SUSTAINABILITY IN ARCHITECTURAL EDUCATION: THE IMPACT OF EDUCATION ON PERCEPTIONS OF SUSTAINABILITY

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ABSTRACT

SUSTAINABILITY IN ARCHITECTURAL EDUCATION: THE IMPACT OF EDUCATION ON PERCEPTIONS OF SUSTAINABILITY

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In recent years, the concept of sustainability has come to the forefront in many areas. The relationship between education and sustainability needs to be examined to understand the broad meaning of the sustainability concept. Architectural education has an important role in understanding sustainability issues and increasing the sustainability awareness of students. Therefore, this study focuses on educational needs for the adoption of sustainability in the architecture. In the study, the design studio education in architecture programs has been investigated in the context of sustainability. Due to limited studies on education for sustainable development, this study aims to contribute to the literature on sustainability in architectural education. The center of the study is the role of design studios in sustainability in architectural education. The overall aim is to examine the impact of design studio education on sustainability perceptions of architecture students. The case studies of this thesis are Middle East Technical University (METU) and Politecnico di Torino (Polito). Information about architectural education, design studio programs and sustainability courses in the curricula was collected from case universities. For the quantitative and qualitative data in the study, a survey study with architecture students and interviews with lecturers were carried out at METU and Polito. With the analysis of data, it was

investigated whether the design studio education affects the sustainability understanding of the architecture students. This study highlights the importance of architectural studio education in the development of knowledge, skills, and awareness in sustainability research. In other words, the role of architectural design education in this field is clarified for sustainability in higher education institutions.

Keywords: Sustainable development, Higher education, Architectural design studio, Curriculum, Architecture education

ÖZ

MİMARİ EĞİTİMDE SÜRDÜRÜLEBİLİRLİK: EĞİTİMİN SÜRDÜRÜLEBİLİRLİK ALGISI ÜZERİNDEKİ ETKİSİ

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Son yıllarda, birçok alanda sürdürülebilirlik kavramı ön plana çıkmaya başlamıştır. Sürdürülebilirlik kavramını doğru anlamak için eğitim ile sürdürülebilirlik arasındaki ilişkinin incelenmesi gerekmektedir. Mimarlık eğitimi, sürdürülebilirlik konularını anlamada ve öğrencilerin sürdürülebilirlik bilincini arttırmada önemli bir role sahiptir. Bu nedenle, bu çalışma mimaride sürdürülebilirliğin benimsenmesi için eğitim ihtiyaçlarına odaklanmaktadır. Çalışmada, mimari tasarım stüdyosu eğitimi araştırılarak sürdürülebilirlik bağlamında incelenmiştir. Sürdürülebilirlik eğitimi konusundaki sınırlı çalışmalardan dolayı, bu çalışma mimarlık eğitiminde sürdürülebilirlik literatürüne katkıda bulunmayı amaçlamaktadır. Çalışmanın merkezini mimari tasarım stüdyolarının sürdürülebilirlik eğitimindeki rolü oluşturmaktadır. Bu tezin genel amacı, tasarım stüdyosu eğitiminin mimarlık öğrencilerinin sürdürülebilirlik algıları üzerindeki etkisini incelemektir. Tezdeki vaka çalışmaları Orta Doğu Teknik Üniversitesi (ODTÜ) ve Politecnico di Torino (Polito) 'dur. Bu üniversitelerdeki mimarlık eğitimi, tasarım stüdyosu programları ve müfredatlarındaki sürdürülebilirlik dersleri ile ilgili bilgiler araştırılmıştır. Çalışmadaki nicel ve nitel veriler için ODTÜ ve Polito'da mimarlık öğrencileri ile anket çalışması ve öğretim görevlileri ile görüşmeler yapılmıştır. Verilerin analizi ile

tasarım stüdyosu eğitiminin mimarlık öğrencilerinin sürdürülebilirlik anlayışını etkileyip etkilemediği araştırılmıştır. Bu çalışma, mimari stüdyo eğitiminin sürdürülebilirlik araştırmalarında bilgi, beceri ve farkındalık gelişimindeki önemini vurgulamaktadır. Özetle, mimari tasarım eğitiminin bu alandaki rolü, yükseköğretim kurumlarında sürdürülebilirlik için açıklığa kavuşturulmuştur.

Anahtar Kelimeler: Sürdürülebilir kalkınma, Yükseköğretim, Mimari tasarım stüdyosu, Müfredat, Mimarlık eğitimi

To my beloved family

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LIST OF ABBREVIATIONS

ABBREVIATIONS

AIA	The American Institute of Architects
AIAS	American Institute of Architecture Students
EDUCATE	Environmental Design in University Curricula and Architectural Training in Europe
ESD	Education for Sustainable Development
FCCC	UN Framework Convention on Climate Change
HEFCE	Higher Education Funding Council for England
KAAB	Korean Architectural Accreditation Board
METU	Middle East Technical University
NAAB	The National Architectural Accrediting Board
NCARB	National Council of Architectural Registration Boards
Polito	Politecnico di Torino
SD	Sustainable Development
SDG	Sustainable Development Goals
SHE	Sustainability in Higher Education
UIA	The International Union of Architects
UN	United Nations
UNCSD	United Nations Conference on Sustainable Development
UNEP	United Nations Environment Program

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNO	The United Nations Organization
WSSD	World Summit on Sustainable Development

CHAPTER 1

INTRODUCTION

The term sustainability, which is frequently encountered in many disciplines in recent years, means meeting our own needs without compromising the needs of future generations.[1] Sustainability ensures the protection and development of environmental, social and economic resources.[2] According to the report published by the World Environment and Development Commission, sustainable development is the process of change in which consumption of resources, investment decisions, technological development and institutional transform take place in harmony and the potential of meeting human needs and desires now and in the future.[3] In other words, sustainability aims to transfer today's natural, material and social resources to future generations and to do this without ignoring the needs of today. Sustainable development seeks to promote the quality of the social life, environment and economic viability.

This study focuses on sustainability understanding in the design studio of architecture programs. In this section, the background, motivation, research questions, research goal and objectives, research methodology and research outline are presented.

1.1. Background

Sustainability was first introduced by the Stockholm Human Resources Conference in 1972 in response to the increasing environmental and development problems. Sustainable development, which draws attention to the struggle between economic development and environmental protection, aims to solve problems related to

[1] Brundtland, G. H., Khalid, M., Agnelli, S., & Al-Athel, S. (1987). Our common future. New York.
[2] Gilbert, R., Stevenson, D., Girardet, H., & Stren, R. (2013). Making cities work: Role of local authorities in the urban environment. Routledge.
[3] WCED (World Commission on Environment and Development), B. C. (1987). Our common future. Report of the world commission on environment and development.

economic growth, environmental quality, and social aspects. Sustainable development focuses primarily on the continuation of existing resources and also on the resource needs that will affect the future.

Many institutions and organizations have made attempts to increase sustainability consciousness since The U.N.'s Brundtland Commission's report (Our Common Future) that initiated the idea of sustainable development in 1987. Among these, education has great importance to promote sustainable development. Following the Brundtland Report in 1992 in Rio de Janeiro, the World Summit published Agenda 21, which was the beginning of the international agreements on environmental issues and sustainable development. With this document, countries have dedicated to support sustainable development through a wide range of tools related to public awareness.

Higher education institutions have a unique opportunity to lead the society in education and development, and also, they are responsible for guiding attempts directed at environmental, social, and economic sustainability. In 1990, The Talloires Declaration, which officially initiated the sustainability approaches in universities, drew attention to important issues, such as enhancing the awareness of environmental sustainability, creating a culture of sustainability, increasing citizens' awareness towards sustainability and environmental issues, and promoting environmental education programs for everyone. In 1993, The Kyoto Declaration called for a clear vision for sustainability in universities and pointed out action plans. The Thessaloniki Declaration, adopted in 1997, highlighted the importance of education for environmental sustainability and stated that every discipline must involve the subjects about environment and sustainable development. It was advocated as an integral approach to education for sustainable development in the universities with this declaration. The United Nations Decade for Sustainable Development Education initiated sustainable development networks and educational practices as a leading organization for sustainability-oriented universities in 2005.

In 2015, the UN published the document titled "2030 Sustainable Development Agenda: Transforming Our World". In the 17 Sustainable Development Goals, Goal 4 was dedicated to education. The objective of this goal was to provide equal access for an affordable, high quality and professional higher education for everyone, including universities, by 2030. There were also more objectives related to higher education like eliminating poverty (Goal 1); health and welfare (Goal 3); gender equality (Goal 5); respectable business and economic growth (Goal 8); responsible for consumption and production (Goal 12); climate change (Goal 13); and peace, justice and powerful institutions (Goal 16).

Universities play an important role in the implementation of sustainable development goals by providing education, research and social contribution. Universities provide basic tools for research, development and communication in education for sustainable development. Architecture behaves as a keystone of forming the built environment and its occupants and their relations with the environment and themselves. Architectural education enhances students' capacity to conceptualize, design, and realize the spaces in the context of architectural environments by developing knowledge and awareness while preparing for professional life. Teymur stated two main architectural education objectives: to support students to be creative, critical thinking, and ethically professional designers; and to educate to be good people who are intellectual, sensitive to the ecological environment and socially responsible for the world.[4]

In the architectural research, there is a wide range of studies related to curriculum development for the integration of sustainability into the architectural education. Recently, many architecture schools have begun to incorporate sustainability-related courses and practices into their curricula. In 2005, UIA and UNESCO published the Charter for Architectural Education which included some of the important features of architectural education. One of them was to provide students with information about

[4] Teymur, N. (1992). Architectural education: Issues in educational practice and policy. ? uestion Press.

ecologically sustainable design and environmental protection. AIA also stated that studio training was an important tool for environmental education and implementation.[5]

In this study, the analysis and evaluation of various aspects of architectural education in the integration of sustainability are discussed. The effects of studio education, which is the main subject of the study, on the perception of sustainability of students are investigated. In addition, the study explores some essential topics about sustainability in higher education, architectural programs and design studio education. It emphasizes the importance of design studios in the integration of sustainability in architectural education. Curriculum reviews, theoretical and pedagogical approaches are examined to contribute to the sustainability awareness of architecture students.

1.2. Motivation

Higher Education plays a crucial role in ways of coping with global issues, creating the vision for society and shaping the future. Sustainability has become an increasingly important issue since the beginning of the awareness of climate change, depletion of natural resources and ongoing economic crises.[6] Architects and planners are responsible for designing a sustainable built environment. Therefore, it is inevitable to create knowledge and awareness on sustainable development among architecture students to create healthy built environments for the future.[7]

Today, most professional architecture practices consider sustainability as an important factor in their design approach. Sustainable development addresses not only the environmental issues but also social, cultural, economic, ethical aspects. It is needed to be promoted to make sustainability as a part of design in architectural applications.

[5] Gould, K. L. (2006). Ecology and Design: Ecological Literacy in Architecture Education, 2006 Report and Proposal. American Institute of Architects. p24.
[6] Elnokaly, A., & Elseragy, A. (2009). Amalgamating sustainable design strategies into architectural curricula. The International Journal of Environmental, Cultural, Economic and Social Sustainability, 103-134.
[7] Smith, P. (2012). Architecture in a Climate of Change. Routledge.

For this, architecture students need to be equipped with knowledge and awareness of sustainability.[8]

Architecture schools are diverse in terms of their educational philosophy, approaches and principles. Similarly, different schools have distinctive approaches in implementing sustainable development. As Wright points out, the integration of sustainable design into the curricula is provided with the connection between theory and practice in the curriculum development, education and professional practice.[9] For the proper implementation of the curriculum for sustainable architectural education, all aspects of sustainability need to be key factors in preparing the content of the courses.[10] Salama et al. states that the architectural curriculum has been formed on changing architectural practices, needs and concerns over the years.[11] NAAB, one of the accreditation systems for the national evaluation of architectural schools, expresses that architecture requires knowledge of the historical, socio-cultural and environmental concepts. According to NAAB, sustainable design promotes the understanding of the principles of sustainability and emphasizes its importance in architectural, urban design decisions, healthy buildings and communities.[12] Altomonte et al. mention that the studies on how to integrate sustainability into the architectural curriculum should be diversified to provide frameworks and models.[13] In this subject, it was expressed that more research on the sustainability consideration in architecture curriculum and the sustainability discussions in design studios can improve the

[8] Altomonte, S. (2009). Environmental education for sustainable architecture. Review of European Studies, 1(2), 12.
[9] Wright, J. (2003). Introducing sustainability into the architecture curriculum in the United States. International Journal of Sustainability in Higher Education, 100-105.
[10] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016). A comparative study on sustainability in architectural education in Asia—With a focus on professional degree curricula. Sustainability, 8(3), 290.
[11] Salama, A. M., O'Reilly, W., & Noschis, K. (2002). Architectural education today: Cross-cultural perspectives. ARTI-ARCH. p.9.
[12] NAAB. (2004). NAAB Conditions for Accreditation for Professional Degree Programs in Architecture, 2004 Edition.
[13] Altomonte, S., Reimer, H., Rutherford, P., & Wilson, R. (2013). Towards Education for Sustainability in University Curricula and in the Practice of Design. In PLEA.

understanding of the sustainability.[14] Stevenson et al. also highlight the importance of design studio education on sustainability awareness and knowledge of students.[15]

There is much more need for research and studies on sustainability in higher education. This thesis contributes to the current literature on the relationship between sustainability and design studio education in architecture. The starting point of this study is to explore the challenges, needs and opportunities in the adoption of sustainability objectives in architectural education.

1.3. Research Questions

Architectural education aims to be comprehensive in content, to specialize in areas where specific focuses are required, to combine knowledge and skills from other disciplines, and to respond to changes in behaviors of society in general.[16] For sustainable development, architectural education is an important factor in the training of professionals with a comprehensive understanding and knowledge of national and global issues. To achieve this, architecture programs need to implement sustainability into the curriculum to provide students with knowledge, skills and awareness to cope with current and future sustainability problems and to find a way to integrate design methodologies with tools and technologies.[17] Sterling stated that the graduates from architecture schools usually could not see the opportunities and potential benefits of sustainable design when implementing design projects in professional lives.[18] In many architecture schools, there is a general trend to work on increasing sustainability issues

[14] Ismail, M. A., Keumala, N., & Dabdoob, R. M. (2017). Review on integrating sustainability knowledge into architectural education: Practice in the UK and the USA. Journal of Cleaner Production, 1542-1552.
[15] Stevenson, F., Roberts, A., & Altomonte, S. (2009). Designs on the Planet. In A workshop series on architectural education and the challenges of climate change, Passive Low Energy Architecture Conference. p23.
[16] Riguet, J. C., General, S., Cox, L., Mejia, S. M. G., Hyett, P., Koudryavtsev, A., Scheeler, J. (2008). UIA and architectural education reflections and recommendations. XXIIth UIA Geneal Assembly (Berlin, Germany, July 2002), 1-43.
[17] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016). A comparative study on sustainability in architectural education in Asia—With a focus on professional degree curricula. Sustainability, 8(3), 290.
[18] Sterling, S., Maxey, L., & Luna, H. (Eds.). (2013). The sustainable university: Progress and prospects. Routledge.p7.

in their architectural education. [19] However there is still a lack of guidance on the integration of sustainability into the architectural education. Also, there has not been sufficient research specifically on how it can be achieved at the studio level, how specific learning outcomes are sought, or the impact of the sustainability awareness of students.[20] This lack of previous work shows the need for more studies to explore sustainability in architectural education. In this study, the main issue to be addressed is the relationship between sustainability awareness of the architecture students and design studio education. The main question of the study is formulated as:

> *To what extent does the design studio education affect the perception of sustainability of the architecture students?*

Addition to this question, the other problems reviewed in the study are;

- *What is the role of sustainability in architectural education and curricula?*
- *How can the sustainability concepts' integration into the architectural design studios be supported?*
- *How is education on sustainability practiced at different architecture design studios?*
- *What are the tools, practices and procedures to improve the awareness and knowledge of sustainability of architecture students?*

These research questions mainly aim to explore the ways in which the studio pedagogy has an influence on sustainability awareness. The researcher examined three aspects of architectural education; the course contents and sustainability relationships in the curriculum, the differences in the content and structure of design projects, and students' and lecturers' opinions on sustainability in architecture.

[19] Cullingford, C., & Blewitt, J. (2013). The sustainability curriculum: The challenge for higher education. Routledge.
[20] Colucci-Gray, L., Camino, E., Barbiero, G., & Gray, D. (2006). From scientific literacy to sustainability literacy: An ecological framework for education. Science Education, 90(2), 227-252.

1.4. Research Objectives

The relationship between education and sustainability needs to be examined. Therefore, this study focuses on the relations of architectural education and sustainability awareness of students. The study aims to contribute to the literature on sustainability in higher education by investigating the sustainability in architectural education in the context of the curriculum, students' and lecturers' perspectives. The overall purpose of this thesis is to investigate the role of design studio education in the understanding of the sustainability of architecture students and the contribution of theoretical courses. For this purpose, sustainability in higher education and architectural education were investigated.

The study investigates architectural education to explore sustainability awareness of students in terms of social, environmental and economic aspects. It focuses on the design studio programs, theoretical courses and sustainability opinions of students and studio instructors. The thesis consists of two case studies to address the following objectives:

- To determine the impact of design studio education on perceptions of sustainability among architecture students.
- To identify the relationship between the integration of sustainability to the design studio education and understanding of sustainability among students.
- To explore the perceptions of sustainability of students in different years from first year to the master degree.

1.5. Research Methodology

This thesis examines the architectural design studio education in the context of sustainability by using case study research. The case study method allows the researcher to closely examine the data in a specific context.[21] Yin describes the case study as an experimental inquiry that investigates a contemporary phenomenon in a

[21] Zainal, Z. (2007). Case study as a research method. Jurnal Kemanusiaan, 5(1).

real-life context, particularly when the boundaries between phenomenon and context are not clearly visible.[22] For sustainability in architectural design studio education, the information about the curriculum, design studio programs and courses, was gathered from case studies. The case studies of this thesis were Middle East Technical University (METU) and Politecnico di Torino (Polito). It was examined whether the design studio education and academic courses increase awareness of sustainability concepts for students. It was aimed to evaluate the relationship between sustainability and the design studio education with different architecture programs of METU and Polito.

Firstly, a comprehensive literature review was conducted to explore sustainable development in higher education. The concept of sustainability was defined, and the term, scope and historical development of sustainability were reviewed. In this part, sustainable development goals were examined and its implementation to universities were investigated. Sustainability and education relations were analyzed by focusing on architectural education. Then, a detailed research on architectural education, design studio and the relations with sustainability was carried out and the previous studies on this subject were searched. The literature review related to the subject was prepared by evaluating the existing studies in the fields of architectural education and sustainability in the design studios. With this review, the conceptual framework of the research was formed.

In the second part of the study, the architecture programs of the case universities were investigated. The courses related to the sustainability concepts were listed in terms of time, program and scope. Two research methods, quantitative and qualitative, were identified depending on the framework of the study to examine the effect of architectural design studio education on students' awareness of sustainability. The methodology to analyze the data used in the thesis is given below:

[22] Yin, R. K. (2003). Case study research: Design and methods. Third Edition. Sage publications. p.13

Gathering information about the case universities: In this study, data was collected about METU and Polito Architecture programs. The architectural curricula in both case universities were examined. The courses related to sustainability were determined and their contents and scopes were investigated.

Quantitative Data: A survey was conducted on the architecture students of the case universities. 237 students from METU and 151 students from Polito participated in the questionnaire. For this survey, the permission of the relevant studio instructors and ethics committee approval of the university were obtained (Appendix C). The quantitative analysis sought to understand the relationship between design studio education and sustainability perception of architecture students. To achieve the aim of the study, the following hypotheses were proposed.

- **Hypothesis One:** Students' perceptions of sustainability have increased over the years.
- **Hypothesis Two:** There is a positive relationship between the seminars and lectures of sustainability given in the design studios and sustainability understanding of students.
- **Hypothesis Three:** The environmental aspect of sustainability is addressed more in comparison to social and economic aspects in the design studios.
- **Hypothesis Four:** Students who previously designed a project and received a theoretical lecture on sustainability in the design studios are more prone to doing projects related to sustainability in professional life.

The survey in the case universities was transferred to the SPSS 22 program.[23] Suitable analysis methods were selected according to each hypothesis.

Qualitative Data: At this stage of the research study, an interview approach was carried out gathering information about sustainability issues in the design studios from the lecturers of architecture department in the case universities. 11 faculty members

[23] SPSS (Statistical Package for Social Sciences) program is used by researchers to conduct statistical analysis. - Stevens, J. P. (2012). Applied multivariate statistics for the social sciences. Routledge.

from the Department of Architecture of METU and 5 faculty members from the Department of Architecture and Design of Polito were interviewed. Personal interviews were arranged with the 11 faculty members from METU and data was collected about studio programs, project topics, and their opinions on sustainability. During these interviews, digital recordings were made using a voice recorder with the consent of the participants. The interviews were then copied and transferred to NVivo 12 program for the qualitative data analysis. The answers obtained from these interviews were analyzed using the thematic analysis method.[24] 5 faculty members of Polito were contacted by e-mail and participated in the open-ended questionnaire. Written answers to this questionnaire were discussed in summary format.

Data analysis findings and discussion: After stating the qualitative and quantitative findings, the focus of this research was discussed with the results of the analysis.

1.6. Research Outline

The study consists of five chapters. The outline of the thesis is presented in Figure 1.1. The contents of each section are as follows:

- Chapter I presents the general introduction and purpose, scope, and method of the research.
- Chapter II presents a literature review on sustainable development, sustainability in higher education, and architecture design studio.
- Chapter III consists of the methodology and materials of the case universities (METU and Polito) that explores the relationship between design studios education and students' perceptions of sustainability.
- Chapter IV includes the results and a discussion of the findings from the two case universities of this study.

[24] Thematic analysis is a method used to identify key points in interview responses by identifying patterns or themes within qualitative data. - Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education, 9(3).

- Chapter V presents the final discussion in the context of literature, research and results.

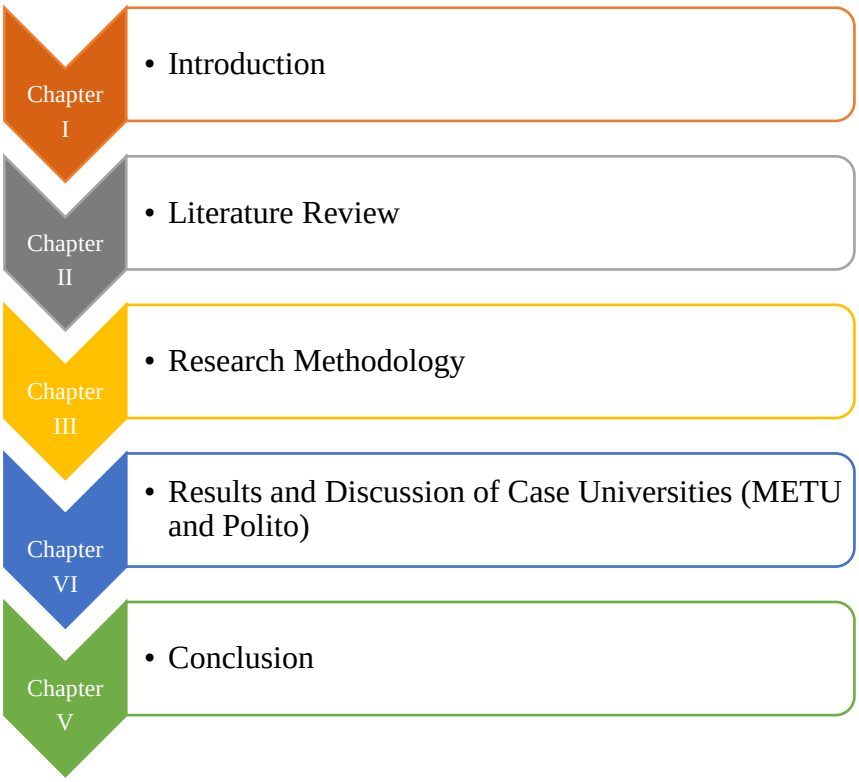

Figure 1.1. The outline of the thesis

CHAPTER 2

LITERATURE REVIEW

> *"We must consider our planet to be on loan from our children, rather than being a gift from our ancestors ... As caretakers of our common future, we have the responsibility to seek scientifically sound policies, nationally as well as internationally. If the long-term viability of humanity is to be ensured, we have no other choice." (Gro Harlem Brundtland)* [25]

This chapter presents a literature review which aims to investigate the main subjects of this research: Sustainability, sustainability in higher education and architectural education. The chapter begins with an overview of the definition of sustainability and sustainable development chronologically, beginning from the 1960s, followed by the 1987 Brundtland Report, and the 2015 UN agenda (Transforming our world: the 2030 Agenda for Sustainable Development). The following section includes key events and declarations about sustainability in higher education (SHE) to highlight the importance of education on the progress of SHE. The relationship between SHE and architectural education is discussed in the context of design studios. Finally, a general view of the methods and approaches to studies on design studios is presented to explore the role of sustainability in architectural education.

2.1. Sustainable Development

Sustainable development (SD) means to ensure that people meet today's needs without compromising the ability to meet the needs of future generations.[26] SD emphasizes the equality between generations by focusing on peace, freedom, development and the

[25] Brundtland, Gro Harlem. (1997). The scientific underpinning of policy. Cited in National Research Council. (1999). Our common journey: a transition toward sustainability. National Academies Press. p275.
[26] Brundtland, G. H., Khalid, M., Agnelli, S., & Al-Athel, S. (1987). Our common future. New York.

environment.[27] Considering a sustainable future, higher education and architectural education are one of the important factors in the training of professionals with a comprehensive understanding and knowledge of national and global issues. Therefore, it is generally argued that architecture programs need to implement sustainability into the curricula. In this chapter, the relationship between architectural education and sustainability is examined. In the study, a detailed literature review was carried out to investigate sustainability in architectural education, the ways in which sustainability can be supported in architectural design , and the types of processes and tools that should be used to develop sustainability issues in the curriculum to improve sustainability awareness of architectural students.

2.1.1. The Definition of Sustainability

The concept of sustainability came forth in the 1960s as a reaction to the environmental degradation caused by deficiencies in resource management. Research studies have been carried out on how to define and measure environmental sustainability and what policies can be implemented to improve development. Then, social and economic aspects of sustainability have been paid attention during the environmental sustainability studies have continued and sustainability has become a common multi-focus agenda.[28]

The decade of the 1980s has been a major change for governments, organizations, and companies in the way they think about the environment and SD.[29] The broad concept of SD has been extensively discussed at the beginning of the 1980s. Sustainability issues were put into the international agenda in 1987 the World Environment and Development Commission with the agenda: Our Common Future. The term sustainability has been widely used since then, and the most cited definition of sustainability dates back to that day. Sustainability was defined as to “meet today's

[27] National Research Council. (1999). Our common journey: a transition toward sustainability. National Academies Press.
[28] McKenzie, S. (2004). Social sustainability: towards some definitions.
[29] Pezzey, J. (1992). Sustainable development concept: An economic analysis. The World Bank.

needs without compromising the ability of future generations to meet their own needs". It included in two key concepts:

- The needs of the present generation (A decent living for a growing part of the population)
- The needs of future generations (a long-standing decent society).[30]

This quote from the Brundtland Report is the most known and widely definition of sustainability used in many declarations and worldwide conferences. In the last two decades, sustainability term has been used in public and academic literature with various and evolving meanings to understand the challenge of SD.[31] In the following part, various definitions of sustainability and SD were examined.

