problems, changing needs, living and communication ways of the new generation, and changes in architectural practice. For example, the curriculum may include more experimental and interdisciplinary studies. The courses may address multitasking character of this generation, who get easily bored in conventional classes.
- There is a need to include acquisition of skills such as critical thinking, problem solving life-long learning, access to correct information and self-learning. These are required in order to be able to adapt to changing conditions. For example, the ability to access to correct information and differentiate reliable source is crucial

in today's information world, where the access to knowledge is easy, but there is an information pollution. Similarly, the self-learning and life-long learning are some of the important skills in a rapidly changing world. To prepare the students for the afterlife of the university, there is a need to teach them how to find and also generate knowledge and educate themselves.

Tools

- It was also known before, but it became more apparent that there is a need of the high level of the integration and use of digital tools. Further, academicians need to have comprehensive skills about the digital teaching tools as well as the field-related tools such as digital design and fabrication tools. Tools specific to architectural education can be developed/discovered in accordance with the structure of the education. The pandemic experience shows that there have been difficulties especially in practical courses in which high level of interaction is required. Tools that are responding to the need of interaction can be increased and enhanced, or different tools can be discovered. Currently, either Zoom or Teams was used in all courses with different content and methods. These platforms can also be specialized according to the courses.
- The tools need to be diversified in terms of designing tools, production tools, and tools that are related to the architectural expression and presentation. Integrating different and contemporary digital tools and experiencing with the state of the art in terms of the tools would have a positive impact on resilience. It is observed that in the pandemic experience, TOBB ETU could achieve a certain level of adaptation because the decision process on which tool to use was faster and easier. It is not necessary to know all the tools but experiencing with contemporary tools from time to time would develop digital literacy skills and the ability to use and shift between tools. This would also enhance resilience, as it builds new digital habits and increases open-mindedness towards new options.

- The physical, digital and software-related infrastructures need to be strengthened. As it is mentioned, the more that there is knowledge and awareness about different tools, the more will be the resilience. The adaptation processes will be easier and faster when the advantages, disadvantages, and potentials of different tools are known. In addition, these amenities, environments and software should be accessible to both instructors and students.

Learning Environment

- There is a need to acknowledge individual differences. The learning process of students differs, and they learn at their own pace, with their own methods. One of the critics by instructors on pandemic was that they could not know student individually and run the process accordingly in design course. The learning environment needs to be designed regarding these individual differences and developed in a way that supports individual learning process of students.
- The learning style of new generations is different; they were born in information technology and their relationship with the information, access to it and processing is very different. For example, they get bored easily and could not focus on the topic if they could not relate with themselves. This aspect needs to be observed correctly and applications should be made accordingly.
- Personalization of learning process and thus the environment needs to be addressed. It is observed that the attitude of both students and instructors toward the online education methods were different due to personal preferences. Including different learning possibilities such as synchronous and asynchronous, and including different learning environments such as physical and virtual elements offer flexibility to learners.

Interaction

- Participation of the experts and academicians from different backgrounds, different schools to the lectures brought different perspectives. This practice needs to be continued to increase the resilience.
- It will be positive to keep the communication between different actors of the education. It is observed that the interaction between the faculty and the students, to be informed about the processes and transparency facilitates adaptation. However, uncertainty makes it difficult to adapt. In this manner students, instructors and administration needs to be in contact, which became easier in digital environments.
- Psychological support is crucial in the face of disturbances. Accepting the situation psychologically triggers the adaptation process. On the other hand, low motivation and emotions such as isolation, anxiety, have an adverse effect in the adaptation process. The increase in personal resilience collectively affects the resilience of the system positively.
- Interaction with other schools and people from the field has also positive effects on the education system and its resilience. Collaborations and networks with different schools, organizations, instructors can be strengthened. The adaptation process was easier and faster when the problems that faced, experiences and solutions in the pandemic are shared.