The word sustain originates from the Latin word sustinere, which means "to hold up from below" (sus-, "from below," and tenure, "to hold").[32] Something is considered as sustainable if it stands, remains or persists over time.[33] In literal English usage, sustainability is the quality of being able to continue over a period of time: the long-term sustainability of the community.[34] The primary idea of sustainability is a system that survives or endures.[35] Sustainability is a general word which expresses the need of a long-term view in which the demand for environmental resources and waste are reduced but also shows the need to make beneficial changes economic and socially.[36] It is also an economic state, where the environment and human demands can be encountered without decreasing future needs.[37] Sustainability provides the welfare of all living systems on the planet with social justice and ecological integrity. It is also

[30] WCED (World Commission on Environment and Development), B. C. (1987). Our common future. Report of the world commission on environment and development.
[31] National Research Council. (1999). Op cit.
[32] Bonda, P., & Sosnowchik, K. (2006). Sustainable commercial interiors. John Wiley & Sons. p6.
[33] Thiele, L. P. (2016). Sustainability. John Wiley & Sons.p7.
[34] Meaning of sustainability in English. Retriewed from: https://dictionary.cambridge.org/dictionary/english/sustainability Accessed on November 2018.
[35] Costanza, R., & Patten, B. C. (1995). Defining and predicting sustainability. Ecological economics, 15(3), p193-196.
[36] Newman, P., & Kenworthy, J. (1999). Sustainability and cities: overcoming automobile dependence. Island press. p4.
[37] Hawken, P. (1992). The ecology of commerce. Inc., 14(4), p93-97.

related to dynamic processes, not just an aim to be achieved, but also an equilibrium to be preserved in space and time.[38] The concept also draws attention to make a strategy of progress towards a sustainable future.[39] With the emergence of the concept of SD, the awareness of the impact of people on the natural surrounding has increased. It has also encouraged to act upon social, cultural, economic and environmental problems facing the world.[40] Sustainable development can be defined as an initial idea of thinking about the concerns of environmental and socio-economic issues in a common ground.[41]

Haughton (1999) stated that sustainable development requires changing both the attitude towards the environment and the systems shaping human behavior.[42] It is necessary to include economic and social systems in environmental policies related to natural resources for use in the long term by bringing forward the sustainable development with social justice, economic prosperity, and environmental management. Haughton also gathered the key principles of sustainable development in five categories: inter-generational equality (futurity), intra-generational equality (social justice), geographical equality (trans-frontier responsibility), procedural equality (regulatory and participatory systems which treated clearly and fairly to people), inter-species equality (the importance of biodiversity).[43]

Sustainability is a practice that has a minimum negative effect on the built and natural environment and strives for a broader integrated approach that encompasses economic and social and environmental performance both locally and environmentally, both within itself and in its immediate surroundings. Sustainability suggests that societies

[38] Dahl, A. L., & Dowdeswell, E. (1996). The eco principle: ecology and economics in symbiosis. Oxford: Zed Books.
[39] Moore, J. (2005). Is higher education ready for transformative learning? A question explored in the study of sustainability. Journal of transformative education, 3(1), p76-91.
[40] Barth, M., Michelsen, G., Rieckmann, M., & Thomas, I. (Eds.). (2015). Routledge handbook of higher education for sustainable development. Routledge.p1.
[41] Hopwood, B., Mellor, M., & O'Brien, G. (2005). Sustainable development: mapping different approaches. Sustainable development, 13(1), p38-52.
[42] Haughton, G. (1999). Environmental justice and the sustainable city. Journal of planning education and research, 18(3), 233-243.
[43] Ibid.

with a good quality of life must ensure that both present and future generations have also able to achieve the same standard of living.[44] SD draws attention to politic issues, socio-economic problems, people and the environment relations.[45] The definitions of sustainability and SD are debated for which one is the most important; however, the common point is that the definitions all involve in the policies and practices to support the economy, society, ecology, and equity.[46]

2.1.2. The Historical Background of Sustainable Development

The term of sustainable development (SD) was used by The United Nations Organization (UNO) to draw attention to the struggle on and environmental protection economic boost. As stated before, SD primarily concentrates on the needs of the existing resources and the needs that will affect the future. SD proposes an integrated approach for solving problems of economic growth, environmental quality, and social aspects.[47] The contribution of sustainable development processes that have begun to take place on the agenda since the later 20th century onwards is important to address the economic, environmental and social issues. In 1962, Rachel Carson addressed the issue of sustainability by mentioning the negative impact of pesticides and other toxic substances in his book "Silent Spring," and in 1968 Paul Ehrlich in his book "The Population Bomb," referring to the dangers posed by the increasing population in the world.[48] Sustainability also has its origins in 1972, with the Stockholm Conference on Human Resources, when debates on environment and development were first defined. Since then, the United Nations Environment Program (UNEP) has been working on environmental problems. The concept of SD was first presented in 1987 by the UN Commission on Environment and Development with the Brundtland Report. The

[44] Kibert, Charles J., et al. "The ethics of sustainability." (2011).
[45] Turner, B. L. (1997). The sustainability principle in global agendas: implications for understanding land use cover change. Geographical Journal, p133-140.
[46] Corcoran, P. B., & Wals, A. E. (2004). Higher education and the challenge of sustainability. Dordrecht: Kluwer Academic Publishers, p.10.
[47] Porras, I. M. (2009). The City and International Law: In Pursuit of Sustainable Development. Fordham Urb. LJ, 36, p537.
[48] Reid, D. (2013). Sustainable development: an introductory guide. Routledge. p.29.

report emphasized the prevention of environmental degradation by providing social equality and justice as well as economic development.[49]

After Brundtland Report, another milestone in SD took place at the 1992 UN Conference on Environment and Development in Rio de Janeiro, also regarded as the World Summit with representatives from 172 countries and more than 2,400 nongovernmental organizations. Five reports were released: Agenda 21, the Rio Declaration on Environment and Development, the Statement of Forest Principles, the United Nations Framework Convention on Climate Change and the United Nations Convention on Biological Diversity.[50] Its major contribution was to give equal importance to development and environment. Agenda 21, which identifies the measures to be taken locally and globally based on social equity, environmental protection and economic growth. The Kyoto Protocol (1997) to the UN Framework Convention on Climate Change (FCCC) was one of the most important agreements signed in the 20th century. The Kyoto Protocol accepted that climate change was largely due to human activity. The Kyoto Protocol aimed to decrease human-induced greenhouse gas emissions as well as to change the basis of production and consumption, transport, investment, and energy supply in the signatory countries.[51]

The international support for the implementation of the agreed principles of Agenda 21 in Rio was confirmed at the "World Summit on Sustainable Development" (WSSD) in Johannesburg in 2002.[52] With the Johannesburg Declaration on Sustainable Development, it was emphasized the importance of promoting human solidarity and encouraging cultural diversity and cooperation.[53] Five target areas were identified:

[49] Bonda, P., & Sosnowchik, K. (2006). Sustainable commercial interiors. John Wiley & Sons. p. 4.
[50] Declaration of the United Nations Conference on the Human Environment. Retriewed from: http://www.un.org/geninfo/bp/enviro.html Accessed on November 2018.
[51] Cosbey, A. J. (2000). The Kyoto Protocol and the WTO. Royal Institute of International Affairs. Introduction.
[52] Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2012). An introduction to sustainable development. Earthscan.
[53] World Summit on Sustainable Development-Johannesburg Declaration on Sustainable Development. (2002) Retriewed from: https://unhabitat.org/wp-content/uploads/2014/07/A_CONF.199_20-Johannesburg-Declaration-on-Sustainable-Development-2002.pdf Accessed on May 2019.

water and sanitation, energy, health and the environment, agriculture, biodiversity and ecosystem management.[54] The reflection of these declarations on SHE was discussed in the next section of the study.

In 2005, the World Summit on Social Development confirmed their commitments to achieving SD refers to the implementation of the Agenda 21 and Johannesburg Implementation Plan. It was highlighted that international cooperation, action and measures should be taken at all levels. Based on these, three essential parts of SD were released: economic growth, social development, and environmental protection.[55] These three components, which are included in many national standards and academic documents, were key points in overcoming the problems that the world is currently facing concerning sustainability. A frame was relied on the coexistence of environmental, social and economic sustainability and their equal impact.[56] Elkington proposed the frame of triple bottom line as a new term in the process of SD.[57] It was stated that economic prosperity, environmental quality, and social equality should be evaluated simultaneously.[58] Figure 2.1 shows a schematic representation of the triple bottom line of sustainability.

[54] Nath, B. (2003). Education for sustainable development: The Johannesburg summit and beyond. Environment, Development and Sustainability, 5(1-2), p231-254.
[55] Assembly, U. G. (2005). World summit outcome. Resolution Adopted by the General Assembly, p24.
[56] Porras, I. M. (2009). Op cit.
[57] Elkington, J. (1998). Partnerships from cannibals with forks: The triple bottom line of 21st-century business. Environmental quality management, p20.
[58] Arowoshegbe, A. O., & Emmanuel, U. (2016). Sustainability And Triple Bottom Line: An Overview Of Two Interrelated Concepts. Igbinedion University Journal of Accounting, 2, p88-126.

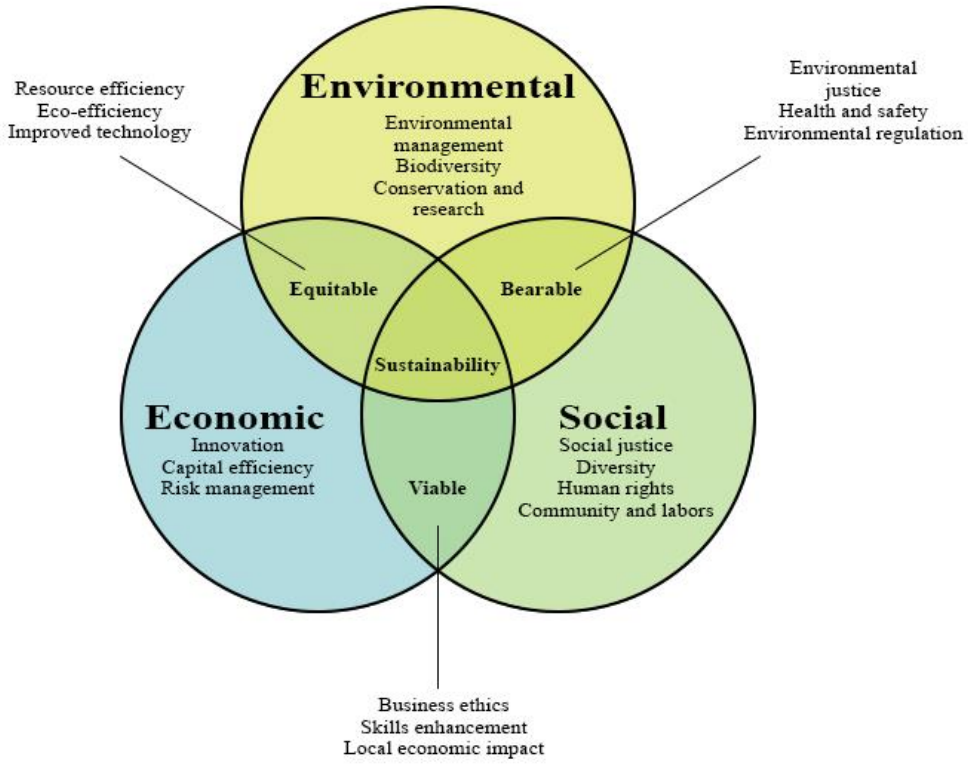

Figure 2.1. Triple bottom line framework of sustainability [59]

Environmental Sustainability

Environmental sustainability means providing the demand of today and the future generations without affecting the health and diversity of ecosystems.[60] According to Meadows et al. if the world's population, industrialization, pollution, and the current growth in the depletion of resources continue, the limits of the growth will be reached within a hundred years.[61] They state that the situation of the global balance can be designed for a sustainable stability situation and have an equal opportunity to supply the basic materials of every person in the world.[62] Morelli (2011) defines

[59] It was prepared to be inspired by this document: http://responsibleearth.com/Sustainability!.html. Accessed 7 November 2018
[60] Morelli, J. (2011). Environmental sustainability: A definition for environmental professionals. Journal of environmental sustainability, p.6.
[61] Meadows, D. H., Meadows, D. H., Randers, J., & Behrens III, W. W. (1972). The limits to growth: a report to the club of Rome.
[62] Ibid.

environmental sustainability as the condition of balance, flexibility, and interdependence, which enables the supportive ecosystems to meet the needs of human society, without exceeding their capacity and losing biodiversity.

Social Sustainability

Social sustainability aims to create healthy and livable communities with good relations to systems, structures, relationships in formal and informal processes. Social sustainability proposes a good quality of life for equal, diverse, connected and democratic communities.[63] The social dimension of sustainability focuses on the impact of an organization, product or process on society.[64] McKenzie (2004) states that social sustainability is a condition that improves life in communities and a process within communities that can accomplish this condition.[65] This definition is supported by the steps towards the implementation of social sustainability that include intergenerational equality, cultural diversity, equal access to health, education, transportation, and housing services, mechanisms of determining the strengths and needs of the society as a whole. According to McKenzie, social sustainability arises within informal or formal systems, structures, and relations which support the creation of healthy and livable communities in the present and future generations.[66] According to Pearce et al., social sustainability focuses on the protection of the political and cultural norms related to ethic, value, language, education, work attitudes, class systems, etc. [67] Social sustainability deals with the problems of all, including users, communities, neighbors, workers and other stakeholders. Bramley et al. suggests that social sustainability should consist of two main dimensions: social equality and sustainability of the community.[68] Social equality is for access to important services

[63] Duggie, J., & Hodgson, N. (2003). Community Sustainability Agenda: Creating a Just and Sustainable Western Australia. Conservation Council of Western Australia for WA Collaboration.
[64] Initiative, G. R. (2006). Sustainability reporting guidelines, Version 3.0. GRI, Amsterdam.
[65] McKenzie, S. (2004). Op cit.
[66] Ibid.
[67] Pearce, D., Barbier, E., & Markandya, A. (2013). Sustainable development: economics and environment in the Third World. Routledge. p.49.
[68] Bramley, G., Dempsey, N., Power, S., Brown, C., & Watkins, D. (2009). Social sustainability and urban form: evidence from five British cities. Environment and planning A, 41(9), 2125-2142

like schools, health centers, recreation areas, public transportation, business connections, affordable and secure accommodation, and the development of community is to participate in the collective and civil actions for the quality of life.[69]

Economic Sustainability

Economic sustainability aims to ensure economic viability, including social, cultural and environmental pillars.[70] With using of resources (human, material, financial) efficiently, economic sustainability focuses on increasing profitability, effective design, good management, planning, and control.[71] Economic sustainability includes many subjects from smart growth to subsidies or tax cuts for green development. It is important to strengthen and support economic sustainability through education programs and to brief the public.[72] The recent concern with sustainability indicates that the widespread deterioration of environmental assets is due to the negative economic effects.[73] Foy states that the current economic actions should not impose responsibility on next generations. Economic sustainability should include minimizing the social costs of standards for the protection of environmental assets, suggesting that sustainability should limit the determination of economic standards.[74] Economic sustainability aims to create efficiency, and to prevent wastage of resources from achieving two normative goals: meet the needs and desires of each person and justice between nature and people of the present and future generations.[75]

The Guiding Principles for Sustainable Spatial Development of the European Continent proposed a fourth dimension: cultural sustainability.[76] Cultural

[69] Ibid.
[70] Tredwell, A. (2004) Design and its effects on Society, Culture, Economics and the Environment, Chapter 13 The Four Pillars of Wisdom, pp. 343-364.
[71] Ibid.
[72] Ibid.
[73] Foy, G. (1990). Economic sustainability and the preservation of environmental assets. Environmental Management, 14(6), 771-778.
[74] Ibid.
[75] Baumgärtner, S., & Quaas, M. (2010). What is sustainability economics?. Ecological Economics, 69(3), 445-450.
[76] Dejeant-Pons, M. (2010). Council of Europe Conference of Ministers Responsible for Spatial/Regional Planning (CEMAT).: 1970-2010. Basic texts (Vol. 3). Council of Europe.

Sustainability focuses on a society that maintains and values cultural heritage and diversity.[77] In the Declaration of Principles of International Cultural Cooperation (1996) it is stated that every culture has its own values to be protected, all cultures have the right and claim to develop, each culture is a part of the heritage of society.[78] Cultural sustainability promotes the importance and factors of culture in regional and global development. Cultural sustainability is also a significant part of sustainable development, expressing how we perceive nature, the environment and human relationships. It emerges gradually from the field of social sustainability and has a separate and complementary function in SD.[79]

A method, called Sustainability Circles, has been developed with a basic dissatisfaction from the common approaches to SD. The sustainability circles are a way to understand sustainability and evaluate proposals related to socially sustainable outcomes. It is aimed to address problems that can be solved that are seemingly difficult, as outlined in the discussions on SD. The method is generally practiced in cities and urban settlements. [80] In the book of "Urban sustainability in theory and practice: circles of sustainability", Paul James also explains the circles of sustainability method except for over-reducing approaches to sustainable development. He states that the circular form has four areas: ecology, economy, politics, and culture. All parts are separated into seven subfields with these subfields names which read from top to bottom in the lists under each field name. This form is carried out on a nine-point scale. The proportion is listed from 'critical sustainability,'

[77] Tredwell, A. (2004) Op cit.
Strachan M. (2010). Design Systems and Service: an inter-disciplinary, experiential, design studio. Sustainability in Design: Now!. Proceedings of the LeNS Conference, Bangalore, India. Volume II. p. 995.
[78] Declaration of the Principles of International Culture Cooperation. (1966) Gen. Conf.of UNESCO.
[79] Pearce, D., Barbier, E., & Markandya, A. (2013). Sustainable development: economics and environment in the Third World. Routledge. p.49.
[80] Circles of Sustainability. Retriewed from: http://www.circlesofsustainability.org/ Accessed on November 2018.

the first step, to 'vibrant sustainability,' the ninth step.[81] Figure 2.2 presents the circles of sustainability method in detail.

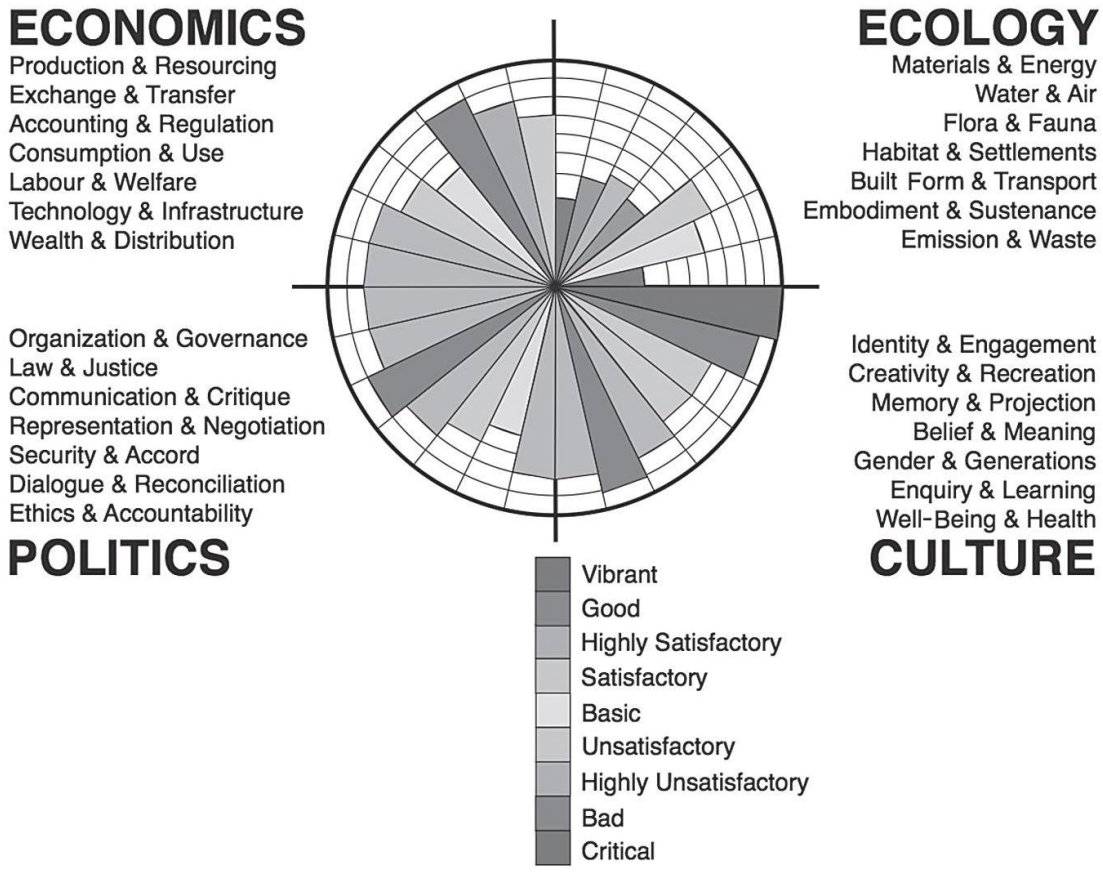

Figure 2.2. The circles of sustainability

In the Guiding Principles for Sustainable Spatial Development of the European Continent, it was been defined a variety of tasks achieving SD.[82] These principles are given in the Table 2.1.

[81] Ibid.
[82] CEMAT. (2000). Guiding principles for sustainable spatial development of the European continent.

Table 2.1. *The principles for sustainable development in Europe* [83]

• Promoting territorial cohesion through a more balanced social and economic development of regions and improved competitiveness.
• Encouraging development generated by urban functions and improving the relationship between town and countryside.
• Promoting more balanced accessibility.
• Developing access to information and knowledge.
• Reducing environmental damage.
• Enhancing and protecting natural resources and the natural heritage.
• Enhancing the cultural heritage as a factor for development.
• Developing energy resources while maintaining safety.
• Encouraging high quality, sustainable tourism.
• Limitation of the impact of natural disasters.

In 2015, the United Nations (UN) declared a report to follow post-2015 development agenda: Transforming our world, 2030 Sustainable Development Agenda. This Agenda is a strong motivation for people and planet. It aims at prosperity, universal peace and freedom. There are 17 Sustainable Development Goals and 169 targets that illustrate the contents and tasks of the universal Agenda (Table 2).[84]

[83] It was prepared to be inspired by this document: Jensen, O. B., & Richardson, T. (2001). Nested visions: new rationalities of space in European spatial planning. Regional studies, 35(8), 703-717.

[84] Transforming our world, 2030 Sustainable Development Agenda Retriewed from: http://www.un.org/sustainabledevelopment/sustainable-development-goals/ -Accessed on November 2018.

Table 2.2. *The Sustainable Development Goals in 2030 Agenda for Sustainable Development*

Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build a resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

In the Agenda, it is stated that these important goals and commitments are interrelated and require integrated solutions. For example, one of the most critical issues regarding the current concern of the planet is healthy, in particular, equal access and justification to health services. The significant developments in health services form the basis of SDG 2, 3 and 6. Improvements in the quality and inclusiveness of education constitute the basis of SDG 4 and are integrated with some of the other objectives related to social equality. With these goals, SD is defined as the alleviation of poverty, the

struggle against inequality within and between countries, the protection of the planet, the enhancing economic boost, and the promotion of social cohesion.[85]

2.2. Sustainability in Higher Education

> *"Universities must function as places of research and learning for sustainable development… Higher education should also provide leadership practicing what they teach through sustainable purchasing, investments, and facilities that are integrated with teaching and learning… Higher education should emphasize experiential, inquiry-based, problem-solving, interdisciplinary systems approaches and critical thinking. Curricula need to be developed, including content, materials, and tools such as case studies and identification of best practices." (UNESCO, 2004)*[86]

2.2.1. Declarations for Sustainability in Higher Education

Higher education institutions are role models to the society both in education and community development. They have the responsibility to guide communities for social improvement as well as environmental, social and economic sustainability. [87] There have been a high number of organizations, actions, and declarations in sustainable development in higher education institutions. These events and documents have an important task for universities and colleges to participate in the process of sustainability. For SD, universities have taken actions on the integration of sustainability into curricula, increasing research and development, training the staff, environmental management on campuses, and social activities with community participation. The declarations of SHE mentioned in this section are given in the table below (Table 2.3).

[85] Summers, D., & Cutting, R. (2016). Education for sustainable development in further education. London: Palgrave Macmillan. p.269.
[86] Sterling, S. (Ed.). (2010). Sustainability education: Perspectives and practice across higher education. Taylor & Francis.
[87] Bantanur, S., Mukherjee, M., & Shankar, R. (2015). Emerging dimensions of sustainability in institutes of higher education in India. International Journal of Sustainable Built Environment, 4(2), 323-329.

Table 2.3. *The chronology of sustainability in higher education declarations*

Date	**Event/declaration**
1972	The Stockholm Declaration On The Human Environment (UNEP 1972)
1977	Tbilisi Declaration (UNESCO 1977)
1978	International Environmental Education Program (UNESCO-UNEP 1978)
1990	University Presidents for a Sustainable Future: The Talloires Declaration (ULSF 2008)
1992	Agenda 21: Report of the United Nations Conference on Environment and Development (UNCED 1992)
1993	The Ninth International Association of Universities Round Table: The Kyoto Declaration (UNFCCC 1993)
1994	CRE Copernicus Charter (COPERNICUS 1994)
1997	International Conference on Environment and Society- Education and Public Awareness for Sustainability:
1998	World Declaration on Higher Education for the twenty-first century: Vision and Action (UNESCO 1998)
2000	The United Nation Earth Charter- United Nations millennium declaration (United Nations 2000).
2001	Lueneburg Declaration (UNESCO 2001)
2002	Ubuntu Declaration (United Nations 2002)
2005	The UN Decade Education for Sustainable Development (UNESCO 2010)
2012	UN Higher Education Sustainability Initiative within Rio+20 (United Nations 2012)
2015	Transforming our world: The 2030 agenda for sustainable development. (United Nations 2015)

In 1972, the common problems of SD regarding education were discussed in the Stockholm Conference on the Human Environment. The Stockholm Declaration, which is specifically relevant to educational institutions, proposed environmental education for all from primary to professional life (Principle 19).[88] In 1977, UNESCO arranged a conference on environmental education in Tbilisi, Georgia. It was emphasized in this meeting that environmental education has a great importance in preserving and developing the world environment.[89] In this conference, it was stated that the aims of environmental education were to raise awareness on economic, social,

[88] Declaration of the United Nations Conference on the Human Environment. Retriewed from: http://www.un-documents.net/unchedec.htm Accessed on November 2018.
[89] Intergovernmental Conference on Environmental Education. (1980). Environmental education in the light of the Tbilisi Conference. Unesco.

political and ecological issues in all regions, to encourage all people to have the knowledge, value, attitude, commitment and skills of the environment protection, to create new behavioral approaches for the environment as individual, group and community.[90] Table 2.4 shows the categorization of the environmental education purposes in the Tbilisi Conference Final Report.

Table 2.4. *The objectives of environmental education of the Tbilisi Conference Final Report* [91]

Awareness: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
Knowledge: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.
Attitudes:to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems.
Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

The United Nations UNESCO-UNEP International Environmental Education Program presented the concept of SHE internationally for the first time in 1978. Since then, there has been various universal declarations directly related to SHE. These declarations were accepted in the higher education community and approved and signed by many universities. In 1990, Talloires Declaration led to the official initiation of the universities' sustainability actions. With the Talloires Declaration, an

[90] Unesco, T. D. (1978). Intergovernmental conference on environmental education. Final Report. Paris.
[91] It was prepared to be inspired by this document: Unesco, T. D. (1978). Intergovernmental conference on environmental education. Final Report. Paris.

international model was presented that influenced the statements from universities.[92] This declaration, which was the first agreement on SHE, was signed by more than 350 university managements and chancellors in over 40 countries.[93] The critical points of the declaration was to raise awareness of environmental sustainability, to create a corporate cultural sustainability, to work for responsible people education, to encourage literacy rate of sustainability for all, to implement organizational ecology programs, to include every stakeholder, to cooperate on interdisciplinary attitudes, to increase the capacity and quality of schools, to expand service and welfare at global level, to continue the movement. The declaration stated that universities play an important part in training, research, development, practices, policies, and transformation of the information to achieve these key points.[94]

For this reason, university leaders must promote the actions of internal and external resources responding to this urgent challenge.[95] In the 1992 World Environment and Development Summit in Rio de Janeiro, SD took place on the global agenda. With this summit, the interests, awareness, and responsibilities of universities have increased, and the actions on sustainability have gained speed. The report of the United Nations Conference on Environment and Development, Agenda 21, includes titles to promote education, practices, general awareness (chapter 36) and scientific researches for SD (chapter 35). In Agenda 21, it was stated that education systems and governments have important responsibilities for SD. [96] In 1993, the Kyoto Declaration, which was closely related to Agenda 21, was signed by the universities. The Kyoto Declaration called for an open vision to achieving SD within universities. With the Kyoto Declaration, it was pointed out the need for specific action plans to achieve the sustainability goal of the international university community. It also drew

[92] Jones, P., Selby, D., & Sterling, S. (2010). The international background. Sustainability Education: Perspectives and Practice Across Higher Education.
[93] Declaration, T. (1990). University Leaders for a Sustainable Future.
[94] Ibid.
[95] Talloires Declaration. Retriewed from: _Accessed on November 2018.
[96] Declaration, U. R. (1992, June). Declaration of the UN Conference on Environment and Development. In Report of the United Nations Conference on Environment and Development (reprinted in 31 ILM 876). Rio de Janiero, Brazil: Annex (Vol. 1).

attention to the ethical dimension of universities in the principles of SD. The declaration required to promote sustainability, not only with environmental training, but also with the effective actions of the universities.[97] After Kyoto, Geneva Declaration (COPERNICUS- Conference of European Rectors (CRE), The university charter for sustainable development, Geneva, 1994), pointed out that all universities were responsible for creating a clear understanding of SD, consistently with their mission.[98]

Another significant event of SHE was the International Conference on Environment and Society: Education and Public Awareness for Sustainability which held in Thessaloniki by UNESCO in 1997. The Declaration of Thessaloniki, signed by 83 countries, acknowledged that the improvements in sustainability require partnership between universities, although some are highly resilient to change.[99] In 1998, the UN Commission on Sustainable Development and UNESCO released the World Declaration on Higher Education for 21st Century: Vision and Action. It was stated that sustainability is vital for the development of social, cultural and economic dimensions for the future within the skills, knowledge, and awareness of young generations. Therefore, the universities have missions to contribute to the development and progress of society as a whole, protected and strengthened.[100] In 2000, The United Nations Earth Charter stated a document of ethics and values for sustainable development, including the need for education.[101] Following years the Luneburg Declaration (2001), Ubuntu Declaration (2002) and the World Summit on Sustainable Development (2002) have stressed the crucial role of SHE. Since 2005,

[97] Wright, T. S. (2002). Definitions and frameworks for environmental sustainability in higher education. Higher education policy, p109.
[98] Ibid.
[99] Barlett, P. F., & Chase, G. W. (Eds.). (2004). Sustainability on campus: Stories and strategies for change. MIT Press. p.9.
[100] Mio, C. (2013). Towards a sustainable university: the Ca'Foscari experience. Springer.
[101] United Nations. Dept. of Public Information. (2000). United Nations millennium declaration. United Nations, Department of Public Information.

UNESCO has been working as a prominent agency to advance and disseminate studies, methods and educational practices on SD for the UN Decade of Education.

> *"Higher Education institutions have a highly relevant role in contributing to education for sustainable development (ESD) through the generation of knowledge related to sustainability challenges and the competences to tackle these challenges." (UNECE,2005)*[102]

In 2012, in the United Nations Conference on Sustainable Development (UNCSD) Earth Summit Rio+20, it was declared a document: The Future We Want. UNCSD Education Report stressed that higher education must take the right place in collaborative, interdisciplinary, cross-border contexts. In the report, the importance of the analysis of climate change issues, as the largest concern for SHE and the responsibilities of universities were outlined.[103]

> *"New forces are transforming higher education at a speed that could not have been foreseen ten years ago… Higher education institutions play a strategic role in finding solutions to today's leading challenges in the fields of health, science, education, higher education institutions to train teachers in the conduct of pedagogical research and develop relevant curricula that integrates the values of sustainable development. (Mr. Walter Erdelen, Assistant Director-General for Natural Sciences, UNESCO)"*[104]

In 2015, the UN issued a conclusion a report to follow post-2015 development agenda: Transforming Our World, 2030 Sustainable Development Agenda. The Agenda includes sustainable development goals (SDG) for a sustainable world and reformer steps urgently needed. The importance of providing access to affordable and high-quality higher education, which provides for comprehensive and equal quality education and lifelong learning potentials for everyone, was emphasized in detail (Goal 4.3). The goals and objectives of the Agenda state the needs for universal

[102] Fadeeva, Z., Galkute, L., Mader, C., Scott, G., & Mohun, S. (Eds.). (2014). Sustainable Development and Quality Assurance in Higher Education: Transformation of Learning and Society. Springer.
[103] Katiliūtė, E., Daunorienė, A., & Katkutė, J. (2014). Communicating the sustainability issues in higher education institutions World Wide Webs. Procedia-Social and Behavioral Sciences, 156, 106-110.
[104] Desha, C. (2013). Higher education and sustainable development: A model for curriculum renewal. Routledge.

literacy.[105] In 2017, UNESCO published a report called Education for Sustainable Development Goals Learning Objectives. The report included specific learning objectives for SDGs: awareness (cognitive), attitudes (socio-emotional) and action (behavioral). It was stated that the cognitive field includes the knowledge and thinking skills needed to improve understanding of SDG and the challenges. According to report, the socio-emotional field provides social skills that enable students to collaborate and communicate to support SDGs. This field also includes self-reflection skills, values, attitudes and motivations that enable students to develop themselves. It was also defined the behavioral field as action competency.

The organizations, actions, and declarations have increased to highlight the significant role of SHE. There is still much work to be done in terms of academic progress and learning strategies to integrate sustainability into higher education properly. In the next chapter, sustainability issues in architecture programs has been detailed this progress for higher education institutions.

2.2.2. Education for Sustainable Development in the Universities

For years, higher education has made a considerable effort in achieving development, progress and change in society. As these progresses and changes are becoming increasingly knowledge-based, higher education not only supports research and education, but also supports the development of society in terms of cultural, social, environmental and economic sustainability. It also faces challenges related to SD.[106] Universities bear the responsibility of contributing to a more sustainable society, as well as supporting sustainability principles.[107] As stated in the previous chapter, some declarations and events highlight education for sustainable development (ESD) principles in the context of higher education. Fundamental elements of ESD are to

[105] United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. Resolution adopted by the General Assembly.
[106] Unesco. (1998). World declaration on higher education for the twenty-first century: Vision and action. In World Conference on Higher Education. Ginebra: Unesco.
[107] Rammel, C., Velazquez, L., & Mader, C. (2015). Sustainability assessment in higher education institutions: what and how? In Routledge Handbook of Higher Education for Sustainable Development. Routledge. p355-370.

provide the essential tools for investigating, testing, developing and transmitting the conditions of transformative change.[108] In this regard, universities have responsibilities to cooperate with other universities, to promote interdisciplinary studies; to make SD a significant part of the organization structure, to operate practices in campus, and to educate the educators on the sustainability.[109]

According to Wals, while promoting SD in universities, sustainability activities need not be limited in environmental issues and sustainability must be integrated into existing curricula entirely.[110] For integrated SD in curricula, sustainability cannot be implemented as a simple attachment, in fact, it has to become a mainstream item. This institutionalization is achieved only when the idea of SD is adopted and integrated into the culture and daily activities of a university.[111] SD should become an integral and structural component of all aspects of higher education institutions.[112] Caeiro et al. stated that critical thinking on sustainability needs to be developed, and systematic studies should be carried out to further interdisciplinarity, the transition to sustainable universities and to improve SD debate.[113]

For the learning and practicing of SD, Scott and Gough (2003) have described three different approaches.[114] First is *'environmental problems understood, social solutions understood'* which supposes that all people face the environmental problems and they

[108] Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Leal Filho, W. (2013). Sustainability science and education for sustainable development in universities: a way for transition. In Sustainability assessment tools in higher education institutions. Springer, Cham. p3-27.
[109] Leal Filho, W., Brandli, L., Castro, P., & Newman, J. (Eds.). (2017). Handbook of theory and practice of sustainable development in higher education (Vol. 4). Springer.
[110] Wals, A. E. (2014). Sustainability in higher education in the context of the UN DESD: a review of learning and institutionalization processes. Journal of Cleaner Production, p8-15.
Leal Filho, W. (Ed.). (2009). Sustainability at universities: opportunities, challenges and trends. Lang.
[111] Lozano, R. (2006). A tool for a Graphical Assessment of Sustainability in Universities (GASU). Journal of cleaner production, p963-972.
[112] Tilbury, D. (2011). Higher education for sustainability: a global overview of commitment and progress. Higher education in the world, 4, p18-28.
[113] Caeiro, S., Leal Filho, W., Jabbour, C., & Azeiteiro, U. (2013). Sustainability assessment tools in higher education institutions: mapping trends and good practices around the world. Springer International Publishing. p.22
[114] Gough, S., & Scott, W. (2003). Sustainable development and learning: Framing the issues. Routledge. p111-116.

can be learned by science. It can be solved by suitable environmental and/or social movements and technologies. Second is *'social problems understood, social and environmental solutions understood'* which assumes that the main social and political problems produce environmental effects. These problems can be understood as everything from social-scientific analysis to attractiveness and domestic knowledge. Third is *'co-evolving problems and adaptive solutions'* which suggests that what is known today is not sufficient. [115]This indicates that learning should be open-ended and continuous. This approach leads to social learning by reflecting the uncertainty and complexities from our experiences today to the future.[116]

The International Implementation Scheme proposed some critical points of ESD which are interdisciplinary and holistic education of sustainability within curricula, the common values and principles supporting SD, leading the way to meet challenges of SD with critical thinking and problem solving, multiple methods with different pedagogies, participation of students in making decisions about learning process, and practicing the learning methods into daily and professional life, addressing local and global.[117]

2.3. Sustainability in Architectural Education

In 1996, the first attempt to promote sustainability in the architectural education at the international level was started by the European Commission with the help of several European architectural schools and research institutes.[118] By the aim of developing curricula and materials, Education of Architects in Solar-Energy and Ecology (EASE) project was launched for the international sustainable architecture. In the project, a survey was conducted on environmental quality and sustainable design lessons given

[115] Ibid.
[116] Vare, P., & Scott, W. (2007). Learning for a change: Exploring the relationship between education and sustainable development. Journal of Education for Sustainable Development, p191-198.
[117] UNESCO, 2006. Framework for the UNDESD International Implementation Scheme. Paris: UNESCO Education Sector.
[118] Gawad I. (2015) Embedding the International Dimension into sustainable architecture's curriculum and programs, Proceedings of the conference specialized in Architectural Education titled as: The INTED (9th International Technology, Education and Development Conference)

in different European architectural institutions. With the results of the survey, four main topics that should be included in the sustainable architecture curriculum and courses were identified: Philosophy as sustainable development approach, methods for life cycle evaluation, thermal simulation, daylighting education, techniques such as photovoltaic systems, passive cooling and products like transparent materials, environmental quality, energy storage. The results showed that the sustainability issues were discussed in the lectures of these architectural schools, but the curriculum and technical knowledge were insufficient.

The challenge of the curriculum for architectural schools is critical: There must be a significant transformation in education for architects to think as a leader in design processes based on sustainability in issues such as land, water, transport, engineering and construction materials.[119]AIA (2006) proposed some catalysts for sustainability integrated architectural education. These are architectural studio, history and theory classes, environmental laboratories, research centers at the university campus, design-build and the connections as participatory design with communities and building occupants, the green campus approaches, certificates and other programs like sustainable design certificate programs. AIA also emphasized the importance of specific catalysts such as teaching passive design, the solar decathlon as student demonstration projects and vital signs and agents of change, with a focus on environmental education for curriculum innovation.[120]

As the main subject of this study is sustainability in architectural education, it is aimed to investigate architectural education, architecture design studios which comprise the backbone of architectural education and their relations with sustainability.

[119] Gould, K. L. (2006). Ecology and Design: Ecological Literacy in Architecture Education, 2006 Report and Proposal. American Institute of Architects. p24.
[120] Ibid. p30.

2.3.1. Architectural Education

Architectural education is a multidisciplinary field that includes social sciences, humanities, physical sciences, creative arts, and technology. Creating competent, creative, innovative and ethical designers who contribute significantly to the social, cultural, economic development is the main objective of architectural education.[121] Architectural education includes some topics related to socio-cultural and political issues, professional practices, technological and industrial advancements, global problems, and science and knowledge objectives, while preparing architects for their professional lives.[122] Teymur (1993) stated that, architectural education has two main objectives:

- Support students to be creative, critical thinking, and ethically professional designers; and
- Educate to be good people who are intellectual, sensitive to the ecological environment and socially responsible for the world.[123]

For the necessity of creative skills of architectural education, Salama (1995) stated that the primary concern of the architects is to design spaces and forms related to human activities. The essence of these concerns is the balance. The first is the balance between formal and informal situations, and the second is the balance between competences of students' work, research and activities. According to Salama, the general philosophy of the architecture curriculum should be compatible with architectural education and the role of architects who will provide a better environment for contemporary societies.[124] Architectural education is not only limited to learning in the school environment but also allows for understanding, questioning

[121] Schreiber, S. (2010). Education for Architecture in the United States and Canada. Cited in Nazidizaji, S., Tome, A., Regateiro, F., & Ghalati, A. K. (2015). Narrative ways of architectural education: A case study. Procedia-Social and Behavioral Sciences, p1640-1646.
[122] Bulos, M., & Teymur, N. (Eds.). (1993). Housing: Design, research, education. Ashgate Publishing.
[123] Teymur, N. (1992). Architectural education: Issues in educational practice and policy. ? uestion Press.
[124] Salama, A. (1995). New trends in architectural education: Designing the design studio. Arti-arch.

and transforming the knowledge of the architectural environment in. Accordingly, architectural education should have critical thinking skills, having opinions on social relations and the production of information that changes according to the conditions of the age.

In 1956, Benjamin Bloom et al. proposed a framework for classifying educational aims: Taxonomy of Educational Objectives. Considering a taxonomy of educational purposes, Bloom demonstrated a classification framework that also applies to architectural education. In this classification developed by Anita Harrow (1972), the cognitive domain is divided into six which is given in the Table 2.5.

Table 2.5. *A framework for Taxonomy of Educational Objectives* [125]

Knowledge: To recognize or remember the information.
Comprehension: To prove that the student has sufficient understanding to organize the material mentally.
Application: A question that asks a student to apply for an answer to the information he/she learned earlier.
Analysis: High-level questions that require students to think critically and in depth.
Synthesis: A higher grade question that asks the student to carry out original and creative thinking.
Evaluation: A higher-level question without a single correct answer.

The main objective of a current education curriculum is to provide students to have the ability of new knowledge in real life. Bloom's taxonomy of educating learning

[125] It was prepared to be inspired by this document: Ghaziani, R., Montazami, A., & Bufton, F. (2013). Architectural Design Pedagogy: Improving Student Learning Outcomes. In AAE Conference.

theories analyzes teaching with these six levels.[126] The students need to examine in detail the value of an idea or the solution to a problem. Given the taxonomy of Bloom and the nature of design, a process of analytical learning, critical reviews, and creative decision-making, architecture students can be able to practice what they have learned in the studio to the different analysis stages and the synthesis of the design studies.

Founded in 1947, The International Union of Architects (UIA) is an international non-governmental organization guiding to architectural education and professional practice.[127] Since the 1970s, UIA has partnered with UNESCO to address the increasing complexity of the profession and the role of the architect. In 2002, the UIA Architectural Education Commission prepared a document called: UIA and architectural education reflections and recommendations(Berlin, July 2002).[128] In the document, the purpose of the International Union of Architects is stated as to establish internationally recognized qualification standards and to work towards mutual recognition; to promote the protection of the rights and status of architects in each country and the identification of their functions in society; to support all aspects of the development of architectural education and to facilitate the exchange of architects, researchers and students in international area.UIA emphasizes the need to acquire the following skills in architectural education: Design, Knowledge, Skill.

[126] Mahdavinejad, M., Samadzadeh, S., Bostani, S., Rafiei, S., Mousavi, K., & Samadzadeh, S. (2014). Nature-Oriented Architectural Learning in Contemporary Educating Environment Paradigms. Procedia-Social and Behavioral Sciences, 131, 432-435.

[127] Gawad I. (2015) Embedding the International Dimension into sustainable architecture's curriculum and programs, Proceedings of the conference specialized in Architectural Education titled as: The INTED (9th International Technology, Education and Development Conference)

[128] Riguet, J. C., General, S., -Cox, L., Mejia, S. M. G., Hyett, P., Koudryavtsev, A., Scheeler, J. (2008). UIA and architectural education reflections and recommendations. XXIIth UIA Geneal Assembly (Berlin, Germany, July 2002), 1-43.

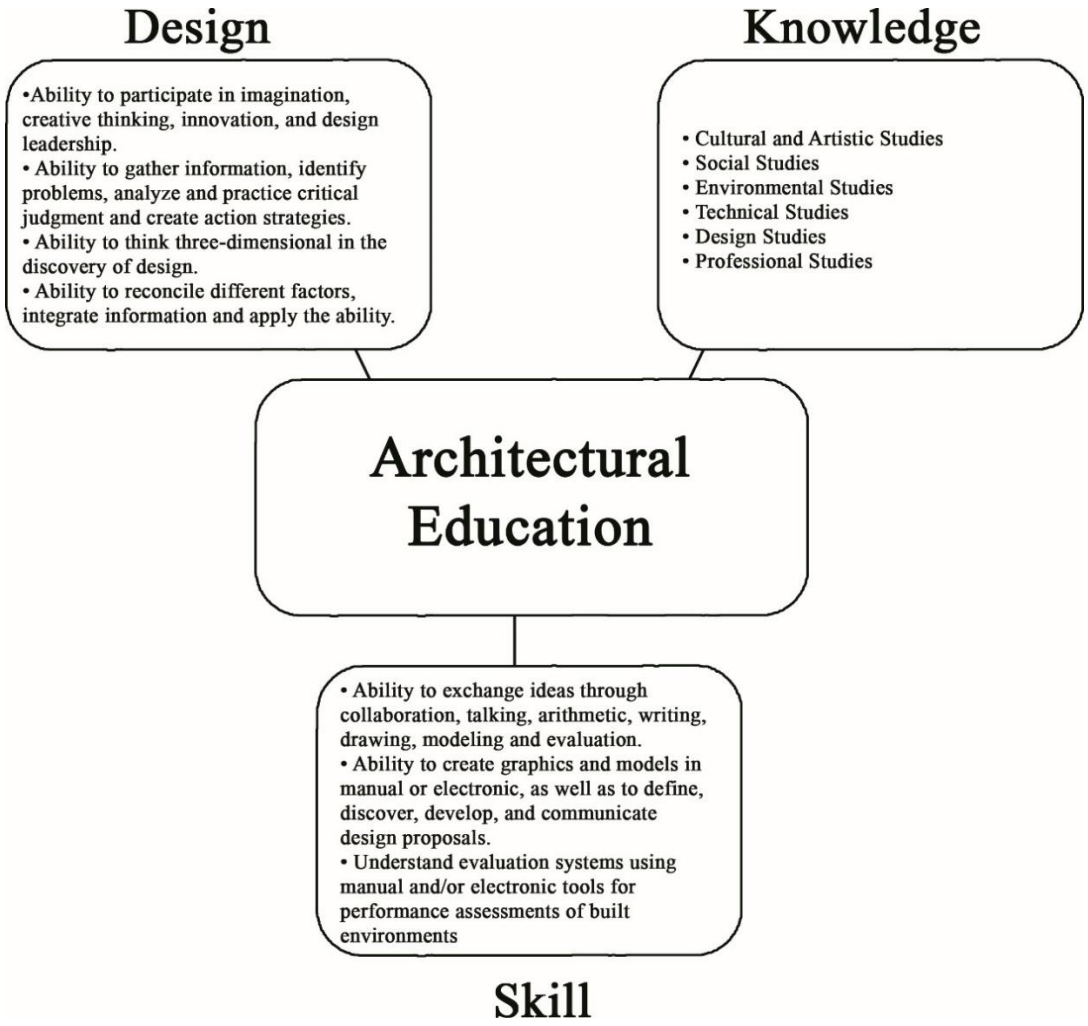

Figure 2.2. The Needs of Architectural Education [129]

At the 24th World Congress 'Design 2050- Beyond disasters, through solidarity, towards sustainability', UIA partnership with UNESCO provided the opportunity to exchange views and share sustainable architectural visions with architects from all over the world. Afterward, UIA published a charter that initiated the creation of a global architectural education network to provide solutions to the problems of architectural education and the challenges experienced by architects in their professional practices. In addition to the previous statements, with this charter, the

[129] It was prepared to be inspired by this document: Riguet, J. C., General, S., Cox, L., Mejia, S. M. G., Hyett, P., Koudryavtsev, A., Scheeler, J. (2008). UIA and architectural education reflections and recommendations. XXIIth UIA Geneal Assembly (Berlin, Germany, July 2002), p1-43.

importance of sustainability is emphasized. UIA stated that this charter is a framework that guides students and instructors of all institutions participating in education of architecture and planning. The main concerns expressed by the charter are the aesthetic, social, technical and financial views of professional life which is the awareness of the role and responsibility of the architect in their society with the progress of the quality of life by sustainable human settlements.[130]

According to Salama et al., modifications in the architecture curricula should be made to respond to changing architectural practices, needs, and concerns brought by years. Architecture curricula should continuously make attempts to question the existing educational approaches and build its future structure. There are some accreditation systems to follow these developments in architectural education, to offer solutions and to evaluate curricula at a national level.[131] Architectural curricula are complemented by formal and rigorous accreditation processes whose core function is to ensure the quality, relevance and competent performance of the students. There are also regional, national and international conferences where educators gather to argue for the future of education, in particular, the impact of the new global order and international economic crises. Unfortunately, there are still many shortcomings in the architecture curriculum, despite the extensive research on architectural and urban design education and the design studio.[132]

In the USA, there are five national organizations that play several roles in architectural education, which are National Council of Architectural Registration Boards (NCARB), the American Institute of Architects (AIA), Association of Collegiate Schools of Architecture (ACSA), American Institute of Architecture Students (AIAS) and the National Architectural Accrediting Board (NAAB). In 1993, these five

[130] UNESCO (2011). UIA Charter for Architectural Education. Tokyo, Japan: International Union of Architects.
[131] Salama, A. M., O'Reilly, W., & Noschis, K. (2002). Architectural education today: Cross-cultural perspectives. ARTI-ARCH. p.9.
[132] Salama, A. M. (2016). Spatial design education: New directions for pedagogy in architecture and beyond. Routledge. p.102.

organizations launched a study on vocational education and practice.[133] In the report of this study, it was stated that these organizations' priorities were to have the most comprehensive impact on how schools and the profession itself would cope with them in the next century. The report examined the problems of architectural education and recommends frameworks for renewal of curricula which have some important suggestions regarding sustainability. [134] About the accreditations systems and their concerns of sustainability were investigated for this thesis and given below.

In 1981, the National Architectural Accreditation Board (NAAB) proposed certain standards for architectural education: Basic Knowledge, Design, Communication, and Practice. According to NAAB, the educational pedagogy of the courses started with the strengthening of the relationship between theory and architecture practice.[135] NAAB requires for understanding the historical, socio-cultural and environmental context of architecture.[136] The NAAB Student Performance Criteria has 34 requirements divided into three areas: technical skills, knowledge and building practices.[137] In the accreditation requirements of NAAB, some of the criteria which are expected from students to have the understanding and ability are related to sustainability: Sustainable Design, Environmental Systems, Comprehensive Design, Building Materials and Assemblies and Building Systems Integration. With sustainable design criteria, it is required to be able to understand the principles of sustainability. It emphasizes the importance of sustainability in architectural and urban design, building healthy buildings and communities. With the comprehensive design criteria, it is explained the ability to produce an extensive project based on

[133] Wright, J. (2003). Introducing sustainability into the architecture curriculum in the United States. International Journal of Sustainability in Higher Education, 4(2), 100-105.
[134] Boyer, E. L., & Mitgang, L. D. (1996). Building Community: A New Future for Architectural education and Practice. A Special Report. California Princeton Fulfillment Services.
135 Bovill, C., Gardner, A. E., & Wiedemann, G. (1997). Intention, form, and execution: A comprehensive studio curriculum. Journal of Architectural Education, 51(2), 84-91.
[136] NAAB. (2004). NAAB Conditions for Accreditation for Professional Degree Programs in Architecture, 2004 Edition.
[137] Ismail, M. A., Keumala, N., & Dabdoob, R. M. (2017). Review on integrating sustainability knowledge into architectural education: Practice in the UK and the USA. Journal of Cleaner Production, 1542-1552.

sustainability principles, structural and environmental systems. In the Environmental Systems criteria, it is indicated the comprehensibility of basic materials and applications of systems based on energy efficient use. The Building Systems Integration criteria describe the integration and evaluation of different methods including the environmental systems. Finally, with the Construction Materials and Assemblies, it is explained the understanding of the environmental impacts and applications of construction materials and products.[138]

The British Institute of Architects (RIBA) which was founded in 1834, promotes the development of Civil Architecture and the various arts and sciences associated with it and to facilitate access to information. [139] In RIBA Working Plan 2013, it was expressed the requirements for sustainability and set tools implementing sustainability in the projects. Some of these tools are design brief to verify sustainability requirements; sustainability in identifying critical areas of design focus; design development to review design, resource utilization, and waste reduction opportunities and to identify and design full formal sustainability assessment.[140] The RIBA also established the Core Curriculum was to ensure that basic architectural skills are addressed in learning activities. In 2017, RIBA started a completely new topic in the updates of the Core Curriculum: Architecture for social purposes. With this topic, it is highlighted the economic and environmental benefits that architecture brings to individuals and communities and discusses the understanding of social value for architecture.[141]

In Turkey, Architectural Accrediting Board (MIAK) founded in 2008 has been a pioneer for the accreditation process of the architecture curriculum. According to MIAK, architectural education should question the relationship between architecture and the fields of culture, art, science, society, environment, technology and

[138] NAAB. (2004). op. cit., p.12-16.
[139] The British Institute of Architects (RIBA). https://www.architecture.com/education-cpd-and-careers/membership-and-accreditation- Accessed on March 2019.
[140] Gething, B. (Ed.). (2011). Green overlay to the RIBA outline plan of work. RIBA Publishing.
[141] RIBA CPD Report (2017), Retrieved from: https://www.architecture.com/education-cpd-and-careers/cpd/cpd-core-curriculum- Accessed on March 2019.

architecture. It was also stated architectural education should aim to develop the capacity of conceptualizing, designing and realizing by using various representation tools. One of the MIAK accreditation criteria is the ability to reach new and distinctive results in the context of sustainability and universal design principles.[142] Table 2.6 shows the different aspects of these institutions.

[142] MiAK Accreditation Requirements (For Architecture Undergraduate Programs)-2014. Retrieved from: http://www.miak.org/- Accessed on March 2019.

Table 2.6. *Some accreditation boards in architectural education*

UIA (2017)	NAAB (2015)	RIBA (2014)	MIAK (2014)
A. Design • Ability to engage imagination, think creatively, innovate, and provide design leadership. • Ability to gather information, define problems, apply analyses and critical judgement, and formulate strategies for action. • Ability to think three dimensionally in the exploration of design. • Ability to reconcile divergent factors, integrate knowledge and apply skills in the creation of a design solution. **B. Knowledge** **• Cultural and Artistic Studies** **• Social Studies** **• Environmental Studies** • Technical Studies • Design Studies • Professional Studies **C. Skill** • Ability to work in collaboration with other architects and members of interdisciplinary teams • Ability to act and to communicate ideas through collaboration, speaking, numeracy, writing, drawing, modeling, and evaluation. • Ability to utilise manual, electronic, graphic and model making capabilities to explore, develop, define, and communicate a design proposal. • Understanding of systems of evaluation that use manual and/or electronic means for performance assessments of built environments.	**Realm A: Critical Thinking and Representation** **A1** Professional Communication Skills **A2** Design Thinking Skills **A3** Investigative Skills **A4** Architectural Design Skills **A5** Ordering Systems **A6** Use of Precedents **A7** History and Culture **A8 Cultural Diversity and Social Equity** **Realm B: Building Practices, Technical Skills and Knowledge** **B1** Pre-Design **B2** Site Design **B3** Codes and Regulations **B4** Technical Documentation **B5** Structural Systems **B6 Environmental Systems** **B7** Building Envelope Systems and Assemblies **B8** Building Materials and Assemblies **B9** Building Service Systems **B10** Financial Considerations **Realm C: Integrated Architectural Solutions** **C1** Integrative Design **C2** Evaluation and Decision Making **Realm D: Professional Practice** **D1** Stakeholder Roles in Architecture **D2** Project Management **D3** Business Practices **D4** Legal Responsibilities **D5** Professional Ethics	**GC1 Ability** to create architectural designs that satisfy both aesthetic and technical requirements. **GC2 Adequate knowledge** of the histories and theories of architecture and the related arts, technologies and human. **GC3 Knowledge** of the fine arts as an influence on the quality of architectural design. **GC4 Adequate knowledge** of urban design, planning and the skills involved in the planning process. **GC5 Understanding** of the relationship between people and buildings, and between buildings and their environment, and the need to relate buildings and the spaces between them to human needs and scale. **GC6 Understanding** of the profession of architecture and the role of the architect in society, in particular in preparing briefs that take account of social factors. **GC7 Understanding** of the methods of investigation and preparation of the brief for a design project. **GC8 Understanding** of the structural design, constructional and engineering problems associated with building design. **GC9 Adequate knowledge of physical problems and technologies and the function of buildings so as to provide them with internal conditions of comfort and protection against the climate, in the framework of sustainable development.** **GC10 The necessary design skills** to meet building users' requirements within the constraints imposed by cost factors and building regulations. **GC11 Adequate knowledge** of the industries, organisations, regulations and procedures involved in translating design concepts into buildings and integrating plans into overall planning.	**I) Architecture-Design / Creative Thinking** • Critical Thinking • Communication • Research • Design **II) Architecture-History / Theory, Culture / Art** • World Architecture • Local Architecture/Cultural Diversity • Cultural Heritage and Conservation **III) Architecture- Environment / City / Society** **• Sustainability** • Social Responsibility • Nature and Human • Geographical Conditions **IV) Architecture - Technology** • Life Safety • Building Structures • Building Physics and Environmental Systems • Building Shell Systems • Building Service Systems • Building Materials and Applications • Integration of Building Systems **V) Architecture - Professional Environment** • Program Preparation and Evaluation • Extensive Project Development • Observing Building Cost • Architect-Employer Relationship • Teamwork and Collaboration • Project management • Application Management • Leadership • Legal Rights and Responsibilities • Professional Practice • Professional Ethics

Accreditation is as a critical criterion for measuring the quality of academic programs. With the accreditation programs mentioned above, it is seen that all of them attach importance of architectural education and practice to ensure a global responsibility on sustainability.[143] Accreditation institutes of architectural education are getting more attention to the integration of sustainability into the curriculum in pedagogy and practice. The reflections of this integration on design education in the architecture curricula are discussed in the next chapter.