As mentioned before, the pandemic experience sets an example for resilience in terms of being able to continue educational processes when it is not possible to be physically in the school. In this manner, the developments in technology enable to continue education in distance. In this part of the study, it is observed that many individual attempts, experiments, and experiences have emerged during these times for particular courses or problems. All of these attempts are very valuable and contribute to the resilience by creating alternative methods, tools, and approaches. These singular examples need to be spread and integrated into the curriculum and architectural education system in general. In this respect, it can be said that a kind of adaptation

memory gene has formed during the pandemic. It is believed that the pandemic experience led to a level of adaptation against similar disturbances. For example, in case of repetition of scenarios where architectural education cannot be realized face-to-face, it will be easier and faster to adapt with the experience gained here. Additionally, the pandemic also revealed the significance of the actors (students, instructors) in the adaptation process, which is highlighted in the adaptive resilience framework. Especially the individual efforts of the instructors directly affect the adaptation of the lectures they give. When these efforts are gathered collectively, they affect the adaptation of the institution. Similarly, the self-resilience and adaptation ability of the students also influence the collective adaptation process. Therefore, it is suggested that individual resilience also should be considered within the resilience of architectural education. It is observed that the individuals directly influence resilience in two ways: i) due to individual attempts and ii) due to self-resilience. This also fits to the adaptive resilience framework where the adaptation process is mainly determined by individuals' ability to learn and organize.

Additionally, it is observed that the pandemic did not lead to a radical change in architectural education as expected. It is evident that not all the changes made during the pandemic will be sustained after the pandemic. What is expected from a resilience system is to create a new normal and carry what the system has learned from this disturbance into the future. It is thought that the most significant contribution of this process in terms of resilience is to trigger the already delayed digital transformation of architectural education. In this manner, many new possibilities are seen, online methods lose their novelty and tools that have existed for years are integrated into architectural education. It is clear that architectural education institutions could not simply return to previous teaching and learning practices after the pandemic ends. As expected from a resilient system, architectural education must not only survive the pandemic but also continue to develop and adapt to long-term changes. Continuing some of the practices and using this experience to develop new practices would strengthen resilience capacity of architectural education in the times of disturbances.

In this manner, the digital transformation of architectural education is not complete yet.

In conclusion, there are potential improvements in the context of resilience, including:

- Triggering the discussions on the need of updating architectural education.
- The status quo of tools, contents and methods are questioned.
- The conservatism of academics is mostly broken.
- The recognition of alternative educational approaches such as blended learning, distant education or virtual studio methods is accelerated.
- New educational approaches, tools, and learning environments are experienced.
- A database on different experiments and experiences which constitute a valuable infrastructure for the development and transformation of architectural education (prepare the ground for the change) has emerged.
- Education system is prepared better against similar disturbances.

The need for the education system to be prepared for uncertainties of the future and be resilient is a widely discussed issue. In this manner, this study aims to contribute to future investigations on the resilience of architectural education by investigating the current reaction of the TOBB ETU Department of Architecture against the pandemic disturbance. The transformation of curriculum, tools, learning environment and interactions are explored within this purpose.

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APPENDICES

Appendix A: The List of Disturbances

year	disturbance	disturbance field	disturbance type	aff. char. Num.	curric	tool	environ	intera	explanation
1671	Royal order	Political	shock	0					Academie Royale d'Architecture establis
1715	Enlightenment	social-economical	long-term	1	x				
1789	French Revolution	social-economical	long-term	0					Academie Royale d'Architecture closed
1793	The student outrag	social-economical	shock	0					Academie Royale d'Architecture closed
1819	Royal order	Political	shock	0					Ecole des Beaux-Arts was established
1820	The Industrial Revo	social-economical	long-term	2	x	x			
1835	Ministry of Culture	Political	shock	0					Ecole des Beaux-Arts was closed
1863	reforms of Napoleo	Political	shock	2	x		x		
1881	mass producation	Building Technology	long-term	1	x				
1890	Engineered Timber	Building Technology	long-term	1	x				
1900	pedagogical though	education	long-term	3	x		x	x	
1900	steel frame	Building Technology	long-term	1	x				
1900	First World War	War	shock	2	x		x		
1923	was hyperinflation i	social-economical	long-term	2	x		x		
1929	great depression	social-economical	long-term	2	x		x		
1932	Nazis	Political	shock	0					Bauhaus closed
1939	Second World War	War	shock	2	x		x		
1950	Reinforced concret	Building Technology	long-term	1	x				
1950	race and gender iss	social-economical	long-term	0					
1950	modern learning th	education	long-term	2			x	x	
1960	shift in the social ar	social-economical	long-term	1	x				
1968	The student outrag	social-economical	shock	0					
1980	robotics and autom	Building Technology	long-term	0					
1980	Innovative material	Building Technology	long-term	0					
1990	democratize knowl	education	long-term	1			x		
1990	new learning cultur	education	long-term	1			x		
1990	distanced educatio	technology	long-term	2		x	x		
1990	CAD	technology	long-term	2	x	x			
1990	computational desi	technology	long-term	4	x	x	x	x	
1990	Sustainability and e	social-economical	long-term	1	x				
1995	Personal Computer	technology	long-term	1		x			
2000	online degrees and	technology	long-term	2		x	x		
2000	BIM	technology	long-term	2	x	x			
2000	Virtual Reality (VR)	technology	long-term	2			x	x	
2000	Artificial intelligenc	technology	long-term	0					
2000	additive manufactu	technology	long-term	1		x			
2000	3D printing	technology	long-term	1		x			
2000	21.th century skills	education	long-term	1	x				
2000	Equality	social-economical	long-term	1	x				
2000	Cloud computing	technology	long-term	0					
2010	internet of things	technology	long-term	0					
2010	Digital twins	technology	long-term	0					
2019	Covid-19 Pandemic	Health	shock	10	x	x	x	x	