2.3.2. Architectural Design Studio

> *"Designers are not trained sufficiently to achieve positive change for people living in undeserving conditions. Design education has to evolve radically to ensure young designers have the capacity to bridge the gap between design and construction, understand the nuances of diverse sites and territories, and communicate more profoundly with local communities and stakeholders. In short, instill a greater social empathy. Manual skills must be developed on the same footing as digital and intellectual skills. Designing the right process must be equally as important as the outcome." (Laufen Manifesto for Humane Design Culture,2013)*[144]

Architectural design studios are at the heart of architectural education, a place of basic learning and experience, providing a good pedagogical learning process.[145] Design studios lead to the students to visualize, represent their thoughts graphically, find solutions to the problem like an architect.[146] According to Salama (1995), the task of architecture is to create a meaningful environment which involves three-dimensional structures for human activities. Therefore, design education provides the ability to coordinate and exhibit a conceptualized building idea based on humanism.[147] As a project-based education model, design studios explore design propositions and results,

[143] Wright, J. (2003). Op cit.
[144] Stonorov, T. (Ed.). (2017). The Design-Build Studio: Crafting Meaningful Work in Architectural education. Routledge. p.2
[145] Ghaziani, R., Montazami, A., & Bufton, F. (2013). Architectural Design Pedagogy: Improving Student Learning Outcomes. In AAE Conference.
[146] Salama, A. M. (2006). Design studio teaching practices: Between traditional, revolutionary, and virtual models. Open House International, 1-116.
[147] Salama, A. (1995). New trends in architectural education: Designing the design studio. Arti-arch. p9.

emphasizing an experimental and iterative process. [148] The design studios focus on creativity, improving drawings and sketches for the projects and also problem-solving and communication for the collaboration. Discussion, conjecture, imagination, and stretching are the nature of architecture projects carried out in the studio.[149]

In architectural education, the design studios teaching method has been used for a long time and is an example of teaching in other disciplines.[150] One of the major paradigms that have a significant part in the development of architectural design education is the Beaux-Arts tradition. Ecole des Beaux-Arts is the first well-established school of architecture in architectural education that provides close training to the method employed in today's design studios.[151] The Beaux-Arts atelier system aimed to develop students' analytical and structural thinking and, also, improve their artistic skills.[152] At the center of École Beaux-Arts Architecture School was the studio which is also under the French name; atelier.[153] The studio was the place where student groups produced designs in response to architectural competitions. Each studio was run under the supervision of a master architect.[154] At École des Beaux-Arts, designers worked in a craftsman's studio for several years until they thought they were qualified to work on their own, gained enough knowledge and skills, and understood the master's approach to design and methods. The curriculum of the school had two aspects: practical and formal. Like in craft training, in practical education students learned to work with different materials such as stone, glass, timber, clay, and metal. In formal education which focused on color, space, and design theories; the students searched solutions to

[148] Rogers, J., & Shepherd, J. (2009). The problem with consensus: The contested terrain of sustainability in a university setting. Environmental Ethics, Sustainability and Education, p232.
[149] Green, L. N., & Bonollo, E. (2003). Studio-based teaching: history and advantages in the teaching of design. World Transactions on Eng. and Tech. Edu, 2(2), 269-272.
[150] Boyer, E. L., & Mitgang, L. D. (1996). Op cit.
[151] Uluoğlu, B. (1990). Mimari tasarım eğitimi: tasarım bilgisi bağlamında stüdyo eleştirileri, (Architectural Design Education: Design Knowledge Communicated in Studio Critiques), ITU (Doctoral dissertation).
[152] Drexler, A. (1984). The Architecture of the Beaux-Arts. London: Secker & Warburg.
[153] Goldschmidt, G., Hochman, H., & Dafni, I. (2010). The design studio "crit": Teacher–student communication. AI EDAM, 24(3), 285-302.
[154] Ostwald, M. J., Williams, A., Learning, A., & Council, T. (2008). Understanding architectural education in Australasia. Australian Learning and Teaching Council.

the architectural form problems through observation, representation, and composition.[155]

The other major paradigm in architectural design education is the Bauhaus School. In the Bauhaus school, the theoretical curriculum of the art academy was combined with the practical curriculum of the art and craft school, and the basis of a comprehensive system for students was established. With all its creative efforts, Bauhaus was trying to achieve the unification of all education in art and design in architecture. [156] Gropius (1992) stated that the fundamental goal of Bauhaus is the Building which is a common artwork that has no obstacles between structural art and decorative arts. For this reason, the Bauhaus guiding principle was the idea of creating a new unity by bringing together the source of many arts and movements. With the Bauhaus, it is seen that the interaction between the student-instructor (master-apprentice) and the teaching method with this interaction have gained importance. According to Gropius; education aims to teach a method and an approach to problems, rather than learning a certain knowledge-skill. Practical and theoretical studies are carried out simultaneously to assist learning the physical nature of materials and the fundamental elements of design, to release their creative powers. The basis for Bauhaus education is the demand for a new and strong working relationship of all creative processes.[157] While using methods are different, there are some common aspects between Bauhaus and Beaux-Arts Schools. [158] The first of these is that Bauhaus, as in Beaux-Arts, considers design education as a process of behavior development, and the second is that it accepts the existence of universal truths, whether it is in the architect him/herself or nature.[159] In the Bauhaus School, the effort to integrate different fields of art and crafts within the discipline of design takes priority. The approach that the tutors teach is adopted a

[155] Pasin, B. (2017). Rethinking the Design Studio-Centered Architectural Education. A Case Study at Schools of Architecture in Turkey. The Design Journal.
[156] Gropius, W. (1992). "The Theory and Organization of the Bauhaus"(1923). Art in.
[157] Gropius, W. (1992). "The Theory and Organization of the Bauhaus"(1923). Art in.
[158] Arıdağ, L., & Aslan, A. E. (2012). The Effect of Creative Drama Activities Performed at the "Design Studies-1" Studio on Development of Creative Thinking Skills of Architecture Students. Megaron, 7(1), 49.
[159] Uluoğlu, B. (1990). Op cit.

training model, built on the culture of learning together instead of the master-apprentice relationship.[160]

The design studio has been at the center of architectural education since the 19th century.[161] It can be seen that architectural design education is becoming more important due to the changing nature of the studio tradition to the present day, from the Beaux-Arts and Bauhaus schools. According to Charalambous et al., based on post-industrial development; the advancement of disciplines, expertise, material, system, and digital equipment have brought about a fundamental change in contextual frameworks in which architectural design. These developments pave the way for a kind of design studio that includes a collaboration and interdisciplinary communication.[162]

> *"The architectural studio has developed traditions of learning- by- doing- the tradition of project-based education, which often seems innovative when it is introduced to other professional schools; the more particular traditions of work, review, and the less easily nameable traditions that inform the ways in which groups of students learn from and with one another. These evolved gradually over many years and contribute to a rich context for learning-by-doing." (Schön,1985)*[163]

Donald Schön (1988) emphasized that architecture is a hybrid and is an experience of feeling the spaces, a profession dealing with the design of buildings and an art based on forms. Design starts with the representation of a non-exist idea, dream, and desire. Schön (1981) defines the design as a graphic and verbal language which include a complementary and integral connection of drawing and speaking.[164] Schön (1985) also stated that architectural studio is a training example for art and problem

[160] Yücel, S. (2015). Türkiye'de Mimarlık Ortamı Ve Mimarın Eğitimi (Architectural Habitat in Turkey and Architect's Education), ITU (Doctoral dissertation).
[161] Schön, D. A. (1985). The design studio: An exploration of its traditions and potentials. International Specialized Book Service Incorporated.
[162] Charalambous, N., & Christou, N. (2016). Re-adjusting the objectives of Architectural Education. Procedia-Social and Behavioral Sciences, p375-382.
[163] Schön, D. A. (1985). Op cit. p6.
[164] Schön, D. (1981). Learning a language, learning to design. Architectural Education Study, 1, 339-471.

determination and there is a lot to learn from the studio.[165] He identified key concepts in architectural education that created reflective learning and reflective practitioner theories. There were two concepts at the center of Schön's design learning approach. It was stated that students needed to participate in studio-based projects to learn how figure out the complexity of the projects in the professional life. Second was the formation of reflections in the design process. These reflections consisted of the students' thoughts, observations and re-adaptation to the projects.[166] According to Schön; the architectural design studio is a virtual world where there are practices that represent the real world, away from distraction or risk. He expressed that in the studios, students learn to think, methods, tools, and practice by doing. He continued this argument with that students develop the idea with the help of a 'master' who criticizes, questions, guides and gives suggestions like a coach.[167] So, the design studio is the place to learn and teach architectural design, where students communicate with each other and develop their project by taking comments from the lecturers. The students have the opportunity to test their skills in professional life through the design studio.[168]

Gross and Do (1997) defined the architectural design studio as follows: Traditionally, architectural design practice is related to project-based 'studio' approach. In architectural studios, designers who make the idea, do researches, build and evaluate alternatives take decisions and action. According to Gross and Do; designers make external representations such as drawing and models and use these representations to question and test hypotheses about their design. Through connected drawing, overview and evaluation, designers produce alternatives, interpret the results and discover new solutions. So, in the studio environment, students find out to

[165] Schön, D. A. (1985). Op cit.
[166] Webster, H. (2008). Architectural education after Schön: Cracks, blurs, boundaries and beyond. Journal for Education in the Built Environment, 3(2), 63-74.
[167] Schön, D. A. (1988). Toward a marriage of artistry & applied science in the architectural design studio. Journal of Architectural Education, p4-10.
[168] Kvan, T., & Jia, Y. (2005). Students' learning styles and their correlation with performance in architectural design studio. Design Studies, 26(1), 19-34.

communicate, evaluate, respond to criticism, and collaborate working.[169] Corona-Martinez (2003) stated that the design studio is the place that the student learns to design, and the design is considered to be the main activity for an architect. Thus, the studio is the fundamental element of design learning which is a major activity of the future architects to become a good designer.[170]

Arıdağ and Aslan stated that today design studios support the students' own experience and search, but it is also influenced by the professional, pedagogical competence and weaknesses of the studio instructor. According to them, design studio instructors have different skills to teach and design with a starting point for improving education.[171] The design studios are study areas where students discover some skills with the help of studio tutors. So, the tutors work with the students during the period of the design course, and then the students continue to improve their projects.

Most review highlighted the importance of the architectural design in the architectural education. The content, methods, techniques, and tools of architectural design education are seen as a rich research area that can be examined and questioned. Salama stated that there is a lack of research in the architectural education and design teaching applications.[172] According to Salama, in architectural education, theoretical and practical discussions should be questioned and critically examined in existing procedures, contents, methods, and tools. Along the same line, Suha Özkan refers that design skills in architectural education, apart from the one-to-one relationship between the lecturer and student in the design studios, are supported by the branches as grouped by the learning which is generally called 'theory lessons': History, Theory, and Criticism (HTC). Özkan continues this argue with that these three areas of knowledge

[169] Gross, M. D., & Do, E. Y. (1997, September). The design studio approach: Learning design in architectural education. In *Design Education Workshop* (Vol. 8). Georgia Institute of Technology.
[170] Lueth, P. L. O. (2008). The architectural design studio as a learning environment: a qualitative exploration of architecture design student learning experiences in design studios from first-through fourth-year. Doctoral thesis of Iowa State University.
[171] Aridağ, L., & Aslan, A. E. (2012). Op cit.
[172] Salama, A. (1995). New trends in architectural education: Designing the design studio. Arti-arch.

come together to form the basis of non-studio teaching and have common features related to architecture goals in professional life and working styles.[173]

2.3.3. Sustainability Awareness in Architectural Education

Architecture has an important role in the development of sustainability. Professionals with an integrated knowledge of local issues and global standards need to be trained.[174] To accomplish that, architecture programs need to implement a sustainable architectural education curriculum properly. In this regard, the three dimensions of sustainability, environment, society, and economics are the main point in integrating this to the course content. The aim is to supply the essential information for the professionals to deal with current and future problems and to find sustainability design methodologies with tools and technologies.[175] Many students graduate poorly to integrate the economic, environmental, cultural and social aspects of sustainability into their profession, to see opportunities or potential benefits in implementing sustainable practices in professional life.[176]

The architecture curriculum is having a broad range of theoretical and technical issues which provide students to equip with the knowledge, awareness, and abilities necessary to the design decisions.[177] Altomonte (2009) argues that the proper adoption of sustainable design requires an important review of the educational process from the beginning of the architecture curriculum to the progress of practicing architects. He emphasizes that it is primarily necessary to determine the current situation according to technical and environmental awareness, information and needs in architectural practices; also, to associate with pedagogical methods used in higher education and architecture training according to specific criteria that can be proposed in the curricula.

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[173] Özkan, S. (2002). Foreword: Changes in Education of Architects. In the book of Architectural education today: Cross-cultural perspectives. ARTI-ARCH. p.7.
[174] Wright, J. (2003). Op cit.
[175] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016). Op cit.
[176] Sterling, S., Maxey, L., & Luna, H. (Eds.). (2013). The sustainable university: Progress and prospects. Routledge.p7.
[177] Altomonte, S. (2009). Environmental education for sustainable architecture. Review of European Studies, p12.

He continues to this argument that these needs must be entirely adopted at the progress of the curriculum for architectural practice and accepted by the institutions currently regulating access to the profession.[178]

Wright stated three different approaches on integration of sustainability into the architectural curriculum.[179] The first is the belief that sustainable design is fundamental. The advantage of this approach is that sustainable design is as important as theory and practical lessons. The second approach develops from existing courses on environmental control systems (ECS). This approach mentions that the curriculum is generally unchanged and interest in ECS and environmental issues is increasing. The third is to integrate the subject into all the coursework fully and to specify it in the curriculum. It is needed a review of the whole curricula. The advantage of this approach is that it integrates the entire faculty, including the design studio, into sustainability and all subjects. [180] Kahn et al. stated that there was an important gap between architectural education and practice. They emphasized that the concepts of sustainability, ecology and energy should be re-considered in architectural education and should be taught as design requirements.[181] According to Kock et al.; more integrated architectural education should be encouraged, which not only improves the approaches of students but also develops a connected understanding of architectural disciplines.[182]

In consideration of these arguments, it is clear that architecture curricula need to be developed carefully to integrate sustainability into architecture programs. The curriculum should promote a holistic pedagogy combining technical and professional

[178] Ibid.
[179]Wright, J. (2003). Op cit.
[180] Ibid.
[181] Khan, A. Z., Vandevyvere, H., & Allacker, K. (2013). Design for the ecological age: Rethinking the role of sustainability in architectural education. Journal of Architectural Education, 67(2), 175-185.
[182] Kock, A., Schwennsen, K., Dutton, T. A., & Smith, D. (2002). The Redesign of Studio Culture. A Report of the AIAS Studio Culture Force.

issues with a creative and sensitive design approach to environmental needs.[183] According to Altomonte, architecture curriculum development should aim to advance the transfer of information between theoretical and practical courses, which is the basis for sustainable architecture.[184] In 2005, the Higher Education Funding Council for England (HEFCE) published a document on Sustainable Development in Higher Education, which provides a plan and perspective that can support SHE.[185] It was emphasized that in the broader scope of institutional change related to sustainability includes the development of curricula, teaching methods and extra-curricular actions to contribute to sustainable development.[186]

The European Commission Energy Agency for Competitiveness and Innovation (EACI) promoted an activity in the Intelligent Energy Europe 2008 Program: Environmental Design in University Curricula and Architectural Training in Europe (EDUCATE).[187] With the EDUCATE project, Altomonte et al. (2010) carried out a comprehensive research and conducted a survey, focusing on the integration of sustainability to the European schools after the Bologna process. According to EDUCATE project; promoting sustainability in the design was fundamental to address the challenges facing humanity to resource management, climate change, environmental degeneration, and energy consumption. It was stated difficulties of integration of environmental sustainability successfully into a creative design process. The aim of EDUCATE project was to determine the challenges and opportunities associated with the applications of sustainability in architectural education and also to explore the plans and scenario needed to promote sustainability.[188] The project also

[183] Altomonte, S., Rutherford, P., & Wilson, R. (2014). Mapping the way forward: Education for sustainability in architecture and urban design. Corporate Social Responsibility and Environmental Management, 143-154.
[184] Ibid.
[185] HEFCE (2005a) Sustainable Development in Higher Education: Consultation on a Support Strategy and Action Plan, HEFCE, Bristol
[186] Sterling, S. (Ed.). (2010). Op cit.
[187] Altomonte, S. (2010). Environmental Design in University Curricula and Architectural Training in Europe. In International Barcelona Conference on Higher Education (Vol. 5).
[188] Environmental Design in University Curricula and Architectural Training in Europe (EDUCATE)-Retrieved from: https://ec.europa.eu/energy/intelligent/projects/en/projects/educate- Accessed on November 2018.

gained the supports of many architects, experts, and associations of professionals in all European countries. Altomonte et al. mentioned that the project support to develop knowledge and skills in sustainable environmental design, which aims to ensure comfort, prosperity and energy in new and existing buildings.[189] It was highlighted that, the project mission was to introduced a design process integrated with cultural, economic and social aspects at every stage of education. The other objectives they stated were:

- To remove educational obstacles integrating environmental sustainability into a creative design;
- To build up an online network that provides relations between higher and post-professional education,
- To establish a model for sustainability in architectural education that harmonizes design and technical information;
- To offer convenient criteria and accreditation of the curriculum that measure the requirements and the knowledge, ability, and capacity for sustainable environmental design;
- To spread information and examples of best practices to others. [190]

Altomonte stated that the first project of EDUCATE was to examine the status of environmental sustainability in higher education and accreditation and professional registration conditions. For this it was selected different curriculum structures from academic organizations in participating European member (United Kingdom, Belgium, Germany, Italy, Spain, Hungary, 29 curricula), a number of other European (not members of the project, 23 curricula) and non-European countries (10 curricula) and analyzed existing course curricula, delivery methods, evaluation criteria, etc.[191] It was highlighted that the project supported to systematization of the current situation

[189] Ibid.
[190] Altomonte, S. (Ed.) (2012). Sustainable Architectural education, White Paper. Nottingham. Retrieved from: www.educate-sustainability.eu- Accessed on November 2018.
[191] Altomonte, S. (Ed.) (2012). Education for Sustainable Environmental Design, Summary of Results. Nottingham. Retrieved from: www.educate-sustainability.eu- Accessed on November 2018.

of architecture curricula and to develop sustainability integrated curricula.[192] Another important project of EDUCATE was gathering data for the evaluation of the awareness and knowledge on sustainable environmental design among the architecture companies with approximately 400 questionnaires from 40 different countries. It was stated that the aim was to learn the ideas and priorities of the practitioners according to their experiences in design practice and sustainability approaches.[193] Moreover, one of the purposes was to manage a process designed to enable the university curriculum to meet the needs of graduates to work in the changing profession life. [194] It was mentioned that the responses were mostly agreed that sustainable environmental design constitutes was an essential part of the design approach in practice and sustainable design should be included in the architecture curricula.[195]

With the EDUCATE project, it was conducted an educational and professional program that can support the integration of sustainable design into architectural education and practice.[196] The project proposed a framework to support sustainable architectural and urban design practice and to measure and demonstrate knowledge, skills, and competence in environmental sustainability. It was focused on five steps: 'Academic Education; Internship; Professional Training; Professional Examination; and Continuing Professional Development'.[197] It was defined as the priorities supporting knowledge, skills, and ability in sustainable design which are comprehensive and interdisciplinary academic education; lifelong learning; the research activities related to sustainability on the practice of architecture and urban design; access to reliable data; the organizations like conferences, seminars, courses

[192] Ibid.
[193] Detailed results of the surveys available on http://www.educate-sustainability.eu/benchmarking-professional-needs.php
[194] Altomonte, S., Rutherford, P., & Wilson, R. (2014). Mapping the way forward: Education for sustainability in architecture and urban design. Corporate Social Responsibility and Environmental Management, p143-154.
[195] Ibid.
[196] Altomonte, S. (Ed.) (2012). Education for Sustainable Environmental Design, Summary of Results. Nottingham. Retrieved from: www.educate-sustainability.eu- Accessed on November 2018.
[197] Ibid.

etc.[198] Through the spread of such actions like EDUCATE, it is possible to see architectural curricula in which sustainability has an important part in the overall design and practice for the achievement of such educational objectives.

Salama and Amir conducted a survey with 14 architectural schools in several Arab countries. They examined the history of architectural education and the courses, curricula, and systems in the selected schools. It was stated that the study's aim was not to view the situation of Arab architectural education in detail; it was intended to investigate the three paradigmatic trends in selected schools. These trends were Environment-Behavior Studies, Sustainability and Environmental Consciousness, Digital and Virtual Practices.[199] Salama and Amir conducted surveys on sustainability and environmental awareness in each faculty. In doing so, environmental behavior studies, sustainability, and environmental awareness, digital and virtual applications are determined as the three-paradigm. Their methodology included some procedures of investigation which includes the classification of non-traditional courses, analysis of course weight, content analysis of program content and discussion of the results. It was stated that although the content of environmental behavior courses seems to be in balance with their knowledge and contextual features, it is not clear whether the design studio definitions can be reflected in the design assignments of the information given in the course format. It was thought that the information content was presented in a fragmented way. In the 17 course samples examined, although most of them discuss the sustainability and environmental awareness paradigm, it was seen that this is not reflected in the content and program. Technical-oriented programs were expected to respond more than the other programs addressing the ecological requirements of sustainable design, but the analysis revealed the opposite. For the third paradigm, digital and virtual practices, it was selected 26 courses to focus on the changing paradigm of analog-to-digital media and the applications in architecture. With the

[198] Ibid.

[199] Salama, A., & Amir, A. (2005). Paradigmatic trends in Arab architectural education: impacts and challenges. In Paper intended for Publication and presentation at the International Congress of Architecture: The International Union of Architects-UIA: Istanbul. Turkey.

study, it was understood that this paradigm was not explicitly concretized in several programs. While some universities offered only one elective course for CAD technologies, some universities did not have any courses. Also, it was stated that most of the schools teach courses in CAD and digital programs which did not fully develop skill development in the use of the programs in design. As a result of the study, it was pointed out that there was an imbalance in the relations of these fields and the inadequacy of integration of theory courses and studio education sufficiently.[200]

Between 1987 and 2007, Ostwald et al. studied with 20 architectural schools in Oceania to analyze these architecture schools, programs, academicians and students as regards the environment. Six areas have been identified for the analysis: design, technology, history and theory, communication, implementation, and the environment. Also, the curriculum category was added selectively. The study investigated a couple of issues which are academic staff profile (like their level, qualification, career, time and profession), student profile (their progress, graduates and employment), distribution of curriculum (mapping curriculum content, teaching professional accreditation), teaching and learning environment (environment in architectural schools, teaching and learning applications, academic and student issues).[201] İt was stated that the curricula of selected schools and the environmental courses were focused.. They categorized the curricula in architectural schools as design, technology, history and theory, communication, application, environment, and elective courses. Different graphs have emerged over the years. Ostwald et al. observed that the effectiveness of the design studio had been weakened in many architectural schools. It was stated that some reason for this were oversized classes, insufficient numbers of academic staff and lack of student commitment.[202]

Stevenson et al. set up a national workshop called ‘Designs on the Planet’ (DOP), which was a 3-session, where the challenges and opportunities in the architectural

[200] Ibid.
[201] Ostwald, M. J., Williams, A., Learning, A., & Council, T. (2008). Understanding architectural education in Australasia. Australian Learning and Teaching Council. p119.
[202] Ibid.

education system were discussed to raise awareness of sustainability. The first of the workshops was held in January 2008 at Oxford Brookes and discussed the relationship between climate change and the design studios. After this meeting, for the first time, all schools in the UK were asked to review their education on climate change and prepare a report a year later. According to Stevenson et al. (2009) at Oxford Brookes University, it was adopted the goal of being carbon neutral in both teaching and organizational management. It was also stated that The Department of Architecture adopted the Sustainable Pre-Design framework for the development of design and technology modules.[203] With the second workshop in September 2008, it was tried to develop a design concept that combines the principles of sustainability and climate change at undergraduate and graduate architecture students. In this meeting, the participants consisting of more than 60 academicians, practitioners and representatives from industry were divided four working groups. Each group brainstormed on some issues like creating the framework of design abstracts, the teaching approaches, the evaluation of technical and creative studies, and obstacles for the integration. The complexity of integration of sustainability into the design studio was accepted by all groups, and it was stated this should be handled in different ways at all levels. It was emphasized that the academic curriculum should be adaptable to the different teaching methods and the achievement of pedagogical goals. They indicated that design tutors need to be aware of the climate change challenges and involve this awareness in their educational approaches. It was pointed out that the students should be supported to have full sustainability issues and to increase their enthusiasm for environmental design. [204] In the last activity (January 2009), the relationship between climate change and architectural education was discussed at the graduate level, and studies were conducted on the research of creative ways. In this study, which aims to investigate the place of sustainability issues such as climate change, it was seen some

[203] Stevenson, F., Roberts, A., & Altomonte, S. (2009). Designs on the Planet. In A workshop series on architectural education and the challenges of climate change, Passive Low Energy Architecture Conference. p23.
[204] Ibid.

shortcomings in architectural education. The concept of team teaching was focused which is enabled to work the design tutors with the technology experts from the very beginning of the project process. It was predicted that by introducing the concept of team teaching, the design lessons which include both design and technology lecturers, will be useful in the conceptual stage of the projects. During the workshop, several key obstacles and worries for UK schools were mentioned. Some of them were staff expertise and lack of resources in terms of current curriculum times. It was also drawn attention; there was no simple, agreed-upon guidance on sustainability principles and standards. Since focusing on concepts related to sustainable development and sustainable design, the study has helped some of the challenges that architecture schools integrate into the curriculum of sustainability debate.[205]

Lee et al. examined 36 Korean schools, in which 30 of them were work with the Korean Architectural Accreditation Board (KAAB). In the study, the scope of sustainability in architectural education was investigated in the schools. The results of the surveys revealed that the relationship between theoretical and architectural studio courses was insufficient. Another result is the lack of awareness about the importance of sustainability at all levels of the academy.[206] Another comprehensive survey study was carried out by Rieh et al., using 48 accredited Korean universities (KAAB-approved) as case studies.[207] It was mentioned that the aim of this study was to support sustainable architectural education in Asian countries. The structures and organizations of the programs in the case studies were analyzed and evaluated. According to the results of this research, some notes were published to include sustainability in architectural education and to develop the curriculum. Four different curriculum typologies were defined for sustainability courses and studio integration:

[205] Ibid.
[206] Lee, K. S., Geon, K. R., & Yoo, D. U. (2012). A Study on Integrating Sustainability into Architectural Education Curriculum in Korea. Journal of the architectural institute of Korea planning & design, 28.
[207] Rieh, S. Y., Lee, B. Y., Oh, J. G., Schuetze, T., Porras Álvarez, S., Lee, K., & Park, J. (2017). Integration of sustainability into architectural education at accredited Korean universities. Sustainability, 1121.

accompanying type, preceding type, fluctuation type, and following type. It was seen that it is better to integrate the principles of sustainability with accompanying, preceding type of curriculum. It was stated that the theoretical information related to sustainability is taught and practiced in a balanced manner in the sustainability courses and studios. The curriculum of fluctuation and the following type was considered more difficult for adequate integration of theory and practice to the sustainable architecture. As one of the most important challenges in the integration of sustainable architectural education, it was stated that sustainability issues had been identified as being late in most studio courses. Another important result of the study was the imbalance attention of environmental, socio-cultural and economic subjects related to sustainability. While focusing on a technological approach and environmental issues in the programs, it was observed that social and economic dimensions are insufficient.[208]

Alvarez et al. (2016) conducted research focusing on education for sustainability in the architecture schools in Asian countries.[209] The aim of the study was to examine the curricula of 20 schools selected from 11 countries and determining and comparing the methods of implementation for sustainable architectural education. The courses related to sustainability in these schools were identified, classified and summarized. In this study, it was explored the Asian architecture curriculum, determining its vision and commitments for sustainable architectural education by determine and compare the methods and degrees of implementation. It was shown that the integration of the sustainability concept in the architectural education of the schools was inconsistent. In the curriculum, environmental, social and economic aspects of sustainability were examined. As a result, most of the programs were concerned with environmental issues focusing on energy; only a few programs addressed sociocultural matters. It

[208] Ibid.
[209] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016). A comparative study on sustainability in architectural education in Asia—With a focus on professional degree curricula. Sustainability, 8(3), 290.

was discovered that the debate on economic sustainability is inadequate in the curricula of the case studies.[210]

Ismail et al. (2017) carried on a study with ten schools of architecture, which were classified by accreditation boards in the United Kingdom and the United States.[211] In this study, the integration approach of the sustainability knowledge to the architectural courses in these selected schools was investigated. It was collected qualitative data for sustainability knowledge in the schools and the courses, learning outcomes and credits were examined. The study showed that schools had different approaches for the integrating sustainability knowledge in their curricula. It was stated that in almost all selected architecture schools, there were only theoretical courses on sustainability in the first year of the program structure. It was observed in the second and third years; partially integrated program structure model was applied. In these years, some courses related to sustainability were given in the design studio when the others were given theoretically. According to Ismail et al., in the last year, it became clear that sustainability knowledge was entirely integrated into the design studio courses where students experience the application of sustainability. In the master programs, while there were schools that integrate sustainability information into the studio completely, there were also studio projects that are given with theoretical courses which partially integrate sustainability knowledge into the courses of the design studio. For future studies, they stated that a survey could be conducted on the perceptions of students in order to evaluate the sustainable architectural education approach.[212]

Hassanpour et al. (2017) stated that an operational framework is needed to integrate sustainability into architectural programs in a coordinated combination.[213] They carried out a study to discuss the place of sustainability issues in architectural education. An architecture school accredited by the NAAB in the Eastern

[210] Ibid.
[211] Ismail, M. A., Keumala, N., & Dabdoob, R. M. (2017). Op cit.
[212] Ibid.
[213] Hassanpour, B., Alpar Atun, R., & Ghaderi, S. (2017). From words to action: Incorporation of sustainability in architectural education. Sustainability, 9(10), 1790.

Mediterranean region was determined as a case study. The study contains the course content, teaching methods and an analysis of lecturers' and students' perceptions for the integration of sustainability to architectural education. In this context, the undergraduate level courses within the curriculum were examined, and a survey was conducted with the students. According to results, it was revealed that there was significant interest on sustainability among students and lecturers and they had awareness and concern about sustainability issues. The authors pointed to the challenge of sustainable design education, the awareness of the need for change in architectural education, and the practical application of this.

Taleghani et al. (2011) compared the architectural education in Iran and Australia as regard to renewable energy in order to reveal the academic challenges in SD. [214] The University of Murdoch in Australia and the University of Tehran in Iran were selected because of their important place in renewable energy and architectural education in their country. The curriculums in these architectural schools were examined, and the courses related to renewable energy were investigated and compared considering their context and scopes. With this study, they showed same and different approaches of the schools to renewable energy. In both countries, renewable energy was emphasized in the education of architecture in the last four years. According to Taleghani et al., the architectural school in Iran was a lack of diversity in the courses related to renewable energy, and it was found that the lessons in the architectural school in Australia were addressed not only in the technical dimension but also in the social and environmental aspects.[215]

Al-Hagla (2012) focused on the role of the design studio in the architectural education process in the study of the principles of incorporating sustainability into architectural pedagogy.[216] He developed an approach combining both macro and micro-scale

[214] Taleghani, M., Ansari, H. R., & Jennings, P. (2011). Sustainability in architectural education: A comparison of Iran and Australia. Renewable energy, 36(7), 2021-2025.
[215] Ibid.
[216] Al-Hagla, K. S. (2012). The Role of the Design Studio in Shaping an Architectural Education for Sustainable Development: The Case of Beirut Arab University. International Journal of Architectural Research: ArchNet-IJAR, 6(1), 23-41.

analyzes to investigate the interdisciplinary aspect of architectural education. He conducted a study at the Faculty of Architecture at the Arab University of Beirut to investigate architectural curricula, characteristics of design studios, and sustainability issues in their education. In the study, with the macro scale analyzes, it was observed a holistic vision lacking a variety of disciplines. Based on the results of the survey, it was stated that the lessons from outside the architecture faculty provided a poor contribution in a correct understanding of sustainability. The author also emphasized that sustainability should be included in design studios. In the micro-scale analysis, a traditional design studio culture was observed in the design studio teaching which negatively affects individualism and experience of students. It was highlighted that traditional studio culture was an obstacle to efforts for a sustainable pedagogy. According to Al-Hagla, the reason was the fact that the studio instructors have focused their attention on issues such as energy efficiency, air quality, green materials which their limited visions affect students negatively. He recommended that these issues be expanded to inspire sustainable building design. It was observed that the approach of the faculty was to increase the courses on environmental sustainability in the curriculum and this was not enough. He concluded that that sustainable design needs a comprehensive integration of all studies. [217]

In Turkey, Kobas and Bahadir (2011) studied the infrastructures and educational systems of the architecture schools considering interdisciplinary sustainability approaches. The curricula of 15 universities offering architectural education in Istanbul were examined, and the number, credits and chronological locations of the courses related to sustainability (such as ecology, sustainability, green, environment, nature, building physics) were examined. As a result of the research, it was seen that the theoretical courses related to sustainability are not enough in the architectural curriculum in all schools, but at least there is one compulsory course is covered in sustainability topics such as building physics in each school. They stated that the

[217] Ibid.

education of architecture should be revised to ensure the integration of sustainability into design studios and architectural curricula.[218]

Ceylan (2016) carried out a study for integrating energy efficiency and sustainable design principles with architectural education in Turkey. The study focused on the architectural programs at the undergraduate level of various educational institutions from the world and Turkey in terms of energy-efficient design and sustainability issues. After the evaluation of these programs, he proposed an architectural program model which incorporates energy efficiency and sustainable design approaches.[219]

İbrahimgil (2019), analyzed the curricula of architectural schools from Turkey in the context of sustainability. She determined ten schools to investigate the current situation of the sustainability concept in architectural education in Turkey. The contribution of sustainability courses to the programs of the architectural schools was analyzed. The curricula were categorized according to the educational models identified by the EDUCATE project.[220] Then, a survey study was conducted with students to examine the impact of sustainability courses on the students' approach to sustainability. As a result of these analyses and evaluations, an exemplary architectural syllabus, including the distribution of sustainability courses, was provided.[221]

[218] Kobas, B. Bahadır Ö. (2011) Sustainability in the architectural curriculum, a research on the architectural departments of the universities in Istanbul. Journal of EkoYapı,5, p. 45. (In Turkish)
[219] Ceylan, S. (2016). A Model Proposal for Integrating Energy Efficient/Sustainable Design Principles with Architectural Education in Turkey (Enerji Etkin / Sürdürülebilir Mimari Tasarım İlkelerinin Türkiye'deki Mimarlık Eğitimi İle Bütünleştirilmesi İçin Bir Model Önerisi), YTU (Doctoral dissertation).
[220] Environmental Design in University Curricula and Architectural Training in Europe (EDUCATE). For detailed information: Altomonte, S. (2010). Environmental Design in University Curricula and Architectural Training in Europe. In International Barcelona Conference on Higher Education (Vol. 5).
[221] İbrahimgil, S. (2019). A Study on The Integration of Sustainability Principles to Architectural Education (Sürdürülebilirlik İlkelerinin Mimarlık Eğitimine Entegrasyonu Üzerine Bir Çalışma), Gazi University (Master Thesis in publication).

2.3.4. Architecture Design Studio Education and Strategies to Integrate Sustainability into the Studio

The design studio is the most dominant course of architectural education, which has the highest credit hours and touches all the subjects of the other courses. In the Report of the AIAS Studio Culture Task Force (2002), it was stated that design studio has high importance with the greatest workload and having the most time spent by educators and students in the architecture schools. According to the report, design studios are a common point for all other courses and educational experiences. The design studio supports critical thinking which allows students to question everything for a better design. The studio is a place where critical inquiry is encouraged, rewarding visionary schemes, and design and thinking.[222]

In architectural design education, students produce ideas in urban, environmental, social, historical and cultural contexts that define the architecture and the structural environment. Students learn creative thinking in the studio and develop their drawing, conceptual and critical abilities by reflecting their thoughts in their design processes.[223] Design studio education allows teaching and learning all aspects of architectural ideas including aesthetics, theory, history, building technology and practical skills such as drawing and model making.[224] For Gross and Do, the studio is the king in architecture. It is the place where the design action is learned and applied with producing, evaluating and developing alternatives.[225] As Corona-Martinez (2003) stated, the primary activity for an architect was design, and architecture students discover this in the design studio.[226] The studio provides students with a unique learning environment by giving problem-solving practice and creative

[222] Koch, A., Schwennsen, K., Dutton, T. A., & Smith, D. (2002). The Redesign of Studio Culture: A Report of the AIAS Studio Culture Task Force.
[223] Rawes, P. (2007). Reflective subjects in Kant and architectural design education. Journal of Aesthetic Education, 74-89.
[224] Ghaziani, R., Montazami, A., & Bufton, F. (2013). Architectural Design Pedagogy: Improving Student Learning Outcomes. In AAE Conference.
[225] Gross, M. D., & Do, E. Y. (1997). The design studio approach: Learning design in architectural education. In Design Education Workshop (Vol. 8). Georgia Institute of Technology.
[226] Corona-Martínez, A. (2003). The architectural project (Vol. 6). Texas A&M University Press.

thinking. Ledewitz (1985) considered the architectural design studio as a physical space in which learned three dimensions of design education: a new language; new skills and architectural thinking. According to Ledewitz, the training experience of the studio involves learning of these three aspects at the same time. He states that the majority of learning to design is integrating skills, language, approaches to problems.[227]

Sustainability in the design studio is a critical potential that enables students to make sustainable decisions in the design process. To recognize this potential, architectural schools and researchers have developed various approaches to include sustainability in design studios. According to NAAB (2004); one of the areas in which graduates must show understanding or ability is the understanding sustainability in maintaining architectural and urban design, including preserving natural and structured resources, and building healthy buildings and communities, as well as culturally important buildings and areas.[228] Nowadays, various institutions have focused on integrating sustainable design into academic programs. As an important part architectural education, the design studio has become the main focus for such integration.

Second Nature (2001) organized a conference in Wisconsin, working with schools of architecture and design in the USA. [229] In the conference, the place of sustainability in architectural education was discussed; principles, strategies, and plans for the changes of the curriculum and institutions have been identified. At the end of the conference, it was published a report called 'How Can the Architect Contribute to a Sustainable World?'.[230]

[227] Ledewitz, S. (1985). Models of design in studio teaching. Journal of Architectural Education, 38(2), 2-8.
[228] NAAB. (2004). Op cit. p14.
[229] Second Nature (founded in 1993) is committed to accelerating climate action in higher education to move towards the goal of a sustainable society. They have established and supervised the commitment to carbon neutrality in various schools in the United States. In order to advance their climate priorities, they act climate commitments, scale campus climate initiatives and produce innovative climate by mobilizing higher education institutions solutions. For detailed information: https://secondnature.org/
[230] Glyphis, J. (Ed.) (2001). How can the architect contribute to a sustainable world. In Proceedings of the Wingspread Conference.

According to this report; in order to integrate sustainability to the studio teaching, it is needed to find practical methods to ensure the integration of studio and theoretical courses, using campus as a sustainable tool in studio education, to increase adaptive and developable learning tools for a sustainable design; to promote and enhance programs in design/construction for sustainability awareness of students; to provide the students with the opportunity to teach in the studio to increase their knowledge about sustainable design; to consider the main disciplines in design education, social, environmental and economic sustainability in design to problem solving. [231] It is stated that different working groups can evolve and improve curriculum and teaching materials in each of the four areas: History/theory; Technology; Studio; and Professional Practice. It is highlighted sustainability for broader theoretical research for the history and theory strategy. It is proposed that architectural history/theory courses bring more perspective to a sustainable concept, but it can be the most difficult also the most useful area. The architectural history/theory courses can include more lessons on ecological design to address various cultures, climates, and regions. According to the report, the use of technology for new examples of sustainability, tools and case studies should be introduced as the basic requirement of the studio like ecology, energy use, and sustainable materials. Design studios should raise awareness of the broader sustainable design context by introducing community and regional scale issues. Special studio programs can be developed and shared widely on sustainable design issues. Sustainability should be asked as one of the requirements of the project. In the report, it was also stated that there should be courses on environmental ethics, responsible design, law and responsibility for the quality of the environment for the practice of students in their professional lives. For the sustainability integration of the design studios, Iulo et al. al (2013) stated that sustainability is a focal point that needs to be integrated into the different social, theoretical, technical and aesthetic

[231] Ibid.

components of the curriculum and, also, the importance of integrating sustainability into design studios to provide students' awareness of SD.[232]

For learning the principles and practices of sustainability, Altomonte et al. stated that students should be interested in analytical and synthetic design processes, and ensure the balance between the environmental, social and economic aspects of sustainability by making critical self-assessment. In this way, they mentioned that students developed a fundamental understanding and awareness of sustainability with multidisciplinary problems. According to them, sustainability should not be considered as an additional subject to design; on the contrary, it should be seen as a basic requirement of the design process. They proposed that curriculum design, teaching methodology, and instructors' education programs should be added to increase sustainability knowledge and awareness in the architecture school.[233] Altomonte et al. highlighted that in the design studios, students should be encouraged to consider sustainability as a design criterion to sustainability issues have a permanent place in architectural education. Creative design capabilities and sustainability must be combined to increase students' sustainability knowledge and awareness in the studios. For them, the sustainability issues given in theoretical courses should be diversified as a source to feed this combination. They stated that the perception of sustainability should exist in all fields of architectural education and should be discussed by all students, academics, and administrators on the importance of the subject. Sustainability for successful education should be in every aspect of the architectural curriculum.[234]

Increasing discussions about sustainability in recent years shows the complexity of sustainability. According to Khan et al. (2013), the integration of sustainability courses into the curriculum is an important mission of architectural education. They

[232] El-Feki, S., & Kenawy, I. (2018). Integrating sustainability within architectural education in Cairo. Resourceedings, 1(1).
[233] Altomonte, S., Reimer, H., Rutherford, P., & Wilson, R. (2013). Towards Education for Sustainability in University Curricula and in the Practice of Design. In PLEA.
[234] Ibid.

stated that focusing on an aspect of sustainability was not enough; the integration of sustainability issues with other courses and design studios was necessary for a sustainable architectural curriculum. They proposed three overlapping layer models to address the need for an integrated curriculum to ensure sustainability in architectural education. The first layer is the vertical courses that include specific expertise to increase students' sustainability understanding. Since the first layer has a specific area of expertise, the concept of sustainability is limited, so the second layer of horizontal integration is required. The horizontal courses ensure that sustainability information remains together and makes more sense. The third layer is the translation of the insight gained by students in the design studios. They stated that this is an exercise for the ecological design of the interdisciplinary problem network. According to Khan et al., design studios should consider all systems. The stronger the interaction of these layers, the more sustainability can be placed in the curriculum as a value. They also highlighted that the instructors of the design studios have important tasks to improve the potential of the students and their perceptions of sustainability by ensuring the continuity of architectural design. The instructors should make special efforts to connect the design studios to theoretical lessons on sustainability. They should exchange information with similar disciplines and interdisciplinary departments. For the integration of sustainability into design studios well, it should be organized workshops in which design studio instructors and academic researchers to present their work to each other and discuss their insights.[235]

Schön (1988) stated that the architects' list of applied sciences was very long which includes energy design, building materials and technologies, topography, solar engineering, acoustics, wind effects, earthquakes and building economics, building finance, urban development and design, anthropology of architectural practice, urban policy and computer science, etc. He continues with the problems to integrate these areas into the architectural curriculum. The problem of a productive union of applied

[235] Khan, A. Z., Vandevyvere, H., & Allacker, K. (2013). Design for the ecological age: Rethinking the role of sustainability in architectural education. Journal of Architectural Education, 67(2), 175-185.

science and studio education is essential not only for the education of architecture but also for the future role of architecture in the university. Schön presented some suggestions for the concerns in this integration. Studio instructors can motivate students to learn and incorporate applied sciences in studio projects. He stated that the applied sciences subjects could be used as the research methods in architectural design. [236]

The United Kingdom Higher Education Partnership for Sustainability (HEPS) report (2003) underlines the need for interdisciplinary methods of education for sustainability.[237] It also explains the characteristics of sustainability literacy. These literate people have sufficient knowledge and skills to act and support sustainable development; ensure that change is sustainable way; determine and reward the actions of sustainable development.[238] AIA noted that studio-based education, which was repeated with design processes, was an primary part of environmental education and practice.[239] According to the AIA report, the biggest challenge ecological literacy brings to the studio system is the need for teaching design as a participatory and collaborative process. The innovative design processes have begun to emerge in the professional practice of architects and must be included in architectural education. The studio education that involves participation and multidisciplinary expertise should focus on sustainability, leading to professional training, and, also this fact is accepted by the schools of architecture as well as the university administration.[240] For the ecologic literacy, Orr (1992) offers six principles for the rethinking of the educational process for earth-centered education. According to him; environmental education is included in all education; environmental issues are not simple to address by one field;

[236] Schön, D. A. (1988). Toward a marriage of artistry & applied science in the architectural design studio. Journal of Architectural Education, 41(4), 4-10.
[237] Lugg, A. (2007). Developing sustainability-literate citizens through outdoor learning: Possibilities for outdoor education in higher education. Journal of adventure education & outdoor learning, 7(2), 97-112.
[238] Gough, S., & Scott, W. (2003). Cited in Ghaderi, S. (2016). Integration of Sustainability in Architectural education: EMU as Case Study.
[239] Gould, K. L. (2006). Ecology and Design: Ecological Literacy in Architectural education, 2006 Report and Proposal. American Institute of Architects. p24.
[240] Ibid.

the method is as critical as the content; experiencing nature promotes better intelligence and practical abilities.[241]

According to Gould, architects seem to have a broad consensus on meaning and strategies of sustainability. The term became so widespread and was used in many different areas that its definition was evacuated.[242] According to the American Institute of Architects (AIA) Committee on the Environment (COTE) report (2006), Sustainable design debates are narrow in terms of focus and ambiguous in purpose when looking at the extent of the scope. Although architects nowadays acknowledge the importance of sustainability, most of them do not understand mechanics or green technologies in a comprehensive way. Architecture in sustainable design is full of ambiguous generalizations. Due to this confusion, designers must first know about it to be able to evaluate sustainability in the best possible way. [243]

The integration of the concept of sustainability in design education is generally based on radical change and professional and interdisciplinary cooperation in academia.[244] Transformative education focuses on reflective and problem-based learning and collaborative group work. This pedagogy provides learning with questioning, experience and reflection.[245] In such a context, reflective and cooperative problem-based learning helps to link theory to future experience and competence. Changes in the educational environment also pave the way for sustainable professional design and discussion of sustainability issues in professional life. For architecture students, the ability to facilitate such processes can become one of the most important elements in their future career. To respond to this call, it is necessary to create new expansions for cooperation within and outside the university, with a focus on the development of

[241] Orr, D. W. (1992). Ecological literacy: Education and the transition to a postmodern world. Suny Press.
[242] Gould, K. L. (2006). Op cit.
[243] Ibid. p13-16.
[244]Altomonte, S. (Ed.) (2012). Framework for Curriculum Development. Nottingham. Retrieved from: www.educate-sustainability.eu- Accessed on November 2018.
[245] Moore, J. (2005). Seven recommendations for creating sustainability education at the university level: A guide for change agents. International Journal of Sustainability in Higher Education, 6(4), 326-339.

architecture schools, changes in design studios and common sustainability issues.[246] Salama (2016) stated that most design studios do not support a more holistic approach to architectural education that promotes sensitivity, awareness, collaboration, teamwork, critical and innovative understanding of socio-cultural and environmental issues. In professional life, many architecture offices find to teach these issues difficult to the graduated architects. According to Salama; because of this lack, it is needed to examine what and how the education of design studio is, and also how the students perceive that.[247]

Altomonte et al. (2013) stated that there is a need to enhance a pedagogical structure that meets the needs and demands of professional life. They highlighted the importance of the working environment where all participants receive the benefits of a sustainable design approach. According to them, for a professional qualification, the knowledge, skills and competing priorities that must be acquired at each level of progress are determined, and the technical capabilities of the design practice are discussed more broadly to implement sustainability in the built environment. They continued with that sustainability should not be limited to issues such as energy efficiency but should be considered as a complex multi and inter-disciplinary concept resulting from commitment and expertise as well as a moral necessity. It is required the freedom to apply in a regulatory environment that encourages this innovation for the professionals with the assist of all companies.[248]

According to Kwok et al., since design has cultural, technical, formal and programmatic aspects, it is a multi-faceted search. The emphasis on one of the different aspects of design influences the outcome of the research and the resulting architectural expression.[249] In the book of The Green Studio Handbook: Environmental Strategies for Schematic Design, Posada recommends examining and

[246] Salama, A. M. (2016). Spatial design education: New directions for pedagogy in architecture and beyond. Routledge. p9.
[247] Ibid.
[248] Altomonte, S., Reimer, H., Rutherford, P., & Wilson, R. (2013). Op cit
[249] Kwok, A. G., & Grondzik, W. (2018). The green studio handbook: Environmental strategies for schematic design. Routledge. p7.

spreading the relationship between ecology, economy and social welfare by addressing the impact of sustainability. According to Posada the green design and buildings are steps towards sustainable design.[250] Briggs and Knowles (2018) states in the same book, designing an ecological design changes the basic values or articulates to the project. Ecological concerns vary according to each design team and are related to whether it is a primary or secondary emphasis. According to Briggs and Knowles, focusing on environmental concerns involves many problems and an extended process. If there is an ecological focus in the design process, especially in the early stages, the architect has vital tasks. An integrated design process is required to help designers achieve a synthesis of ecological design principles. For a project with environmental strategies, they introduced the stages of design as follows. [251]

[250] Ibid.p15.
[251] Briggs L., Knowles J. (2018) The green studio handbook: Environmental strategies for schematic design. Routledge. p7-13.

Table 2.7. *Design Process in The Green Studio Handbook: Environmental Strategies for Schematic Design* [252]

Design Process	
Defining the Problem	**Schema:** The first phase of design involves moments when the project is conceptualized, developed and based on a logic. **Intention:** In the initial moments of the project, it is important to define expectations for building performance. **Criteria:** Project criteria are the standards in which the provisions and decisions are tested. **Verification:** It is the stage where the subjects to be framed and the appropriate design methods and strategies are used. **Prioritizing:** It is the stage required to understand which goals are prioritized, what is most important to the designer and the client, and how flexible the proposed solutions are.
Project Data	**Collect:** Each ecological design is at different scales, so it requires its own archive. **Site analysis:** Site analysis is to find resources and identify the problems of a site in the context of the project and the values of the designer. **Location selection:** The site selection process reveals the relationship of the building with localized ecological conditions. Each building interacts with the environment and changes the indoor and outdoor climate.
Form Givers	**Daylight:** Throughout the history of architecture, light has a place that influences the form. In order to achieve a lighting strategy, appropriate lighting solutions should be determined according to the functions and requirements of various locations and these solutions should be tested and evaluated by using daylight models or different tools. **Passive and active strategies:** Passive strategies adapt to environmental conditions and should be considered before using the active strategy.
Feedback Loops	A number of design tools can be used to estimate the performance of a building before it is built such as hand calculations, computer simulations and drawings.
Building organization	The architectural program developed by the architect and the customer determines the basic potential for building performance.
Transitional Spaces	The connection between the two environments.
Structure	The structure is also one of the elements that affect the form. Different systems have different opportunities and also natural results.
Envelope	**Material:** A project must be continuously examined throughout its development and must be a meticulous process about the behavior of materials. The choice of materials is directly related the building, construction and environmental systems. **Insulation:** A good insulation allows the designer to reduce the size of climate control systems.
Climate Control Systems	Green heating and cooling systems include the use of natural ambient conditions as possible to provide heating and cooling for a building

2.4. The Integration of Sustainability to Architectural Design Studio and Curriculum

The importance of architectural education leading to sustainability is clearly stated in the literature review. Existing studies have different approaches, strategies, and methods to address integrating the architectural education curriculum into sustainability. Based on the literature review, sustainability in the architectural

[252] It was prepared to be inspired by this document: Briggs L., Knowles J. (2018) Op cit.

education can be grouped in three different titles: Challenges and obstacles; strategies, approaches, and priorities; actors and solutions.

2.4.1. Challenges and Obstacles

Most of the researches in the literature review agreed on the need for the development of the curriculum to integrate sustainability into architectural education. The architectural curriculum should develop a holistic pedagogy combining a creative and responsive design approach to the needs of sustainability issues.[253] For this integration, the main challenge is the lack of guidance on principles of sustainability in architectural education pedagogy. According to the studies, the obstacles can be summarized as follows:

- Sustainability is a multi-disciplinary field. Understanding the different layers and complexity of this area was a challenging task for educators and students.[254] Since sustainability teaching requires multidisciplinary knowledge, academic and theoretical course contents were sometimes insufficient.[255]
- Social and economic aspects of sustainability haven't the same importance as much as environmental which is generally considered to relate the sustainability directly.[256] It was observed the imbalance between environmental, social and economic dimensions of sustainability. [257] In the studies, it was revealed that the discussion of economic and social sustainability topics in the architectural curricula of the schools was not

[253] Altomonte, S., Rutherford, P., & Wilson, R. (2014). Op cit.
[254] Altomonte, S. (Ed.) (2012). Op cit.
[255] Stasinopoulos, T. N. (2005). Sustainable architecture teaching in non-sustainable societies. In nd Conference on Passive and low Energy Architecture (PLEA), Beirut, Lebanon, Nov. p13-16.
[256] Lee, K. S., Geon, K. R., & Yoo, D. U. (2012). Op cit.
[257] Rieh, S. Y., Lee, B. Y., Oh, J. G., Schuetze, T., Porras Álvarez, S., Lee, K., & Park, J. (2017). Op cit.

sufficient.[258] It was seen that the integration of sustainability into the studio education and theoretical courses was not enough. [259]

- Many studies stated that there was a lack of sustainability-related courses in the architectural curriculum.[260] Sustainability has often been a concept taught in elective courses rather than the main course. The integration of sustainability to the design studio was not satisfactory; it should be paying more attention to sustainability issues in the design studios.[261]
- Sustainability issues in education was also faced with different and challenging problems with resources, expertise, and commitment.[262] It was observed the needs for more study, research, and expert on the field of sustainability.[263] The lack of sustainability of academic staff and resources affect the students' awareness of sustainability.[264]
- Since the sustainable design was a multidisciplinary and broad discussion, it faces problems such as misunderstanding, marginalization or rejection.[265] Sometimes, sustainable design can be perceived by the studio instructors with distance because of considered as a new theme.[266]
- Changes in the educational environment should ensure discussion of sustainable issues and design in professional life.[267]

2.4.2. Strategies, Approaches, and Priorities

In the literature review, it was observed that most of the studies analyzed the curriculum, design studios and theoretical courses related to sustainability. The studies conducted surveys with students, graduates, lecturers and administration of the

[258] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016).Op cit.
[259] Altomonte, S. (Ed.) (2012).Op cit.
[260] Stasinopoulos, T. N. (2005).Op cit.
[261] Stevenson, F., Roberts, A., & Altomonte, S. (2009).Op cit.
[262] Altomonte, S. (Ed.) (2012). Op cit.
[263] Ostwald, M. J., Williams, A., Learning, A., & Council, T. (2008). Op cit.
[264] Lee, K. S., Geon, K. R., & Yoo, D. U. (2012). Op cit.
[265] Gould, K. L. (2006). Op cit.
[266] Stasinopoulos, T. N. (2005). Op cit.
[267] Salama, A. M. (2016). Op cit.

architecture schools. Wright stated three different approaches to integrate sustainability into the architectural curricula which are the belief that sustainable design is fundamental, developing the existing courses on environmental control systems, and combining sustainability with all courses.[268] Khan et al. emphasized that sustainability should be considered as a critical part of design and it should be a more integrated architectural education that develops an interdependent understanding of the architectural discipline.[269] Altomonte emphasized that it is necessary to determine the current situation according to the technical and environmental awareness, knowledge and needs in architectural applications. [270] The EDUCATE project demonstrated the requirements for sustainable environmental design and defined some criteria that measure knowledge, capabilities, and capacity. It was stated the spread of application examples and knowledge to increase the awareness of sustainability in architectural education. Altomonte et al. defined some principles to promote a sustainable design process that was culturally, economically and socially applicable in all stages of education.[271] It was stated that sustainable design should be considered as fundamental in studies from the beginning of education to professional development. This priority should be accepted by universities, educators, students, professionals and organizations. Teaching and learning sustainability should encourage students to work design challenges meticulously and creatively. According to Altomonte et al., educators should develop appropriate pedagogies, methods, and techniques for a sustainable design approach. These pedagogies should care about critical thinking, awareness, and responsibility.[272]

For the sustainability awareness, Salama and Amir classified the courses and analyzed the content of the program in the schools which they conducted the survey study. They determined three paradigms: environmental behavior studies, sustainability, and

[268] Wright, J. (2003). Op cit.
[269] Khan, A. Z., Vandevyvere, H., & Allacker, K. (2013). Op cit.
[270] Altomonte, S. (2009). Op cit.
[271] Altomonte, S. (Ed.) (2012). Op cit.
[272] Ibid.

environmental awareness, digital and virtual applications.[273] During the 3-session workshop of Designs on the Planet (DOP), Stevenson et al. discussed the relationship between climate change and design studios, developed a design concept that combines principles of sustainability and climate change with undergraduate and graduate student, and finally talked about the tasks of project tutors and the need for a flexible curriculum.[274] Rieh et al. analyzed the structure and content of the programs of some architecture schools in Korea and brought some proposals to enhance the KAAB accreditation system as well as the curriculum. Different types of curricula have been defined as the accompanying type, preceding type, fluctuation type, and following type.[275] Ismail et al. (2017) investigated the sustainability integration into the architectural courses in architecture schools. The courses, learning outcomes, and credits were examined, and descriptive qualitative analysis of sustainability information was adopted.[276] El Hagla investigated sustainability in the design studios in the case study. He developed an approach combining macro and micro-scale analyzes to investigate the interdisciplinary aspect of architectural education by examining architectural curriculum, design studios.[277] AIA stated that for sustainability in architectural education, there were some catalysts: architectural studio, history and theory classes, environmental laboratories, research centers at the university campus, design-build and community, community connections as participatory design with communities and building occupants, the green campus practices, certificates and other programs like sustainable design certificate programs.[278]

[273] Salama, A., & Amir, A. (2005). Op cit.
[274] Stevenson, F., Roberts, A., & Altomonte, S. (2009). Op cit.
[275] Rieh, S. Y., Lee, B. Y., Oh, J. G., Schuetze, T., Porras Álvarez, S., Lee, K., & Park, J. (2017). Op cit.
[276] Ismail, M. A., Keumala, N., & Dabdoob, R. M. (2017). Op cit.
[277] Al-Hagla, K. S. (2012). Op cit.
[278] Gould, K. L. (2006). Op cit.

2.4.3. Actors and Solutions

Based on the literature reviewed, the actors can be grouped in three way: faculty, university, and the community. For the sustainability awareness in the architecture schools, the faculty has essential roles which include transforming curriculum, supporting students' leadership, having the adequate number of staff and expert on sustainability and providing research and course development related to sustainability.[279] According to Altomonte, the architecture curriculum should support different disciplines and research. He stated that educators, students, and professionals must develop sustainable environmental design knowledge with research and design practice. It was emphasized that sustainability in architecture should be supported in organizations such as education, accreditation, and regulatory bodies.[280] Ostwald et al. examined the academic staff and student profile, the distribution of curricula, teaching and learning environment. They identified specific areas for analysis which were design, technology, history and theory, communication, application, and environment.[281]

Second Nature also identified several strategies for sustainable design that enable each school to make progress in their paths.[282] These were the modifications of curriculum and studio teaching; encouraging student leadership; helping faculty by organizing seminars and workshops; spreading information to facilitate the information exchange and update; using the accreditation systems to support change; making a comprehensive evaluation of architecture schools; involving students and faculty in organizations of campus practices and rethinking the relationship between space and new forms of learning.[283] According to the Second Nature, to integrate sustainability into studio teaching it was necessary to use the campus as a tool, to increase adaptive

[279] Glyphis, J. (Ed.) (2001). Op cit.
[280] Altomonte, S. (Ed.) (2012). Op cit.
[281] Ostwald, M. J., Williams, A., Learning, A., & Council, T. (2008). Op cit.
[282] Ibid.
[283] Ibid.

and improved learning tools, and to find practical methods to integrate studio and theoretical courses.

Stevenson et al. stated that design studio instructors should be aware of sustainability issues and support this awareness to increase their enthusiasm by including them in their pedagogical behavior.[284] It was stated that since the beginning of the project process in the design studios, the expert and the instructor should work together for the integration of sustainability to the studios.[285]

In the literature review, it was stated that the idea of SD should be included in the culture and daily activities of the universities.[286] The important responsibilities of the university administrations have been underlined. Some of these were making sustainability an integral part of the institutional framework, promoting interdisciplinary work, cooperating with other universities, and creating on-campus life experiences.[287] By using the campus as a sustainable tool in studio education, it was necessary to find practical methods to integrate studio and theoretical courses.[288] Also, it was mentioned that the financial incentives, courses, seminars and workshops on sustainability supported faculty and students for increasing the awareness.[289]

According to Salama, incorporating sustainability into design studios facilitates the sustainable design processes of architects and can make sustainability an essential element in their careers.[290] According to Alvarez et al., professionals should be provided with the necessary information to deal with current and future sustainability problems.[291]

Laufen Manifesto for Humane Design Culture mentioned the task of instilling great social empathy by stating that design education should enable deeper communication

[284] Stevenson, F., Roberts, A., & Altomonte, S. (2009). Op cit.
[285] Ibid.
[286] Lozano, R. (2006). Op cit.
[287] Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Leal Filho, W. (2015). Op cit.
[288] Glyphis, J. (Ed.) (2001). Op cit.
[289] Altomonte, S. (Ed.) (2012).Op cit.
[290] Salama, A. M. (2016). Op cit.
[291] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016). Op cit.

with local communities and stakeholders. It was also stated that design studios should raise awareness of the broader context of sustainable design by putting forward community and regional issues.[292]

[292] Glyphis, J. (Ed.) (2001). Op cit.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

Sustainable Development, sustainability in higher education, and the relationship between sustainability and architectural education were reviewed in Chapter II, which highlighted the importance of sustainability in the architecture design studios. As explained in the introduction to this study, the focus of the research is sustainability in the architectural design studios. In the literature, the main concepts regarding sustainability definitions, the history of sustainability development, the role of higher education in sustainable development, architectural education, and design studio, were examined in Chapter II. For the integration of sustainability in architectural design education, encountered problems, various methods, and tools used in the studies were introduced. In this sense, the findings obtained from previous studies were taken into consideration while collecting the data.