Appendix B: Guiding Questions

Genel değerlendirme

1. Mimarlık eğitiminde acil uzaktan eğitimin olumlu ve olumsuz etkileri nelerdir?

Dersler

2. Mimarlık, yapısı gereği hem teorik hem de uygulamalı derslerin ağırlıkta olduğu bir eğitim sistemi gerektirmektedir. Bunun yanı sıra acil uzaktan eğitim mimarlık ortamında hâlihazırda yaşanan dijital dönüşüme farklı bir boyut ve ivme kazandırmıştır. Dijital araçların kullanılmasının ötesine geçilerek eğitim sistemi tamamen dijital ortama aktarılmış ve derslerde kullanılan araçlar/ortamlar/yöntemler değişmiştir. Teorik ve uygulamalı dersler bağlamında bu değişimi değerlendirebilir misiniz?

3. Günümüzde bilgisayar karşısında öğrenme kapasitesinin ve maksimum süresinin standart öğrenimden farklı olduğu tartışılmaktadır. Verdiğiniz ders sürelerinde değişime gerek duydunuz mu? Duydunuz ise bu gereksinim ne şekildedir?

4. Acil uzaktan eğitimin tartışmalı bir diğer konusu da derslerde kullanılan ölçme ve değerlendirme yöntemleridir. Acil uzaktan eğitimde sınav yapma yöntemleri için arayışlar devam ederken bir yandan da ödev, rapor, jüri/forum/tartışma gibi süreç odaklı değerlendirme yöntemleri kullanılmaktadır. Derslerinizde ölçme ve değerlendirme için kullandığınız yöntemi acil uzaktan eğitimde değiştirdiniz mi? Kullandığınız yöntemin acil uzaktan eğitim açısından olumlu ve olumsuz yönleri nelerdir?

5. Yükseköğrenim hem akranlar arasında hem de öğretim elemanları ve öğrenciler arasında zengin bir etkileşim ve iletişim üzerine kuruludur. Hatta çoğu durumda bu aktörler arasındaki farkın en aza indiği ortamdır. Acil uzaktan eğitimin öğrencilerle iletişim ve etkileşim ortamınıza etkileri nelerdir?

Karşılaştırma

6. Neredeyse Türkiye'deki tüm üniversitelerde birden fazla acil uzaktan eğitim dönemi tamamlanmıştır. Bölümünüzde acil uzaktan eğitimin ilk dönemi ile sonraki dönemleri karşılaştırır mısınız?

Appendix C: Approval of The Human Research Evaluation Board

Evrak Tarih ve Sayısı: 07.03.2021-E.2546

T.C.
TOBB EKONOMİ VE TEKNOLOJİ ÜNİVERSİTESİ
İnsan Araştırmaları Değerlendirme Kurulu
İnsan Araştırmaları Değerlendirme Kurulu

Sayı : E-27393295-100-2546
Konu : 2021-17 Numaralı Başvuru

Sayın Dr. Zelal ÖZTOPRAK

İnsan Araştırmaları Değerlendirme Kurulu'na etik yönden değerlendirilmek üzere sunmuş olduğunuz 2021-17 kayıt numaralı "Covıd-19 Salgını Dönemindeki Acil Uzaktan Eğitimin Esnek Dayanıklılık Perspektifinden İncelenmesi: TOBB ETÜ Mimarlık Bölümü Örneği" başlığını taşıyan projeniz etik yönden uygun görülerek onaylanmasına karar verilmiştir.

Bilgilerinizi rica ederiz.

Prof. Dr. Tayyibe Nur ÇAĞLAR
Kurul Başkanı

Bu belge, güvenli elektronik imza ile imzalanmıştır.

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