This chapter presents the materials and methodology used in the case universities to explore the effect of design studios on the sustainability perceptions of architecture students. In this chapter, qualitative and quantitative research approaches used in data collection and analysis, research material, and methodology are described. The first case study was selected as Middle East Technical University (METU), and the second was Politecnico di Torino (Polito). Each case study section included brief information about METU and Polito and a review of the curriculum of architecture programs. Then, the methodologies of the studies were presented with the research question, objectives, and hypotheses. The study consisted of a curriculum review, a survey with architecture students, and interviews with some of the faculty members in the architecture departments from case universities. At METU, the survey was conducted

on 237 students from different years. In addition, interviews with 11 studio instructors were carried out, and data was gathered on design studios and lectures about sustainability in the Department of Architecture of METU. At Polito, 151 architecture students participated in the survey, and interviews were held with 5 faculty members from the Department of Architecture and Design. The survey with architecture students, the topics of the interviews with lecturers and analysis methods of both researches were described in this section. The reasons for the decisions taken in the analysis of the data, the details of the programs, and the stages of the analysis were given in detail.

3.2. Case study 1: Middle East Technical University (METU)

Middle East Technical University (METU), founded in 1956, has adopted the mission of research and development, education and training, and community service by supporting creative and critical thinking, innovation and leadership within the framework of universal values for society, humanity, and nature.[293] METU 2018-2022 Strategic Plan, which was adopted by the Senate-University Executive Board in 2017, mentions the essential duties of universities in increasing environmental awareness and responsibility in society. It was emphasized that the university should also actively promote sustainability in order to ensure the benefit of the community. In this plan, it was aimed to spread examples like sustainable practices in energy consumption. Four strategic priorities have been identified within the framework of the work undertaken for the 2018-2022 Strategic Plan: Holistic Approach, Cooperation, and Interaction, Reinforcing the Foundation, and Strengthening the Resources.[294] In the Strategic Plan, more accessible, integrated, and sustainable systems in campus life and efficient and effective use of all resources were proposed. One of the objectives of the strategic plan was to meet the spatial use needs within the framework of sustainable campus approaches while preserving the original architectural structure of the campus. In this

[293] Middle East Technical University (METU) Mission and Vision. Retriewed from: https://www.metu.edu.tr/mission-vision. - Accessed on May 2019

[294] The METU 2018-2022 Strategic Plan. (2017). http://sp.metu.edu.tr/system/files/odtu_sp_2018_11_01.pdf -Accessed on May 2019.

plan, it was expressed that METU is hosting a wide range of research, studies, and theses on sustainability from various departments, as well as student societies, social events, and conferences.[295]

The Faculty of Architecture, which is one of the first established faculties of METU, is hosting three departments with the Architecture, City and Regional Planning and Industrial Design. The program at Middle East Technical University consists of a 4-year undergraduate degree program, a 2-year master degree, and a 4-year doctoral program. In this study, the curriculum of the Bachelor of Architecture was examined as the case study. There are 12 undergraduate and graduate courses that the relevancy of sustainability was indicated in their programs by instructors in the 2018-2019 academic year. The course names, contents, and credits were presented in Table 6.1 in Appendix A.

3.2.1. Research Aims

The primary purpose of this thesis is to explore the role of design studio education in the context of sustainability. This study focuses on the design studio programs and theoretical courses related to sustainability in architectural education to evaluate the sustainability awareness of the students. To achieve the purpose, a survey study with students and interviews with the faculty members from the Architecture Program at METU was conducted to address the following research question:

> *To what extent does the design studio education affect the perception of sustainability of the architecture students of METU?*

This research question was addressed by the following research aims to investigate:

- The impact of design studio education on perceptions of sustainability among architecture students.
- The relationship between the integration of sustainability to the design studio education and the understanding of sustainability among students.

[295] Ibid.

- The perception of sustainability of students in different years from the first year to the master degree.

Five Research Hypotheses were formulated, based on the research literature:

Hypothesis One: Students' perceptions of sustainability have increased over the years.

Hypothesis Two: There is a positive relationship between the seminars and lectures of sustainability given in the design studios and sustainability understanding of students.

Hypothesis Three: The environmental aspect of sustainability is addressed more in comparison to social and economic aspects in the design studios.

Hypothesis Four: Students who previously designed a project and received a theoretical lecture on sustainability in the design studios are more prone to doing projects related to sustainability in professional life.

3.2.2. Methodological Approach

Quantitative and qualitative data were collected and analyzed by statistical analysis methods, and the similarities were found between them. Then, hypotheses were evaluated according to these results.

Quantitative Methods: Data analysis of the survey with architecture students

The study started with a quantitative approach. As stated earlier, the main objective of adopting a quantitative method was to determine the relationship between sustainability perception and design studios among undergraduate and graduate students. Quantitative data provided information exploring perceptions on the sustainability of 237 architecture students. These tools explored the students' opinions about design studio education, theoretical lessons, and sustainability in the Architecture Program. In the survey, the questions included four sections, general knowledge, the information about design studios, their experiences in the university,

and their opinions about professional life in the future. The types of questions in the survey were divided into three types; categorical (Yes, No), Likert scale (1=Not at all, 5=Very Much) and comments requested questions. The details of the questionnaire were placed in the Appendix B. The demographics of the participants and the data collection and analysis methods used in the quantitative part of the research were explained below.

For this research, the survey was conducted on undergraduate architecture students enrolled in studio courses and master students in the same program. A total number of 237 students completed the questionnaire, including the undergraduate students enrolled in studio courses from the four-year B.Arch (Bachelor of Architectural Degree) program and graduate students from the two-year M.Arch (Master of Architecture) program at METU. The survey was distributed between November 2018 and February 2019 in the design studios. The first-year students filled out the survey in the ending of the first semester in their architectural education. The author took the questionnaires with the permission of the relevant studio instructors and ethics committee approval of the university (Appendix C). While in the 1st and 2nd-grade design studios, students were in one section, in the 3rd and 4th-grade design studios students divided into 3 or 4 sections. So, the survey was conducted 3rd and 4th year students in their elective courses. Since the students of Master degree had not a design studio, the questionnaire was given separately to them. Before data collection, the researcher introduced herself to the students and verbally informed about the purpose and procedure of the study. Also, at the beginning of the survey, there was a guideline that provided information about the purpose and scope of the study. The survey was held in English. 18 students completed the survey online. Other participants filled out the questionnaires in paper format. Studio instructors or their assistants had no contribution or influence on the answers of students when responding to the questionnaire. The survey was conducted with 237 students, of which 152 were female, and 85 were male.

Of all participants, 82 students are first-year, 51 students are second-year, 47 students are third-year, 38 students are the fourth year, and 19 students are from master degree.

The main research question of this study aimed to investigate whether students increased their sustainability understanding in the design studios. The main factors related to students' perceptions about the subject were identified as knowledge, awareness, and ability after reviewing the related literature (see Chapter II). Data analysis focused on the relationship between sustainability perception among students and design studio education. As described previously, the following section provides detailed information about the survey, data analysis, and reliability and validity tests. The suitable analysis method was chosen according to each hypothesis. For the analysis, SPSS Statistics 22 program was used in the study.[296]

Hypothesis One focuses on the relationship between sustainability understanding of the students (dependent variable) and degree (independent variable). The participants were asked three different questions whether they had acquired sustainability understanding (knowledge), whether they used sustainability principles (design skills) and whether they had been aware of the issue (awareness) in their previous design studios. They were asked to rate the answers on a five-point Likert-type scale. (1=Not at all, 5=Very Much)

First, the normality test was performed to determine whether the data were suitable for normal distribution. The normality assumption of the data was tested according to the significance value set at 0.05 with the Shapiro Wilk test. Descriptive statistics were calculated for scale questions (means, standard deviations, and frequencies). It was investigated whether this varies according to years. The Dependent Variable (sustainability knowledge) was evaluated according to the total score of three questions (Question number: 12.1, 12.2, 12.3). The independent variable of this

[296] The SPSS (Statistical Package for the Social Sciences) program, which provides statistical inferences from the data, is computer software that helps to comment on decision making by establishing cause and effect relationships. - Stevens, J. P. (2012). Applied multivariate statistics for the social sciences. Routledge.

hypothesis is the education years of students (Question number: 4). Difference tests were performed according to these variables. First, the correlation between dependent and independent variables was examined. The Pearson Correlation Test, which was used to determine the linear relationship between two continuous variables when the distribution is normal, was used for the correlation between the variables. According to the Shapiro Wilk test result, which approved the normal distribution of variance and correlation between the data, the ANOVA One-way Test was applied. ANOVA summaries were generated to compare the degree of students related to the knowledge of sustainability. To determine which Post-Hoc multiple comparison technique was used after ANOVA, the hypothesis was tested whether the variances of the group distributions were homogeneous or not. Post-hoc tests were performed to determine the differences between the averages of groups with a significance value of 0.05. Scheffe multiple comparison technique was preferred for Post hoc. According to the Post-hoc value, it was determined the different Mean Scores between the years.

Hypothesis Two questions how sustainability perception of the students develop through the seminars and lectures of sustainability given in the design studios. Total scores were calculated to see whether there was a correlation between the seminars and lectures given in the studio and sustainability knowledge of the students. Then, correlation analysis was conducted to find out if there was a linear relationship, and if so, what was the direction and severity of this relationship. Pearson correlation coefficient value (r) was interpreted. The coefficient of correlation took between -1 and +1. ($r = -1$ is a full negative, $r = +1$ is a full positive linear relationship, $r = 0$ there is no relationship between the two variables.) The results were evaluated according to these values.

Hypothesis Three investigates differences between environmental, social, and economic aspects addressed in the design studios. For the analysis, One-sample T-Test was used to determine whether the mean scores between the variables were statistically different. One-sample T-Test was performed separately according to each degree to find out which aspects the students focused more on. Analysis results were

evaluated according to the significant value. (sig<0.05 different, sig> 0.05 similar) Then the results of interviews with the lecturers were combined, and the analysis was interpreted.

Hypothesis Four examines whether students who previously designed a project and took a theoretical lecture on sustainability in the design studios are more prone to conduct sustainability-related projects in professional life. The independent sample t-test was used to determine the attitudes of the students who did and did not make projects related to sustainability and receive a theoretical lesson about that, towards the projects on sustainability in their professional lives. Independent Group T-Test which is a parametric technique used to test the significance of the difference between two arithmetic mean scores when each variable shows normal distribution.[297] Mean scores of groups were compared, and it was evaluated whether there was a difference according to the significant value set at 0.05.

Qualitative Methods: Data analysis of the interviews with the faculty members

In addition to quantitative research, the study was also supported by a qualitative approach. As stated earlier, the qualitative study aimed to determine based on the interviews with faculty members how design studio education affects students' perceptions of sustainability. The researcher benefited from in-depth interviews to provide a detailed description of faculty members' attitudes and perceptions of sustainability in architectural education. The participants, the data collection, and data analysis methods used in the qualitative part of the research were explained below.

Interviews were held with design studio instructors from the Department of Architecture. The interviews were conducted with 11 faculty members who volunteered. In this context, one from the 1st class studios, two from the 2nd grade, four from the 3rd-grade and two from 4th-grade design studio instructors were interviewed. Also, an interview with a lecturer who gave one of the courses related to sustainability

[297] Independent T-Test for two samples. Retriewed from: https://statistics.laerd.com/statistical-guides/independent-t-test-statistical-guide.php -Accessed on May 2019.

was held. Depending on the answers of the lecturers, each interview lasted for about 15 to 45 minutes. Meetings took place in the Architecture Department at METU in the academic year of 2018-2019.

Based on the literature review, interview questions included in four main headings. First, the lecturers were asked to give information about the design studio programs/ lectures, and how they conduct their studio/lessons. Then, it was inquired about the project topics and lectures on sustainability. They were asked about the relationship between design studios and theoretical courses related to sustainability and how they interpret sustainability issues in the studio. Finally, it was examined how the sustainability concept should be in architectural education to increase the knowledge and awareness of students. Interview questions are given at the end of the study (Appendix D)

Research Question: What are the ways in which architecture lecturers can improve sustainability awareness and knowledge of architecture students?

Interviews were held with design studio instructors and the lecturers who gave the theoretical courses related to sustainability from the Department of Architecture. Interview responses were recorded, categorized, and analyzed for the determination and regulation of consistent themes. The researcher transcribed the answers of open-ended survey questions. In the next chapter, answers to the questions were summarized (see Chapter 4). The thematic analysis, which is the process of identifying patterns or themes within qualitative data, was used to determine the important points in the answers to the questions.[298] Braun and Clarke (2006) stated that thematic analysis was the first qualitative method to be learned because it provided basic skills that would be useful.[299] In the study, the data was transferred to the NVivo 12 program, which helped organize and manage data analysis. To create the first codes, phrases,

[298] Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education, 9(3).
[299] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101.

sentences, and paragraphs were labeled with the same topics. After the transcripts were encoded, the first themes were created and clustered together, with similar meanings or a relationship with each other. The themes were examined according to the data. When this was completed, the researcher identified the themes in terms of the content and meaning of the codes and summarized the content of what was discussed. Accordingly, the last report was written (see Chapter 5).

3.3. Case Study 2: Politecnico di Torino (Polito)

Founded in 1859, Politecnico di Torino (Polito) offers education, research, technological transfer and services in architecture and engineering departments in Piemonte, Italy.[300] The university declared that not only the theoretical and application researches but also the analysis and suggestion of the solutions of the challenges of today's society for a sustainable future were taken into consideration. It was stated that university graduates could manage interdisciplinary science with caring about social, ethical, economic, and environmental impacts.[301] The University expressed that it supported scientific research and studies, but also aimed to include the Sustainable Development Goals (SDF) of the UN 2030 Agenda in the curriculum.[302]

In 2015, the sustainability office of the university was established. It was called the Green Team Polito which included professors, students, administrative staff, and researchers.[303] The team declared that one of the goals of Polito was to increase awareness of the social role in the whole society as individuals and institutions that can direct change to a more sustainable future. In the campus management, Politecnico di Torino defined five dimensions of sustainability which were energy and buildings; mobility and transport; urban outreach; food, water, and waste; green procurement. In the Sustainability Report Polito Green Team, it was pointed out some topics like

[300] Politecnico di Torino University mission and history- Retriewed from: https://www.polito.it/ateneo/storia/?lang=en -Accessed on May 2019.
[301] Ibid.
[302] Polito Strategic Plan 2018-2024. http://www.pianostrategico.polito.it/en/the_strategic_plan -Accessed on May 2019.
[303] Ibid.

energy-efficient strategies implemented in 20 years; renewal of historical buildings for educational purposes; continuous encouragement innovation in sustainable technologies, and providing relevant environmental awareness skills to students and staff; knowledgeable management of UNESCO heritage sites and campus areas that cover old industrial environments, and many actions about green, smart resources.[304]

In the program of architecture, 3 + 2 Bachelor-Master model was applied following the reform of the Italian university system. On the website of Polito Department of Architecture and Design (DAD), it was stated that three-year of architecture degree focus on the implementation of architectural design in various aspects and on different scales with humanist and technical discipline contributions.[305]

The Department of Architecture and Design (DAD) has different master programs, which are Architecture Construction City, Sustainability Design, Territorial, Urban, Environmental and Landscape Planning, Architecture Heritage Preservation and Enhancement and Systemic Design.[306] The researcher examined the curriculum and listed the courses with the sustainability outputs, which stated in their content. On the University website, each of these courses was associated with the numbers of Sustainable Development Goals.[307] In the 2018-2019 academic year, there were 14 courses related to sustainability in the Bachelor Degree, 16 courses in Architecture Construction and City Master Program and 21 courses in the Sustainable Design Master Program. The courses that relevancy of sustainability was indicated in the programs by instructors are given in Appendix A (Table 6.2, Table 6.3). It was observed that different atelier groups were offered every grade in the DAD of Polito. The multidisciplinary ateliers included the main units like architectural and urban

[304] Polito Strategic Plan 2018-2024. Op cit.
[305] Polito Architecture Course Catalog- Retriewed from: https://didattica.polito.it/laurea/architecture/en/presentation -Accessed on May 2019.
[306] Politecnico di Torino Teaching Portal- Retriewed from: https://didattica.polito.it/offerta/index_en.html -Accessed on May 2019.
[307] Polito Bachelor program of architecture. Retriewed from: https://didattica.polito.it/pls/portal30/gap.a_mds.vis_coorte?p_sdu=80&p_cds=2 -Accessed on May 2019.

design, structural engineering, restoration, and sociology. There was at least one lecturer from each department attends the atelier. The students chose the studio which they wanted to study. Different workshops and theoretical lectures supported the ateliers in the architecture program of Polito.

3.3.1. Research Aims

This study aimed to investigate the influence of the design studio education on sustainability perceptions of architecture students. In the study, the architecture curriculum at the Polito was evaluated to assess the students' sustainability knowledge. In order to introduce the relationship between students' perceptions and the design studios on, a survey study with students and interviews with lecturers were conducted at Polito. The following research question and objectives were based on the literature review and the previous study (METU).

> *To what extent does the design studio education affect the perception of sustainability of the architecture students of Polito?*

The objectives of the study that emerged about this question were stated below. **Research Aims** included the evaluation of:

- The impact of design studio education on perceptions of sustainability among architecture students.
- The relationship between the integration of sustainability to the design studio education and the understanding of sustainability among students.
- The perception of sustainability of students in different years from first year to the master degree.

There were four hypotheses for achieving these aims:

Hypothesis One: Students' perceptions of sustainability have increased over the years.

Hypothesis Two: There is a positive correlation between the integration of sustainability into the design studios and sustainability understanding of students.

Hypothesis Three: The environmental aspect of sustainability is addressed more in comparison to social and economic aspects in the design studios.

Hypothesis Four: Students who previously designed a project and received a theoretical lecture on sustainability in the design studios are more prone to doing projects related to sustainability in professional life.

3.3.2. Methodological Approach

The research at Polito included qualitative and quantitative data. There were different methodological approaches for them. This section presents the methods of data analysis.

Quantitative Methods: Data analysis of the survey with students

In the quantitative part of the study, the survey was conducted with undergraduate and master students to determine the sustainability perceptions and the design studio experiences. A total of 151 students participated in the study at the Polito. Questions were asked about design studio education, theoretical lectures, and sustainability approach of the university. The questionnaire consists of four sections, general information of students, previous experiences in the design studios and the university, and their opinions for the future. The types of questions in the questionnaire were divided into three types; categorical (Yes, No), Likert scale (1 = Not at all, 5 = Very Much) and comments requested questions. The details of the survey were given in Appendix E. The demographics of the participants, the data collection and analysis methods used in the research were as follows.

The questionnaire was applied to undergraduate architecture students and graduate students with a total of 151 students enrolled in the studio programs. Three-year B.Arch (Bachelor of Science Degree) undergraduate students and the two-year M.Arch (Master of Architecture-Architecture Construction City, Sustainability

Design) program students involved in this study. The survey was conducted in Turin between February and July 2018. The author firstly requested an interview from studio instructors via e-mail. The meetings with the studio instructors were about the aim and scope of the study. Then the studios were visited by the director for the survey. Before collecting data, the researcher introduced herself to the students and made a presentation about the purpose and procedure of the study. At the end of this presentation, the questionnaire was accessed via the Internet link or Qr code. Google Forms was used for the survey. There was a guide at the beginning of the study which included the purpose of the study, where to use these data, the importance of the study's objectivity, how many minutes it takes, the basis of volunteerism and acknowledges. The survey was conducted in English and Italian. Participants filled out the questionnaire by selecting language they wanted. These answers were then collected and translated by the researcher. Studio instructors and assistants had no contribution or influence on the answers of the respondents. The survey was conducted with 151 students (82 female, 69 male). The detailed descriptive statistics of participation were given in the findings and results (Chapter 4).

This research focused on the impact of the design studio education on the sustainability knowledge of the architecture students at Polito. Data analysis examined the relationship between sustainability perception and design studio experiences of students. According to each hypothesis, the suitable analysis method was chosen; independent and dependent variables were defined. SPSS Statistics 22 program was used for analysis. Detailed information about the data analysis, reliability, and validity tests used in the study were given in the following section.

Hypothesis One examines the relationship between sustainability understanding (dependent variable) and degree (independent variable) of the architecture students at Polito. For the argument data, the participants were asked to answer the following question.

12. To what extent have your knowledge and awareness of sustainability concept developed after you carried out design projects about the sustainability concept?

The answers were scored on a five-point Likert-type scale. (1 = Not at all, 5 = Too Much) For the analysis, the normality test was performed to determine the normal distribution. The Shapiro Wilk test was used to test the normality assumption with a significance value at 0.05. Descriptive statistics were calculated for the question of each degree (averages, standard deviations, and frequencies). Difference tests were performed according to the dependent variable (Sustainability understanding-question 12) and independent variable (students' degree- question 4). First, the correlation between these dependent and independent variables was examined. Pearson Correlation Test was used to determine the linear relationship between two these variables. Then, ANOVA One-Way Test was used to compare the students' degree of sustainability understanding. After ANOVA, the Post-Hoc multiple comparison technique was used. The Post hoc tests were performed to determine the differences between the means of the groups with a significance level of 0.05. To determine which Post-hoc test was used, it was analyzed whether the variances of the group distributions are homogeneous. The Scheffe Post-hoc analysis was preferred, and different mean scores were determined over the years.

Hypothesis Two investigates the relationship between sustainability integration of the design studios and the sustainability understanding of students. The variables of this hypothesis were the responses of to what extent integrated the concepts they learned in their studios with sustainability (Question 11) and the understanding of sustainability (Question 12). Mean scores were calculated to determine whether there was a correlation between these two variables. The Pearson Correlation analysis was then performed to find out if there was a linear relationship. Pearson Correlation coefficient value (r) was interpreted. The correlation coefficient varied between -1 and +1 (r = -1 is a full negative, r = +1 is a full positive linear relationship, r = 0 there is no relationship between the two variables). Results were evaluated according to these values.

Hypothesis Three explores the differences between environmental, social, and economic aspects of sustainability in the design studios. For this purpose, students were asked which dimension of sustainability they carried out projects in the studios (Question 8.1). Mean scores and frequency were calculated, and the hypothesis was interpreted.

Hypothesis Four evaluated the relationship between the ideas of the students who had previously designed a project and took a theoretical course on sustainability in design studios and their perceptions about professional life in this context. The Independent Sample T-Test was used for this hypothesis. The Independent Sample T-Test is a parametric technique used to test the significance of the difference between the two arithmetic mean scores when each variable is normally distributed. The variables were determined as students who designed or not a project on sustainability (Independent categorical variable) and their opinions about professional life (Continuous dependent variable). The mean scores of these variables were compared and evaluated whether there was a significant difference according to the test results.

Qualitative Methods: Data analysis of the interviews with the lecturers

The research covers qualitative data as well as quantitative part. The researcher conducted meetings in the spring of 2018 to explore the lecturers' perceptions of sustainability issues in the design studios at Polito. In the qualitative part of the research, the participants, data collection, and analysis methods were explained below.

In the Department of Architecture and Design (DAD) of Polito, 15 studio instructors were accepted to involve in the study. The interviews were conducted by the researcher personally on the date set by the participants. There were lecturers from different design studios which of four from the first-grade studios, one from the second grade, and two from the third grade. Also, it was interviewed with two lecturers from the Master Program of Architecture Construction City, six from the Master Program of Sustainability Design. The participants were asked about the purpose and scope of their design studios and their opinions about sustainability in architectural education.

Interviews took place in different buildings of Polito between February and June 2018. Then it was requested from the participants to fill out a questionnaire in writing. The questions were sent to the lecturers via e-mail. Five of the participants involved in this survey and wrote their comments on open-ended questions (Appendix F). These questions were about lectures, practices, projects, and attitudes on sustainability in the design studios, related theoretical courses in the curricula, and suggestions for enhancing students' perceptions of sustainability. With these questions, the researcher tried to have a general idea about sustainability perceptions, approaches, and the studio culture in the Department of Architecture of Polito.

3.3.3. Limitations

There were some limitations in the study while collecting data at Polito. The researcher was in Turin for the Spring semester in 2018 with a fund provided by the METU. Since her education time at the Polito was limited, she reached the data in 5 months. Another issue which the researcher had difficulty with was the language of education of Polito which hold in both English and Italian. The contents and the lecturers of the courses given in Italian were not reached. Therefore, the questionnaire with the students was translated into Italian. There could be some changes in translations between the two languages. The design studio system, lectures, and curriculum details of DAD were investigated through the university website and lecturers. Due to time constraints, observations were also limited.

CHAPTER 4

RESULTS AND DISCUSSION

4.1. Introduction

The Fourth Chapter provides insight into the research findings through statistical evidence and the analysis of the data collected from the case universities (METU and Polito). It describes the findings and results of the research study. It also provides an integrated and critical discussion of the findings of the two cases. The primary purpose of the researcher was to explore the impact of the design studios on sustainability perception through an evaluation of students' questionnaire responses and lecturers' interviews. The methodology, the research questions, and hypotheses were presented in Chapter 3. In this chapter, firstly, it was designed to examine quantitative data to analyze the survey study related to the perception of sustainability of architecture students in the case universities. The survey was carried out with 237 students of METU and 151 students of Polito. Demographic characteristics of the sample; participants' ages, gender, program, and degree were presented. Also, descriptive statistics were given as a result of the analyses. In the second part, the qualitative data were reviewed, which were analyzes of lecturers' interviews to support the results of the quantitative data. The interview findings of the lecturers were summarized for supporting the results of these quantitative data.

4.2. The Analysis of the Case Study 1: METU

Quantitative Data

The survey with architecture students of Middle East Technical University was conducted between November 2018 and February 2019. Of 237 students, 153 (64%) were female and 85 (36%) were male with different age range (18-22 (66%), 22-26

(%29), >26 (%5)). Sample ages for each gender were presented in Table 6.4 in Appendix G.

The majority of students (218 (92%)) were bachelor students, and 19 students (8%) were in the Master Degree of METU. Among 237 students who participated in the study, 82 students (%34,6) were first-year, 51 students (%21,5) were second-year, 47 students (%19,8) were third-year, 38 students (%16) were the fourth year, and 19 students (%8) were from Master degree. It was shown in Figure 4.1 below.

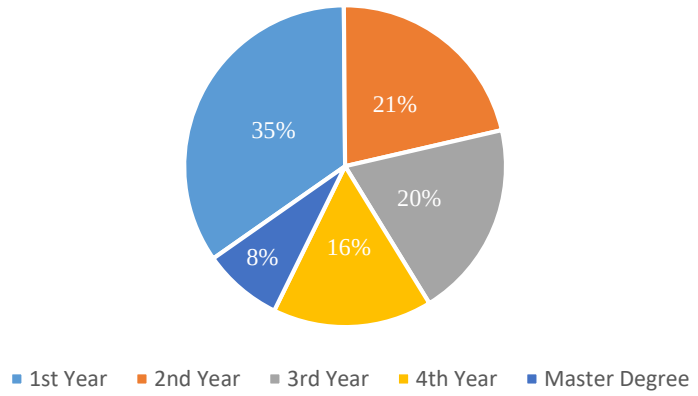

Figure 4.1. Distribution of students regarding degree in the survey at METU

The analysis method to be used for each hypothesis was determined by considering the normality, homogeneity, and data numbers, which is higher than 30. After the survey data were obtained from the users, reliability analysis was applied. According to the reliability analysis, Cronbach's Alpha value was 0.795 (Table 6.5 in Appendix G). This means that 80% of the data obtained from the survey was reliable.

Based on the methodology, the following hypotheses were examined, and the results were revealed.

> **Research Question:** *To what extent does the design studio education affect the perception of sustainability of the architecture students?*

Hypothesis 1: Students' perceptions of sustainability have increased over the years.

The purpose of this hypothesis was to find out the impact of years and experiences with design studios on the sustainability knowledge of students. The results for the first hypothesis were presented below. It was analyzed whether there is an improvement in the sustainability understanding of the students over the years. Then, to facilitate a more in-depth analysis, the regression analysis results were obtained from the analyses that examined the extent to which students differed in terms of sustainability understanding according to their degree. According to the Shapiro Wilk test, it was determined that the data were suitable for normal distribution ($p > 0.05$). In the correlation test between variables, the relationship between the degree of students and sustainability understanding variables was statistically significant at $p<0.01$ level according to the Pearson Correlation test (Table 6.6 in Appendix G). According to Table 6.6, there was a positive correlation between variables (r= 0,501).

According to the suitability of the data distribution for the hypothesis, it was performed the Anova One-way Test which was used to compare the mean scores of more than three groups. As a result of the Anova One-Way Test analysis, it was found that there was a statistically significant difference in terms of Sig. coefficient $p = 0.00 <0.01$ (Table 4.1), which concluded that the degree of architecture students affects their sustainability understanding. Since $p <0.01$, our hypothesis has been confirmed.

Table 4.1. *Anova One-Way Test Analysis*

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	677,069	4	169,267	19,783	,000
Within Groups	1779,701	208	8,556		
Total	2456,770	212			

Dependent variable: Degree of students
Independent variable: Sustainability understanding

Table 4.2 reports the mean scores and standard deviations of sustainability understanding of the students for each year. For this purpose, three different questions (see Appendix B- question 12.1, 12.2, 12.3) were asked to the students, and the mean scores of the answers were found. For the total sustainability understanding score, the questions of knowledge, design skills, and awareness of sustainability scores were combined. The scale of sustainability knowledge variable mean scores was from 3 to 15.

Table 4.2. *Mean and standard deviations of the sustainability understanding of students by years*

	Number of Students	**Mean Score**	**Std. Deviation**
1st Year	66	4,88	3,051
2nd Year	45	7,58	3,115
3rd Year	46	7,85	2,521
4th Year	37	9,24	2,650
Master	19	9,95	3,407
Total	213	7,30	3,404

According to Table 4.2, there were different mean scores between groups. As can be seen from the table, the mean score of the first year students in the sample group was 4,88 ; the mean score of 2nd grade students was 7,58; the mean score of 3rd grade students was 7,85; the mean score of the 4th grade students was 9,24, and the mean score of the master group was 9,95. Although there was an increasing mean score compared to the years, the Post-hoc test was used to determine whether there was a significant difference between the two years statistically. The Post-hoc tests were performed to explore the changes between the years. To decide which Post-hoc multiple comparison technique was to be used after ANOVA, firstly, the hypothesis was tested whether the variances of the group distributions were homogeneous with the Levene's test. The variances were found to be homogeneous ($p = 0,317>0,05$). Scheffe multiple comparison technique, which is widely used in case of homogeneity

of variances, was preferred. The results of the Scheffe multiple comparison analysis were presented below (Table 4.3).

Table 4.3. *The Scheffe Multiple Comparisons Analysis*

The degree of students	The degree of students	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1st Year	2nd Year	-2,699*	,565	,000	-4,46	-,94
	3rd Year	-2,969*	,562	,000	-4,72	-1,22
	4th Year	-4,364*	,601	,000	-6,23	-2,50
	Master	-5,069*	,762	,000	-7,44	-2,70
2nd Year	1st Year	2,699*	,565	,000	,94	4,46
	3rd Year	-,270	,613	,996	-2,18	1,64
	4th Year	-1,665	,649	,164	-3,68	,35
	Master	-2,370	,800	,071	-4,86	,12
3rd Year	1st Year	2,969*	,562	,000	1,22	4,72
	2nd Year	,270	,613	,996	-1,64	2,18
	4th Year	-1,395	,646	,327	-3,40	,61
	Master	-2,100	,798	,144	-4,58	,38
4th Year	1st Year	4,364*	,601	,000	2,50	6,23
	2nd Year	1,665	,649	,164	-,35	3,68
	3rd Year	1,395	,646	,327	-,61	3,40
	Master	-,704	,826	,948	-3,27	1,86
Master	1st Year	5,069*	,762	,000	2,70	7,44
	2nd Year	2,370	,800	,071	-,12	4,86
	3rd Year	2,100	,798	,144	-,38	4,58
	4th Year	,704	,826	,948	-1,86	3,27

*. The mean difference is significant at the 0.05 level.

According to the Scheffe Multiple Comparisons Analysis, it was determined that there was a significant difference between 1st-grade students' sustainability knowledge mean score and the others ($p= 0 < 0.05$).

With this hypothesis, it was predicted that the studio education and courses of architecture students increase the sustainability knowledge of architecture students. In METU, this hypothesis was confirmed in the analysis (One way ANOVA test results-

Table 4.1, p = 0.00 <0.01). It was observed that the sustainability understanding of first-year students was deficient compared to other years. It was interpreted that design studio training and theoretical courses have been effective in developing sustainability understanding of students over the years.

Hypothesis 2: There is a positive relationship between the seminars and lectures of sustainability given in the design studios and sustainability understanding of students.

The researcher conducted a correlation test to determine whether there was a relationship between the sustainability knowledge of the participants and the theoretical studies such as seminars and lectures on sustainability in the design studio courses. For this, one variable was specified with question 14 (To what extent was the concept of sustainability instructed using seminars, lectures, etc. during the design studios?). The other variable was the student's sustainability understanding. The mean scores and standard deviations for both variables were reported (Table 6.7 in Appendix G). For the total sustainability understanding score, knowledge, design skills, and awareness of sustainability scores were totalized. The average of the sustainability knowledge variable was from 3 to 15. Pearson's correlation analysis was used to measure the statistical relationship between these two variables. Findings showed there was a significant (p= 0< 0.01) relationship between sustainability understanding of students and lectures, discussing the sustainability concepts in the design studios (Table 4.4).

Table 4.4. *Pearson Correlation Analysis*

		M.14. To what extent was the concept of sustainability instructed by means of seminars, lectures, etc. during the design studios?	**Sustainability Understanding of students**
14. To what extent was the concept of sustainability instructed by means of seminars, lectures, etc. during the design studios?	Pearson Correlation	1	**,697****
	Sig. (2-tailed)		**,000**
	N	216	209
Sustainability Understanding of students	Pearson Correlation	**,697****	1
	Sig. (2-tailed)	**,000**	
	N	209	213

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient was affected by the sample size, ranging from -1 to +1. Therefore the correlations were separated as follows by using Evans' (1996) guide for the absolute value of r (r= .00-.19 means very weak; r= .20- .39 means weak; r= .40- .59 means moderate; r= .60- .79 means strong; r= .80- 1.0 means very strong).[308] Results revealed that there was a strong positive correlation since the p-value is 0.697. It was interpreted as instructional methods (seminars, lectures, etc.) given in the design studio were increasing sustainability understanding of students. This hypothesis supported that the studio was to be supported with theoretical teaching for the understanding of sustainability. The theoretical information given in the studio was also useful in developing students' perception of sustainability. In the case of METU, it was observed that the seminars and courses on sustainability in the studio increased students' understanding of sustainability (Table 4.4).

[308] Evans, J. D. (1996). Straightforward statistics for the behavioral sciences. Thomson Brooks/Cole Publishing Co.

Hypothesis 3: The environmental aspect of sustainability is addressed more in comparison to social and economic aspects in the design studios.

With this hypothesis, it was wanted to find out which aspects of sustainability was more addressed in the design studios. For this purpose, the One-Sample T-Test was used to compare the mean of the aspects of sustainability. The mean scores of these pillars were evaluated from three questions (see Appendix B, question number: 8.1, 8.2, 8.3) which ask the students who carried out a project related to sustainability before. Firstly, the mean scores and standard deviations of these three problems were listed (Table 6.8, 6.9, 6.10, 6.11, 6.12, see in Appendix G). The scale of the social, environmental, and economic aspects of sustainability variables' mean scores were from 1 to 5. The mean scores of each year were compared, and it was investigated whether there was a difference between the three aspects of sustainability.

- There were 9 students who answered these three questions in the first year. The descriptive analysis of these students who conducted projects involves sustainability concepts was given in Table 6.8 in Appendix G. In the analysis, the social sustainability mean score was 3,00; the environmental sustainability was 3,11, and economic sustainability was 2,22 in the first year of bachelor's degree in the Department of Architecture at METU.
- The descriptive statistics of 15 students who answered the three questions in the 2nd grade shows the mean scores and standard deviations of the aspects of sustainability in Table 6.9(Appendix G). In the analysis of the second year, the social sustainability mean score was 3,00; the environmental sustainability was 3,67, and economic sustainability was 2,13.
- In the third-grade design studios, 25 students answered these questions for the hypothesis. The mean scores and standard deviations are given in Table 6.10 (Appendix G). According to the analysis result, the social sustainability mean score was 2,68; the environmental sustainability was 3,48, and economic sustainability was 2,08 in the third year of METU.

- 25 students answered the questions in the fourth year. In the analysis, the social sustainability mean score was 3,56; the environmental sustainability was 4,28, and economic sustainability was 2,92 in the fourth year (see in Table 6.11, Appendix G)
- In the descriptive statistics of 11 master students whose projects involved sustainability aspects, the social sustainability mean score was 3,36; the environmental sustainability was 4,09, and economic sustainability was 3,27 in the Architecture Master Program of METU (see in Table 6.12, Appendix G).

The descriptive statistics were shown below the difference between the aspects of sustainability in the projects of students in each year. Table 4.5 shows the different mean scores in all years.

Table 4.5. *The mean scores of each year for hypothesis three*

		Social sustainability	**Environmental sustainability**	**Economic sustainability**
Mean Scores	1st Year	3,00	3,11	2,22
	2nd Year	3,00	3,67	2,13
	3rd Year	2,68	3,48	2,08
	4th Year	3,56	4,28	2,92
	Master	3,36	4,09	3,27

According to mean scores of the three aspects of sustainability for each year, environmental sustainability was more addressed than others. The lowest mean score of these aspects was economic sustainability in all years. The results revealed that the hypothesis that the environmental aspect of sustainability was addressed more in comparison to social and economic sustainability in the design studios was confirmed. As stated in the literature review, in sustainability understanding, it is obligatory to

integrating the three aspects of sustainability, which are environment, society, and economy together into the course contents. If the concern of this hypothesis was analyzing the weightiness of three aspects, the environmental dimension came to the forefront in the discussions and projects of the design studios at METU.

Hypothesis 4: Students who previously designed a project and received a theoretical lecture on sustainability in the design studios are more prone to doing projects related to sustainability in professional life.

For this hypothesis, first, the students participating in the survey were asked whether they carried out a project and took a lecture on sustainability in the design studios. They were asked to answer this question (see Appendix B, question number:8) as yes or no (nominal). According to these two different responses, it was analyzed whether they are prone to carry out projects related to sustainability in the future carriers. As stated before, it was determined that the data were suitable for normal distribution with the Shapiro Wilk test ($p < 0.05$). So, the Independent Samples T-Test was used to compare the averages of the two independent groups. For this test, it was determined that the independent categorical variable was their experience on sustainability in the design studios (question 8), the continuous dependent variable was their opinions about the future practices (question 20). Table 4.6 shows the descriptive statistics of these groups.

Table 4.6. *The descriptive statistics of the variables*

	8. Within your design studios at Middle East Technical University (METU), have you received any theoretical lectures, and have you carried out any projects related to sustainability?	Number	Mean Score	Std. Deviation
20. In your future professional practices as an architect, do you want to design projects integrated with sustainability concepts?	No	139	4,18	1,085
	Yes	86	4,57	,695

According to Table 4.6, there were 86 students who carried a project and received a theoretical course related to sustainability in the design studios at METU. For the answer to question 20, their mean score is 4,57. Also, the table shows that 139 students answered the question 8 as no. Their mean score on question 20 is 4,18. As stated earlier, the scale was from 1 to 5 for the Likert type questions. The Independent Samples T-Test was performed to compare these mean scores. The results revealed that there was a significant difference between these two groups ($p < 0.05$, see Table 6.13 - Appendix G). It was interpreted as the students who carried out a project and took a theoretical lecture on sustainability in the design studios were more prone to design projects on sustainability in their professional life.

Qualitative Data

After the quantitative data analysis, the qualitative research method of the study continued. The researcher interviewed with 11 faculty members from METU Department of Architecture. All interviews were done in person. Depending on the lecturers' answers, each interview lasted approximately 15 to 45 minutes. The lecturers were asked four main, two sub-sequence questions about the project topics in the

design studios, the relationship between sustainability and design studio (See Appendix D). Interviews were transcribed and transferred to NVivo 12 for analysis. Transcripts were provided in Appendix E of this study. The researcher copied, analyzed, and categorized the interview responses to the study topics for the determination and organization of coherent themes. The information obtained at this stage was examined and divided into meaningful sections, and it was tried to find out what each section means. The coding process was performed by creating a general framework according to the prominent. Firstly; the codes of the written interviews were listed. Any speech that fits under a given pattern was identified and placed in the corresponding codes. Then, the relevant patterns were combined in sub-themes to form the main titles. The answers to the questions asked to the lecturers were combined and summarized under these four headings: Sustainability in the architectural education, projects related to sustainability in the design studios, the relationship between the design studio education and theoretical courses on sustainability, suggestions to improve awareness of sustainability among students. The last report with the themes was presented in the conclusion (Chapter 5).

- **Sustainability in Architectural Education**

The faculty members expressed some general ideas and assumptions about sustainability. All participants agreed that sustainability was an important issue. Also, most of them stated that sustainability was an extensive, complex, multi-layered, transdisciplinary, and open-ended field. One of them defined sustainability with two basic keywords as sustainability is an epistemological phenomenon that requires ethical sensitivity. The lecturers stated that sustainability must be one of the main subjects of architectural education. One commented as *Sustainability should be one of the main issues of architectural design just like form, composition, and structure.* The two lecturers commented that sustainability was a critical issue in architectural curricula and also in the accreditation process. Also, most of them mentioned that sustainability should be more in architectural design studios. One stated that *Sustainability, both theoretical and practical, has become one of the main subjects*

with the student's skills and competence. One of the themes of the study at the end of the analysis was: *Sustainability is not a new concept*. Some lecturer considered that sustainability was very parallel to the architectural debate.

One of the lecturers stated that they are already dealing with problems that address human-environment relations in architecture discipline. He/she stated the architecture and sustainability fields have a lot of common issues. Another lecturer who supports this assertion stated that from the Vitruvius to the present day, the essence of architectural design and production was based on the concept of sustainability. Addition of these comments, one of them stated that he/she had a critical position to sustainability. He/she mentioned that sustainability was a very prominent issue in architectural education in both global and local academia, but the concept was emptied and marginalized. The three lecturers also stated that architectural education included most of the sustainability issues.

- **Projects Related to Sustainability in the Design Studios**

Most of the lecturers agreed that sustainability should be involved in the design studio education. One said that although the name and content were not clearly defined in the sustainability studio environment, they discussed sustainability issues in the studio classes, especially in the 3rd and 4th grades from the 2nd grade. In the 1st grade studio, it was stated that there was no project or lecture on sustainability. Most of the participants agreed, generally, the main theme of the projects was not sustainability, but issues related to sustainability in projects were discussed. One expressed that they observed when the theme was directly addressed sustainability; students understood the concept comprehensively. Some stated that if they saw a clue related to sustainability in the students' projects, they support the students to develop this idea.

One of the themes stated in the conclusion part of the study was: *The imbalance between dimensions of sustainability.* Most of the lecturers talked about the need to address social and economic aspects as sustainability should not be limited to the environmental dimension. The studio instructors from 3rd and 4th year design studios

stated that they discussed the sustainability concept with all dimensions. The lecturers stated some topics on sustainability discussed in the design studios. They stated that some of the issues related to sustainability in the 2nd year studio, they were climate, topography, environmentally friendly buildings, passive systems. In the 3rd year they stated that the topics related to sustainability was environmental, economic, social and cultural sustainability which involved historical context of the site, ethical sensitivity, natural balance, ecosystem, ecological design, urban harvesting, urban agriculture, healthy food production, orientation of buildings, passive systems, climate change, environmental ethics, solar panels, waste management, energy conservation, wind energy systems, heat insulation, water cleaning systems, sustainable materials, waterfronts/riverfronts design, the importance of plants, trees and landscape in urban areas. The scope of sustainability related issues expand in years. The lecturers also mentioned that the topics related to sustainability in the 4th year design studios also included all dimensions of sustainability. They were industrial heritage, cultural history, the previous urban structures of cultural, social, economic policy of the site, cultural hub, historical peninsula existing structures, urban farming, vertical agriculture, resource consumption, built environment, energy efficiency, sustainable materials, energy efficiency, wind energy, climate, solar energy, photovoltaic systems, green corridors, transportation etc.

Another theme of the study at the end of the analysis was: *Sustainability should be more involved in architectural education.* Some lecturers emphasized the programs of the design studios have a heavy workload, so there is no time to discuss the sustainability issues. The need for extra time to discussions for sustainability discussions has shown that sustainability was seen as not a priority area in the design studio. They stated that it was possible to focus on sustainability in master and doctoral programs. Opposite of this argument some stated that sustainability should be discussed from the first year to graduation in all design studios. Most of them highlighted that if there were more time in the studios, they would talk about the sustainability concept more. Some expressed that although sustainability issues were

mentioned in studios, it could not be the priority or main theme because of the many achievements which students should have in the studios.

- **The Relationship Between the Design Studio Education and Theoretical Courses on Sustainability**

Most of the lecturers stated that sustainability was one of the most challenging issues to integrate into architectural curricula. Since sustainability is a complex, multi-layered, and multidisciplinary field, it has not been fully involved in the design studio. But they agreed on that sustainability should be more integrated into the architecture curriculum. Some of them mentioned that the theoretical courses were not integrated well with the design studio projects. One said that *there is a gap between the theoretical courses on sustainability and the design studios*. It was stated that students had difficulty in implementing what they learned in theoretical courses. One also commented that there should be more interaction between the design studios and these courses; sustainability should be more visible in the design phase of the projects. Some of the participants agreed that sustainability should take place in every lesson, including design studios.

Most of the respondents stated that the Department of Architecture had elective courses related to sustainability. It was mentioned that there were mostly about environmental sustainability. The lecturers expressed the need for more experts on sustainability. They observed that more comprehensive courses on sustainability were also needed. Many participants repeated that it should be increased and diversified the number of courses on sustainability. Some stated the elective courses on sustainability should be the must courses in order to make students understand better. One commented that he/she satisfied to see the achievements of theoretical lectures on sustainability taken simultaneously with the architectural studios. He/she expressed that students were learning how to implement sustainability on their projects in these lectures.

Participants were asked whether it was given a lecture on sustainability or whether an expert was invited before in their design studios. Mostly agreed they had lectures on sustainability by them or someone else in the studios. Some stated they invited some experts from other departments like urban planning and engineering. However, they said it was not very common.

- **Suggestions to Improve Awareness of Sustainability among Students**

Most of the participants stated the need for more integrated curricula in architectural education. Some of them suggested sustainability should be involved in all stages of design education from 1st year. Some stated it should be discussed from the 3rd year due to the limited time in the studio schedule. However, they all agreed it should be in the design studios. One said that it should be taught the students what is sustainability in detail for avoiding misunderstanding. It was expressed that examples, lectures, and theoretical lessons should support sustainability in the design studios. Some emphasized that it was needed more experts; lecturers whom specialization on sustainability issues should give more courses. Also, it was highlighted that working with lecturers from other departments in the studio support to increase sustainability understanding of students. Some commented as it should be better giving lectures and seminars about sustainability to the faculty members.

The lecturers all agreed that every student must have an understanding and awareness of sustainability during the architectural education. Some of the participants suggest supporting student communities about sustainability issues. One said that the students perceived the lectures as an obligation, so sustainability issues should be provided with student communities. To improve sustainability perceptions of students, they stated some events, workshops, and trips should be organized. One said last summer there was a summer school on sustainability with Beuth University of Applied Sciences in Germany. He/she continued that in this summer school, the students took both training and practice about sustainability in a month in Turkey and Germany. One of them noted that this awareness should start from micro scale, which was the

environment they live in. It was exemplified that it should be developed a sensitivity to the faculty building. He/she emphasized that sustainability would be more in the academy. He/she continued as the knowledge and competence of students would increase in this regard when it existed in daily life. One stated that to draw attention to the subject campus should be used as a sustainable working area. Some highlighted that students should be supported by doing research and studies on sustainability. One suggested that there should be a master program on sustainability at METU.

4.3. The Analysis of the Case Study 2: Polito

Quantitative Data

The program of Architecture at the Politecnico di Torino University consisted of a 3-year undergraduate program and 2-year master programs. The survey was conducted with 13 design studios from five of a bachelor degree, two of Master Program of Architecture Construction City, six of Master Program of Sustainability Design in the spring of 2018 academic year. In total, 151 architecture students of Polito participated in the survey. Among these students, 82 (54.3%) were female, 69 (45.7%) were male. The age and gender distributions of the students are shown in Table 6.14 (Appendix H).

In the present study, 151 students were divided into three groups regarding programs. Among the participating students, 39 were from first-grade of a bachelor degree, 15 were from second-grade, nine from third-grade, 27 were from Master of Architecture Construction City and 60 were from Master of Sustainability Design (Figure 4.2).

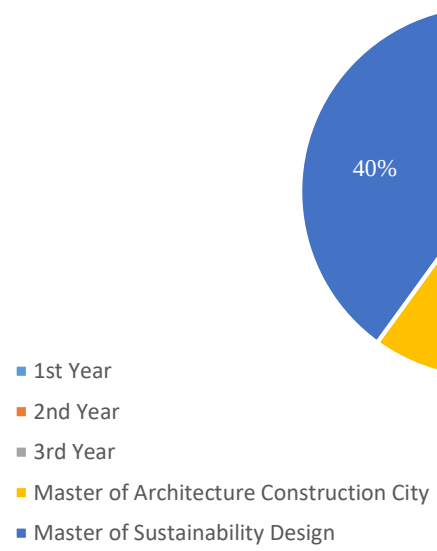

Figure 4.2. Distribution of students regarding degree of Polito

As stated before, four hypotheses were determined for the study. For each hypothesis, the method of analysis to be used considering the normality, homogeneity, and data numbers, was determined.

Hypothesis 1: Students' perceptions of sustainability have increased over the years.

The first hypothesis explored the effect of years on the sustainability perceptions of architecture students in Polito. The hypothesis suggests that sustainability knowledge and awareness has increased over the years since the student has different design studios in each degree. The dependent variable for this hypothesis was the sustainability understanding, and the independent variable was the degree of students. Of the 151 students participated in the survey at Polito, 137 answered this question (Question 12). The normality test of this hypothesis showed that the distribution was normal, according to the Shapiro Wilk test ($p>0.05$). The mean scores and standard deviations of sustainability understanding were presented according to students' degree (Table 4.7). The scale of the dependent variable mean scores was from 1 to 5.

Table 4.7. *Descriptive of the sustainability understanding of students by years*

	Number of Students	Mean Score	Std.Deviation
1st Year	30	3,37	1,217
2nd Year	12	3,42	1,240
3rd Year	8	3,00	,926
Master	88	3,35	1,040
Total	138	3,34	1,084

Anova One-Way Test was determined for the analysis data. The results were shown in Table 4.8.

Table 4.8. *ANOVA One-way Analysis Results*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1,030	3	,343	,288	,834
Within Groups	159,963	134	1,194		
Total	160,993	137			

Although there were differentiates in sustainability understanding of students between the years in Polito (Table 4.7), this difference was not statistically significant ($p=0.834 > 0.01$) according to ANOVA One-way analysis results (Table 4.8). With this hypothesis, it was predicted that studio education and courses improved the sustainability understanding of architecture students. In Polito, this hypothesis was not confirmed in the analysis. Although there has been an increase in Polito over the years, it was not statistically significant. The reason can be the difference between the number of participants over the years. As stated before, the result of the analysis for this hypothesis was confirmed at METU. The reason for selecting two case studies was not to make comparisons, but to include such differences in the study. In both studies, it was observed that the sustainability knowledge of first-year students was

deficient compared to other years. It was concluded that design studio training and theoretical courses on this subject were effective in developing sustainability understanding of students over the years.

Hypothesis 2: There is a positive correlation between the integration of sustainability to the design studios and sustainability understanding of students.

With this hypothesis, a correlation test was conducted to demonstrate the relationship between the sustainability knowledge of the participants and sustainability integration of design studio courses. The variable of the sustainability integration into the design studio was measured by the following question.

11. To what extent did the concepts which you learned/studied in the design studios integrate with the sustainability?

Students' understanding of sustainability was measured by question 12, as stated in the previous hypothesis (see Appendix E). The mean scores of the sustainability understanding variable were between 1 and 5. The mean scores and standard deviations for both variables were shown in Table 4.9.

Table 4.9. *Descriptive Statistics of two variables*

	Mean Score	**Std. Deviation**
The Integration of sustainability into design studios	3,22	,996
Sustainability Understanding of students	3,34	1,084

There was a positive relationship between the integration of the concepts on sustainability that students learned in design studios with sustainability understanding. Pearson's Correlation test was performed to investigate the relationship between these variables. The correlation test results were shown in Table 6.15 (see Appendix H). It was interpreted by the results; there was a moderate positive correlation since the p-

value is 0.529. (r= .00-.19 means very weak; r= .20- .39 means weak; r= .40- .59 means moderate; r= .60- .79 means strong; r= .80- 1.0 means very strong).[309]

With this hypothesis, it was supported the importance of instructional methods in the design studio to learn sustainability issues. It was seen that the theoretical information given in the studio was also useful in developing students' understanding. So, in the case of POLITO, it was shown that instructional methods (seminars, lectures, etc.) given in design studios had increased students' understanding of sustainability (Pearson's Correlation test results-Table 6.15).

Hypothesis 3: The environmental aspect of sustainability is addressed more in comparison to social and economic aspects in the design studios.

In this hypothesis, it was investigated which aspects of sustainability were taken more attention in the design studios of Polito. Students who previously conducted a project on sustainability were asked about the aspects. Multiple answers were accepted with the question (Question number 8- see Appendix E). Numbers were collected according to the responses of the participants. Then, these variables were compared by the degree of the Architecture Program of Polito. Of all 153 students, 109 answered the question.

- In the first year of Polito, 19 students answered the question. In Table 6.16, it was given the number of answers for each aspect of sustainability (See Appendix H). According to the table, the highest number of answers belonged to environmental sustainability. (16 answers- environmental sustainability (84,2%), 12 answers- social sustainability (63,2%), and 7 answers- economic sustainability (36,8%))
- The analysis of 8 answers to the question in the 2nd grade showed the mean scores of the sustainability dimensions (Table 6.17. See Appendix H). It was observed that there were 7 answers for environmental sustainability (87,5%),

[309] Evans, J. D. (1996). Op cit.

3 answers for social sustainability (37,5%), and 3 answers for economic sustainability (37,5%) in the second year at Polito.

- In the third-grade design studios, eight students answered the question. The mean scores and percentages were given in Table 6.18 (See Appendix H). According to the table, there were 8 answers of environmental sustainability (100%), 5 answers of social sustainability (62,5%) and 4 answers of economic sustainability (50%) in the third year.
- In the master degree, there were 74 students who answered the question for hypothesis three. The analysis of these answers on sustainability aspects was shown in Table 6.19 (See Appendix H). According to the table, the highest number of responses belongs to environmental sustainability (65 answers environmental- (87,8%), 37 social (50%), 27 economic sustainability (36,5%)).

The Table 4.10 and Table 4.11 shows the numbers of respond to the each aspect of sustainability for this hypothesis.

Table 4.10. *The number of the students who previously conducted a project on the specified aspect of sustainability (YES)*

	Social sustainability	**Environmental sustainability**	**Economic sustainability**
1st Year	12 (63,2%)	16 (84,2%)	7 (36,8%)
2nd Year	3 (37,5%)	7 (87,5%)	3 (37,5%)
3rd Year	5 (62,5%)	8 (100%)	4 (50%)
Master	37 (50%)	65 (87,8%)	27 (36,5%)

Table 4.11. *The number of the students who previously did not conduct a project on the specified aspect of sustainability (NO)*

	Social sustainability	**Environmental sustainability**	**Economic sustainability**
1st Year	7 (36,8%)	3 (15,8%)	12 (63,2%)
2nd Year	5 (62,5%)	1 (12,5%)	5 (62,5%)
3rd Year	3 (37,5%)	-	4 (50%)
Master	37 (50%)	9(12,2%)	47 (63,5%)

The analysis shows that there was an imbalance between sustainability aspects. The students who responded to the question (Question number 8- see Appendix E) whether they received any theoretical lectures and any projects related to sustainability and which aspect of sustainability. In the results, it was observed that most answers were given to the environmental, then social and lastly economic sustainability. It was interpreted that it was given more attention to environmental sustainability in the design studios at Polito.

Hypothesis 4: Students who previously designed a project and received a theoretical lecture on sustainability in the design studios are more prone to doing projects related to sustainability in professional life.

For this hypothesis, participants were asked two questions. First, they were asked whether they carried out a project or whether they took a course on sustainability in their design studios (Question number 8-Nominal, yes or no). According to this answer, it was analyzed whether they are prone to do projects related to sustainability in their professional lives. The Independent Samples T-Test was used to compare the two independent groups in the analysis of this hypothesis. As shown in Table 4.12, it was calculated that 109 students carried out projects and took a theoretical course on sustainability in the design studios of Polito. The mean score of these students who wanted to make projects related to sustainability in their professional lives was 4.60.

The mean score of the others was 4.53. As mentioned before, the scale for questions of Likert type is from 1 to 5.

Table 4.12. *The descriptive statistics of the variables at Polito*

	8. Within your design studios at Polito, have you received any theoretical lectures and have you carried out any projects related to sustainability?	Number	Mean Score	Std. Deviation
20. When you become an architect, do you want to design projects integrated with the sustainability concept?	No	38	4,53	,687
	Yes	109	4,60	,640

In Table 6.20 (See Appendix H), the results of the Independent T-test revealed. The mean difference between these two variables was found 0,07. According to the results of the analysis, it was reported that there was no significant difference between these two groups which affect the tendency to design projects on sustainability in their professional lives ($p > 0.05$). It was observed that most of the students who participated in the survey received a studio or lecture about sustainability. So, the reason for the result of this hypothesis can be the difference between the participant groups. Also, the reason for the differences between the two schools in this hypothesis can be also the number of participants, demographic characteristics, cultural differences, educational policies, and mission differences of the institutions.

Qualitative Data

In the spring of 2018, 15 faculty members of the Department of Architecture and Design were interviewed to reach a general idea about sustainability in the design studio education at Polito. Then, the questionnaire was sent to these lecturers by e-mail (Appendix F). The answers of the five lecturers who participated in this survey were discussed in summary format. The response to the questions were combined and

summarized under these three headings: the content and the scope of projects in the design studios at Polito, the projects and theoretical lectures on sustainability in the design studios and the suggestions to improve sustainability awareness and knowledge of architecture students. The last report with the themes was shown in the conclusion part of the study (Chapter 5).

- **The Content and the Scope of Projects in the Design Studios at Polito**

In Polito, the lecturers stated the first year of design studio was a multidisciplinary class that integrates the architectural design with urban analysis. It was mainly focused on how to develop an architectural project. One of the lecturers stated that the project topic of one of the first year was the redevelopment of former industrial area. One also added, the other first-year project was the housing project for the elderly people in Bologna focusing on the individual skills and technical development. One expressed that the studio in the second year developed a project in the urban context that explores the typology of housing can be combined with the relevant structural and constructional schema. One of the studio instructors specified that in the third-year design studios, it was offered architectural and urban design with structural design. He/she explained the project topics as the housing units for the bicycle users in the riverfront. One studio instructor expressed that, the studio of Master of Constructions City had four main areas as architectural, urban, landscape design and technology. He/she stated that each contribution of the lecturers is proportional to the credits of their subject. Some lecturers mentioned that the Sustainability Design Master program offered an urban design atelier to the students. The lecturers of the studio expressed that the topic was to design a masterplan in Lyon City called Confluence involved in the urban design and urban sociology modules. One lecturer of the studios stated that he had a must course called Building Physics in the architecture degree and also participated in the design studios called Sustainable Project in Architecture. This design studio, which they entered with four instructors, was given in the first year of the master program.

- **The Projects and Theoretical Lectures on Sustainability in the Design Studios**

One lecturer of the first-year design studio in the bachelor degree stated that referring to sustainability and sustainable development; he/she focused on general sustainability issues during a few lessons focusing on spatial management, planning tools, and practices. He/she also commented that it was difficult to carry out a design project about sustainability since the first-year architecture students have not much knowledge about it. He/she stated that upper-grade students had processed more the sustainability concepts in the design studios. Another lecturer stated that it was given the lectures and were produced sustainability projects before in the studio. One of the instructors said that the sustainability issues discussed in the studio included the advanced combination of daylight and electrical lighting; the strategies to enhance thermal inertia of buildings; annual energy performance of a building (lighting, cooling, heating, domestic hot water); implementation of technologies that use renewable energy. He/she stated that the lectures about sustainability in the studio taught were to provide students with professional knowledge of design strategies for the indoor environmental quality of a space and minimization of energy use by utilizing renewable energies.

One of the themes stated in the conclusion part of the study was: *The imbalance between dimensions of sustainability.* All the lecturers agreed on the importance of telling all dimensions of sustainability in the design studios. They expressed that since there was a group of at least 3 or 4 lecturers in the studios, each of them dealt with sustainability issues in their field. One of the participants focused on sustainability in terms of Indoor Environmental Quality (in terms of visual, thermal, acoustical comfort for the occupants) and energy savings (minimization of the energy demand for lighting, cooling, heating, domestic hot water) for a building. The other participants stated that they focused on the relationship between sustainability and urban planning, analysis, and design. The topics they mentioned were urban planning policies such as water supply and sewerage systems, urban health facilities, environmental hazards due

to rapid urbanization in high-density urban areas, international cooperation policies and programs to increase sustainability in urban areas, economic content of sustainability policies and projects in urban areas, demographic contents for sustainability projects in socio-urban areas. One of them stated that he/she mostly suggests that environmental, social, and economic dimensions of sustainability into design solutions. In addition to the three aspects of sustainability, one lecturer mentioned the governance and time dimension of sustainability. One participant also expressed that sustainability should be deepened both in general and in specific areas. He/she argued that economic sustainability should be addressed more because of the financial crisis and scarce public resources nowadays.

- **The suggestions to improve sustainability awareness and knowledge of architecture students**

All participants agreed on the importance of design studios to increase awareness of sustainability. One of the respondents said that the design studios are the first opportunity to adopt architecture thinking and produce intelligent solutions. One argued that the relationship between sustainability in buildings, energy saving, and attention to network urbanization services is the priority today. He/she believed that the design studios aimed to apply the concepts from theoretical courses to the design process professionally. In this context, he/she said that each design studio included different courses such as design composition, structure, physics, restoration, and history. On the other hand, he/she suggested that all lecturers must involve a strong effort to work in synergy since this is crucial to the outcome.

One lecturer mentioned that sustainability was discussed in detail, especially during the master degree. He/she said that undergraduate programs at Polito focused on various aspects approaching an architectural project. In this context, he/she suggested to introduce more courses and lectures on sustainability in the undergraduate degree should and to invite professionals and architects who are recognizable to their studies on sustainability. One lecturer stated that the number of topics devoted to ethical issues

in the field of regional governance, spatial planning, sustainable land use, and consumption should be increased. He/she argued that there should be less focus on sustainable buildings and more focus on sustainable areas and territorial transformations. One stated that it would be beneficial to draw the students' attention to the costs of the projects, materials, energy, the maintenance plans of the design and the waste disposal system generated during the construction process.

Another theme of the study at the end of the analysis was: *Sustainability is not a new concept*. One instructor asserted that sustainability was doubtful that it had become a keyword for environmental awareness, and it loses its effectiveness in this way. He/she said, “Who would not say that his/her architecture is unsustainable?” Therefore, he/she preferred to talk about strong structures that could effectively withstand climatic conditions and could be more severe for years. He/she added, “I also warn students that no 100% sustainable building is possible.”

In addition to these comments, many participants suggested taking students to visit construction sites and buildings to demonstrate practices and interesting case studies about sustainability. Some proposed to organize trips and workshops in areas affected by disasters, pollution, and problems related to poor urban, regional, architectural planning.

CHAPTER 5

CONCLUSION

Universities have missions in the development and change of society.[310] Thinking of a sustainable future, higher education has a unique position in promoting sustainability awareness while preparing future professionals. For the studies on strategies, suggestions, and challenges in terms of sustainability in higher education, many types of research are continuing due to the size of the subject. In this study, it was focused on architectural education in the context of sustainability with environmental, social, and economic aspects. The overall purpose of this thesis was to explore the effect of the design studio education on the perception of sustainability of architecture students. So, it was aimed to contribute to the literature on sustainability in architectural education.

In the study, firstly, the concept of sustainability was defined, followed by sustainability in higher education development and important events. Then, a comprehensive literature review was conducted on sustainability in architectural design studios. The challenges, processes, and needs of the integration of sustainability into the architectural education and design studios were identified. The case studies of the thesis, which were Politecnico di Torino (Polito) and Middle East Technical University (METU), provided the data to investigate the role of design studio on the understanding of sustainability of architecture students.

This chapter presents the study with an integrated conclusion to explore design studio education on the perception of sustainability of architecture students. The conclusion of the study is provided with the following four titles according to the results of the

[310] Unesco. (1998). World declaration on higher education for the twenty-first century: Vision and action. In World Conference on Higher Education. Ginebra: Unesco.

students' questionnaires, the interviews with faculty members, and the analysis of architectural curricula in the case universities.

5.1. Sustainability is not a new concept

Since the 1960s, environmental problems have been brought to the fore by various communities, governmental and nongovernmental organizations from around the world. International events, conferences, and movements on environmental protection aimed to raise awareness about this issue by undertaking initiatives against environmental pollution and the use of clean energy. Sustainability is based on the Stockholm Human Resources Conference in 1972, where discussions on environment and development were first defined. Sustainability was first introduced as sustainable development for the first time in 1987 through the Brundtland Report titled 'Our Common Future' prepared by the UN World Commission on Environment and Development (WCED). From the beginning of the history of sustainable development, it is observed that environmental awareness has evolved into the concept of sustainability. Sustainability, which had only an environmental aspect in the past, has been discussed in many conferences, studies, and researches and it has been a concept that includes economic development, social equality and justice, and environmental protection.

With this study, it was observed that architecture had been concerned with the same problems before sustainability has come front in academia and global media in recent years. It was seen that the issues and problems that architecture cares about were mostly related to the sustainability discussions. The environmental debates that have been focused on architectural education since the beginning of environmental awareness have become one of the main architectural subjects. In architecture, the environment includes not only nature but also the entire physical space as nature, city, and architecture. The environmental issues, which are the starting point of sustainability, are also one of the essential subjects of architecture. So, sustainability covers issues that are at the heart of architecture. In the interviews conducted in the

case studies in this study, a few professors commented that sustainability is not a new term in architecture. Architecture is a discipline which includes social and physical sciences, art and culture, technology, and innovation. The architect's task is not only about building design, but also social, cultural, and political contexts and dealing with local and global problems. Architecture has a lot in common with the concept of sustainability.

With the case universities of the study, it was observed that there were courses related to sustainability under the name of the environment. This observation led to an examination of the concept of sustainability that has changed over time in terms of architecture. The term was used as an environmental design in the 1970s, as green design in the 1980s, as ecological design in the late 1980s and 1990s, and as sustainable design from the mid-1990s to the present. The terminological change of sustainability in architecture draws attention to the expanding architectural theory and practice regarding sustainability. The concept of sustainability is the main title covering all these approaches in the architecture discipline. In architectural education, it is often considered that designs should sustain cultural values and ecological structure, support local economic production, and assist socio-economic development, which is parallel with the sustainability discussions. To improve sustainability awareness of the architecture students, they need to be encouraged to create architectural designs by contributing to environmental, social, cultural, and economic development. Architecture schools should be one of the places that enable students to be aware and generate ideas about global environmental problems, social development, and economic employment. For this purpose, architectural education should provide students with knowledge, awareness, and skills of sustainability. Supporting the architectural education system with programs aiming at sustainability understanding is of great importance for the sustainable future.

5.2. Sustainability should be defined to the students clearly

Sustainability is one of the concepts encountered in almost every aspect of daily life, from the environment to the economy, from non-governmental organizations to private companies. Nowadays, the branding and advertising strategies of many institution and companies have made the term of sustainability a rapidly consumed concept. Although the concept of sustainability is quite popular and often used, it is misunderstood and misrepresented mostly. Therefore, sustainability has begun to face the marginalization and emptying of meaning. Sustainability appears as a concept that has been recently discovered in today's architecture and is not accepted or even resisted in some situations.

One of the significant results of studies was that sustainability should be defined clearly in the courses of architecture curricula to avoid misunderstanding of the term. In this study, it was observed that the students in the case universities mostly do not know the concept of sustainability properly. As mentioned in the previous discussion, sustainability is not actually a new concept in the architecture discipline. Since architectural education deals with issues and problems dealing with human-environment relations, sustainability is one of the debates of architecture. In the case universities of the study, the sustainability issues, whether or not specified in the programs, were included in the studios and lectures. However, students mostly did not know that the subjects they learned were involved in sustainability. The fact that sustainability distinguished with its environmental dimension in many areas caused misunderstand to the students. Therefore, this misunderstanding could lead students to associate sustainability mostly with the projects which include concepts such as green building and renewable energy. So, firstly students should be aware of what sustainability is and what it is not. This can be provided by supporting theoretical courses on sustainability in the architectural design studio. As mentioned before, design studios are not only an environment where design and applications are learned but also a place where theoretical knowledge and concepts are taught. As in most of the interviews of the study, students' interest in this issue increased after the projects

given under sustainability. So, the lecturers should provide the information on sustainability and encourage the students to draw attention to the topic. Also, the relationship between the design studio and theoretical courses on sustainability should be cooperative and supportive to encourage students having sustainability awareness. In addition to the theoretical courses, the contribution of the lectures, presentations, and seminars in the design studios, which co-occurred in the development of the project has improved the sustainability understanding of students. The architectural students should have an awareness of sustainability since everyone has a certain role in overcoming environmental problems and supporting social and economic development for a sustainable future.

Sustainability is one of the most essential elements of architecture. Initiatives to improve the sustainability understanding of students in architectural education will be step-in tackling the difficulty like the misunderstanding of sustainability. It is foreseen that sustainability will continue to be important in the future and will become even more critical in the coming periods. Therefore, sustainability in architectural education should be a design approach that should be permanently embedded in architectural practice, not a temporary architectural trend. The architects should have the responsibility to adapt the sustainability approach to his designs and to produce solutions.

5.3. The imbalance between dimensions of sustainability

The three aspects of sustainability play an equally important role in overcoming the sustainability challenges the world is currently facing.[311] A cultural, economic, and socially applicable design process should be supported at every stage of architectural education.[312] The main objective of integrating the three dimensions of sustainability into the course contents is to provide professionals with the information they need to

[311] Porras, I. M. (2009). The City and International Law: In Pursuit of Sustainable Development. Fordham Urb. LJ, 36, p537.
[312] Altomonte, S. (Ed.) (2012). Education for Sustainable Environmental Design, Summary of Results. Nottingham. Retrieved from: www.educate-sustainability.eu- Accessed on November 2018.

deal with current and future problems and to find tools and technologies and sustainable design methodologies.[313] Therefore, it is crucial to give equal importance to each of these three pillars and to balance them.

In this study, the imbalance between sustainability aspects discussed in the design studios was another important result. According to the data collected from the case universities, all professors agreed on the integration of all aspect of sustainability into architectural education. However, most of the sustainability-related projects in the design studios were mostly limited to the environmental and social dimension. Also, when the curriculum was examined, it was noted that sustainability-related courses were mostly related to the environmental, then social. It was almost a few lessons related to the economic dimension.

With the analysis of the survey result, it was shown that environmental sustainability was more discussed in the design studios compare to social and economic aspects (See Hypothesis 3). The discussions of sustainability in the design studios have mostly related to concepts like renewable energy, passive systems, and smart buildings, etc. Since sustainability remains in the building scale in architecture, comments, and solutions on the subject have been mostly environmental and technology oriented. It can be said that the imbalance between the three aspects of sustainability in architectural education leads students to the linking of sustainability issues with environmental issues mostly. Also, associating sustainability to only environmental issues is not only a problem of architectural education but a general misconception. The limitation of sustainability to ecological concepts stems from the irreversible destruction of environmental resources today. At the same time, some of the reasons for this are the fact that environmental awareness has turned into sustainability and the lack of sustainability understanding mentioned in the previous discussion. A

[313] Porras Álvarez, S., Lee, K., Park, J., & Rieh, S. Y. (2016). A comparative study on sustainability in architectural education in Asia—With a focus on professional degree curricula. Sustainability, 8(3), 290.

holistic approach should be provided by addressing the need for common solutions to global problems and equal weighting of all three aspects of sustainability.

5.4. Sustainability should be more involved in architectural education

In the reviews of the study, one of the striking approaches in the integration of sustainability into architectural education was the belief that sustainable design was the basis. In the case universities, all the lecturers underlined that sustainability is a significant issue. In some interviews, it was stated that sustainability should not be an additional subject, and it was an inherent issue of architecture. With this study, it was concluded that architectural faculties should make more effective decisions to improve sustainability awareness of architecture students.

Firstly, sustainability awareness should be created from the beginning of undergraduate architectural education. In undergraduate, must and elective courses related to sustainability and sustainable design should be increased. The importance of studio education in awareness of sustainability was confirmed in this study. As stated in the second hypothesis of the study, theoretical lectures and seminars in the studio have an effective role in improving sustainability understanding. After having enough knowledge about the concept of sustainability, the students need to be guided by the studio instructors. Most lecturers agreed that there should be better integration of sustainability into architectural education. Some of the reasons why sustainability was not included in the programs, were time constraints, over workload, and intensive programs which include issues that architectural education must address. Based on these interpretations, it was observed that sustainability was not one of the critical concerns such as form, structure, and aesthetics in architectural education. Sustainability stayed to be an additional topic in most design studios unless it was specified as a design requirement. Therefore, it was concluded that sustainability remained a concept that was incorporated into the detail and concept processes rather than the initial ideas of the projects. Also, in some of the interviews, it was stated that the tendency of graduate students to pursue a master's degree in sustainability has

increased in Turkey. So, there should be a master program on sustainability in Turkey like Sustainable Design Master Program of Polito.

So, the initiatives of some faculty members will not be permanent solution for involving sustainability into architectural education; it should be developed in an organized institutional manner to adapt sustainability to the philosophy of education. It is necessary to establish an infrastructure for sustainability in architectural schools. Considering the sustainability one of the design requirements in the studios, increasing the number of courses on sustainability, having an adequate number of lecturers in this field and having sustainability awareness of all faculty members are crucial parts to improve the sustainability understanding of students. Also, the sustainability approaches of architectural schools need to be supported by the Chamber of Architects and NGOs. At this point, it should be noted that the architectural education environment is not limited to the classroom. Architecture education is not limited to a one-place, single-perspective, and standardized education.

For this reason, sustainability in architectural education should not be limited to courses but should be supported by extracurricular and student-oriented activities. Therefore, extracurricular activities on sustainability, such as educational trips, workshops, seminars, conferences, exhibitions will increase the awareness of sustainability. Acceptance of the idea of sustainability is achieved when integrated into the university's culture and daily activities. Thus, it is possible to provide the students with an interdisciplinary approach to understand sustainability and acquire the necessary skills to create a more sustainable future.

With this study, it was concluded the lack of awareness that sustainability is not one of the subjects that need to be learned, but a sustainability lifestyle that should guide our lives. To reach a better world than today, we need to integrate sustainability into our daily lifestyle. To achieve this, sustainability awareness should be established as a government policy starting from primary schools to higher education. The greater

involvement of sustainability in architectural education will make an important contribution to this change.

5.5. Recommendations

The following recommendations, which can be used to improve sustainability awareness of students in architectural schools, are based on the findings of the study at METU and Polito.

- Design studios are one of the opportunities to injection of sustainability into architectural education. Studio education should consider sustainability as a design requirement to develop sustainability understanding among students. Sustainability should be one of the design criteria, not as an addition or concept project. Seminars and lectures on sustainability concepts in design studios help to improve this perception. Because of the multidisciplinary aspect of sustainability, the group of studio instructors with different experts can provide students with a versatile design process on sustainability.
- Improving the relationship between the design studio and the theoretical courses on sustainability can facilitate the implementation of sustainability information in the design process for the students. The options, challenges, and benefits of sustainability that encountered in professional life should be discussed in the studio environment. Students also need to be encouraged to sustainable design in the studio by the lecturers.
- Sustainability needs to become a significant issue in the architectural curriculum. Increasing the number of courses on sustainability and drawing attention to social and economic sustainability issues can help to understand sustainability properly. Having lessons on ‘what is sustainability’ from general to specific details, can improve awareness of sustainability of students. Moreover, it should be useful that giving sustainability subjects as a must course rather than elective courses would increase in students' attention.

- To improve sustainability awareness of students, the whole faculty should be aware of this issue. Faculty managers need to plan sustainability-related activities for their students, instructors, and staff. Faculty should have tasks such as organizing workshops, conferences, and seminars to instill sustainability as a lifestyle. Also, it is necessary to provide contribution and support to sustainability-related student communities. Since architectural education is not limited to the school building, it is useful for students to see sustainability practices by using the campus more effectively and organizing field trips.

5.6. For future studies

This study explored the important effect of design studios on the students' understanding of sustainability (social, economic, environmental) in architectural schools. In this study, it was observed that the design studios and the courses in the curriculum were mostly about environmental and social. It would be interesting to explore different aspects of sustainability awareness of students. To better understand the relationship between design studios and sustainability perception, it would be useful to have periodical interviews with the same sample group from the beginning to the end of their education and to examine this process in detail. At the same time, it is necessary to define which tools and resources are more effective in creating sustainability awareness. Studies on sustainability events, organizations, and student communities throughout the university can be examined and why students participate in these activities. Finally, a detailed study can be useful in investigating the impact of a university on sustainability awareness. Interviews with all academic units and a comprehensive examination of each area of the campus's organizational chart would help to promote sustainability awareness among students.

The study showed that the concept of sustainability and the discipline of architecture have many in common. Therefore, it can be concluded that architectural education is one of the best learning opportunities for sustainability. This study contributes to

sustainability in architecture education by regarding of the importance of design studio in teaching sustainability in environmental, social, and economic terms to the students. Also, it will be possible to study with different schools for various data analysis consisting of students, lecturers, and curricula. Therefore, it is thought that applying the same research to more architectural schools from different countries, comparing and evaluating the obtained studies will constitute the next stage of the study.

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APPENDICES

A. The Courses on Sustainability in the Case Universities

The courses on sustainability of the Sustainable Design Master Program of Polito

- Advanced parametric modeling for the building envelope
- Atelier: the sustainable architectural design
- Atelier Compatibility and sustainability of architectural restoration
- Atelier Urban Design
- Anthropology of Education
- Design and development: the transition to the circular economy
- Digital history
- Education, technologies and educational research
- Evaluation of Project Economic Sustainability
- History of architecture
- Learning and Developmental Psychology
- Materials and Products for a sustainable architecture
- Structural design
- Sustainability of processes and products concerned with architectural materials
- School and Inclusive Pedagogy
- Architecture, Stage designing, and Music Workshop
- Drawing from life and imagination Workshop
- Lighting Design Workshop
- 3D Imaging and ranging methods for heritage documentation Workshop
- Communicating Architecture: virtual reality and other media Workshop
- Energy Performance and Certification of Buildings Workshop
- Profession Workshop

Table 6.1. *The Courses on Sustainability in the Department of Architecture of METU*

	Course Name	Course Description	Course Credit	Course ECTS
1	**ARCH 282 Principles Of Built Environment**	This course focuses on the design of buildings including environmental and climatic factors, thermal characteristics and behavior of building materials, and the importance of fire prevention and safety in architecture.	3	4
2	**Arch 325 Architecture In Situ**	This course includes architectural works based on direct experience built in Turkey or abroad, facilitated by field studies and the design workshops.	3	4
3	**ARCH 344 Environment and Man: Cause and Effect**	This course describes some topics such as the relationship between environment and human, the basic phenomena of the domains, the continuity of time and space, human qualities, space, and built environment.	3	4
4	**ARCH 382 Environmental Control Technologies**	The course highlightes the creation of basic understanding of issues related to mechanical and electrical equipment/services in buildings, acoustics, and behavior of light in the built environment; the requirements related to installation, operation and maintenance of such equipment, technical drawings of such systems.	3	4
5	**ARCH 403 Advanced Architectural Surveying**	This course describes the methods of making a through measured and descriptive survey and research of a building by means of various techniques; examination of historical studies on building; evaluation of building and conservation principles at the end.	6	8
6	**ARCH 415 Fundamentals of Site Planning**	This course aims to introduce students to a sustainability discourse on urban design. It draws attention to the importance of examining residential design in terms of economic resources, ecological constraints and social construction of space (social sustainability).	3	4
7	**ARCH 434 Vernacular Architecture**	The course focuses on examination of architectural characteristics and spatial qualities of traditional residential architecture in different regions of Anatolia; understanding the effects of geographical location, climate, and topography on vernacular houses and domestic life.	3	4
8	**ARCH 482 Conservation of Archaeological Sites**	The course focuses on conservation and restoration of the archaeological sites in Turkey. It provides evaluation and discussion of the subject within international theoretical approaches.	3	4
9	**ARCH 517 Principles of Universal Design**	This course is an introduction to the principles of universal design. It focuses on ethical, moral and legal issues involved, and of the related international legal instruments, including Convention for the Protection of the Human Rights and Fundamental Freedoms, the revised European Social Charter, and recommendations, declarations, resolutions of international bodies in chronological order.	3	8
10	**BS 581 Energy Analysis of Buildings**	This course focuses on determining the energy situation of a building from: weather data; response factors; thermal load analysis; necessary equipment and systems analysis; owning and operating cost analysis.	3	8
11	**BS 583 Sustainability in Construction: Concepts and Technologies**	The main objectives of this course are to develop an understanding of the historical origins of high performance green buildings, to provide knowledge of terminology on sustainability and green buildings, to provide knowledge of green building evaluation systems, to provide knowledge of green building components.	3	4
12	**ARCH 750 Performative Architecture Lab.**	The course aims to deepen some issues on computational design applied on performative architecture; research by design; design and prototyping for a small-scale architectural program; computational methods for modelling; simulation, optimization and prototyping; design context on architectural form generation and envelope design.	3	8

Table 6.2. *The Courses on Sustainability in the Bachelor degree of Architecture at PoliTO*

	The programme	Course Description	Credits	Hours			The Sustainable Development Goals
				Lessons	Classroom exercises	Tutoring	
1	**Digital parametric modeling**	The course, organized in lectures and exercises, aims to provide not only the operational tools for a correct use of parametric software, but also cultural knowledge to critically evaluate the strong change brought by BIM technology to the construction industry.	6	48	12	20	SDG 4-5
2	**Economics and design organisation: Building Management and procedures**	The objective of this course is to position and discuss architecture in relation to the practicing of the profession.	6	60			SDG 4-11
3	**History of architecture A**	The course of History of architecture A aims at providing the Master student with a double capacity of investigation and knowledge: the history of architectures, through the analysis of design and construction processes, and, the history of their reception and critical interpretation.	6	48	12		SDG 4-5
4	**Acoustics and lighting in building design**	The disciplinary laboratory of Building physics and energy systems in architecture: Lighting and Acoustic is aimed at providing students with knowledge of lighting and acoustical topics applied to architectural projects.	6	60		30	SDG 3-11
5	**Building physics and energy system in architecture**	The course aims at providing students with knowledge of acoustical, lighting and energy topics applied to architectural projects.	6	48	12	30	SDG 3-11-13
6	**Energy systems in building design**	The objective is that of making students conscious of the cultural richness, the requirements, the methodologies and the tools typical of building physics, in order to be able to carry out a disciplinary thesis on these themes.	6	48	12	30	SDG 7-11-12
7	**Economics and design organisation: Building Management and procedures**	The objective of this course is to position and discuss architecture in relation to the practicing of the profession.	6	60			SDG 4-11
8	**Economics and design organisaton: new methods for the architect's practice**	The course analyses opportunities and challenges for architect in a global world, a world characterized by areas with various economic cycles and needs, and different levels of economic development.	6	60			SDG 4-11
9	**Restoration and methodology for architectural conservation**	The course analyses the issues related to the permanence of the built heritage and cultural systems, from XXth Century last quarter disciplinary debate up to current topics and pressing questions nowadays discussion:	6	60			SDG 4-11
10	**Restoration**	The course aims to deepen some themes of the contemporary debate about Restoration, using tools and theory belonging also to other disciplines.	6	60			SDG 4-5-8-11-16
11	**The Design Unit 1- Architecture and construction systems**	In the Design Unit 1, the students will enhance their skills in managing a complex architectural project autonomously, both at the urban and architectural scales, acquiring the techniques, the methodologies and the specific abilities of the European architect.	14	64	16	45	SDG 1-5-7-8-9-10-11-12-13-15-17
12	**The Design Unit 2- Architecture and urban economics A-B**	The topics of Design Unit 2 will be focused on a complex urban project and takes into account both the settlement components and the economic ones.	14	64	16	45	SDG 4-8-9-11-12-15-16-17

13	**The Design Unit 2- Architecture and urban space A-B**	The goal of this course is elaborate a complex urban project from the knowledge and skills provided by two specific subjects, complementary between them: Architectural Design, and Urban Planning, the latter providing specialist knowledge about the urban dimension of architecture.	14	Not Specified			SDG 3-11-12-13-16
14	**Technologies for the built environment**	In the international context, the field of meanings and competences under the concept of environment technologies for built landscape are more complex than that, largely of the Italian cultural context, are reconsiderable to the concept of Architecture Technology in Italy.	6	60			SDG- 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17
15	**Appropriate technology and Low-Tech Architecture**	The course deals with theoretical and applied aspects of architectural technology and construction, and tackles the choices of construction products and methods as well as building systems, the reduction of energy consumption, the environmental impact of the building process, the holistic understanding of architectural design.	6	42	18		SDG- 11-12-13-15
16	**Materials and Products for a sustainable architecture**	The course aims at providing technical-scientific fundamentals for an aware choice of materials in the sustainable architectural project, by completing the knowledge acquired during the course of Science and Technology of Materials of the BSc in Architecture.	6	48	12		SDG 3-4-7-11-12-13

Table 6.3. *The Courses on Sustainability in the Architecture Construction City Master Program at Polito*

		The programme	Course Description	Credits	Hours			The Sustainable Development Goals
					Lessons	Classroom exercises	Tutoring	
First Year	1	**Architectural technology - Culture and fundamentals**	The course introduces the needs-requirements approach as a main method to develop the architectural project, to analyze building materials, construction elements and systems and to understand the way these are linked within the process of designing and making a building.	8	60	20	10	SDG 9
	2	**Urban planning**	The objective of this course is to position and discuss architecture in relation to the practicing of the profession.	8	64	16		SDG 10-11-13
Second Year	3	**Laboratory of Geomatics for Architecture modeling**	The Laboratory aims to introduce the basic information useful to approach, by using appropriate technologies and methodologies, the metric survey of the architectures and of the urban spaces. .	6	20	20+20	35	SDG 4-5-8-10
	4	**Building physics**	The course aims at providing the students with a knowledge on technologies, quantitative assessment tools and benchmark data to analyze the environmental quality and energy performance of indoor spaces.	10	60	40	40	SDG 7-11-12-13
	5	**Science and technology of materials**	The teaching aims at supplying the technical-scientific fundamentals necessary for the correct choice and responsible use of building materials which are continuously requested to present new and more complex functionalities: both increased structural performances and better functional properties, in terms of physical and thermal behaviour, economic and environmental sustainability, etc.	6	42	18		Not Specified
Third Year	6	**Real Estate evaluation**	The course aims at providing the basic knowledge in the domain of evaluation focusing on real estate as well as links with urban and environmental factors. It will present some introductory basic notions about values, cost-benefit, cost-effectiveness analysis, mathematics of finance, behavioral economics, complexity, spatial analysis.	8	Not Specified			SDG 3-11-15
Design Studios	8	**Atelier Interior design**	This Atelier aims to develop the specific sensitivity to interior space and to the necessary, technical and cultural, expertises. In fact, this is a relevant field in professional practice, so students need to know its tools and skills (referred to graphic requirements, to distribution principles, to materials performances and elements features, to furniture and lighting).	12	20	40		SDG 3-11
	9	**Atelier:Urban design**	The Studio experience reproduces – with some necessary simplifications and differences – the practices of a real urban regeneration process, and develops knowledge and understanding of the higher level of complexity typical of urban environments, in which sustainability is assumed as the cultural and operable scenario of the interplay of constrains and resources.	12	Not Specified			SDG 10-11

Electi-ves	10	**Building technology and built environment culture**	The aim of the course is providing the knowledge and an overall framework of built environment, including both constructions and its environmental context. The attention is focused on the whole designing and building process including all the phases involved from the architectural design to the building, maintenance and management.	6	48	12	12	SDG 4-5-8-10-11-17
	11	**Climate and Socio-Economic Change**	The course aims to form the basis for the understanding of the global phenomena leading to the Earth system change, both in terms of climate change and of change in the socio-economic conditions.	6	50	10	20	SDG 6-7-8-10-11-13
	12	**Environmental impact assessment**	The course aims at proposing some guide lines for the environmental analysis and for the evaluation of the impacts produced by projects/plans/programmes on the environmental system.	6	48	12		SDG 11-12-13-15
	13	**Safety and legislation of environmental and land**	The course has the intent to convey to the student the knowledge on methods of analysis and study of the state and the safety conditions of a territory, intended as a set of natural and anthropic components containing emissive sources potentially polluting.	6	48	12		SDG 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17
	14	**Unmanned Aerial Vehicle (UAV) for architectural and territorial surveying**	The course aims to describe the instruments, methods and operating procedures for the use of Unmanned Aerial Vehicle (UAV) for surveying purposes, using an approach based on images and Structure from Motion (SFM) techniques.	6	40	20		SDG 4-9-11-17

B. The Survey Study at METU

SUSTAINABILITY IN ARCHITECTURE EDUCATION

The main purpose of this study is to explore the role of architecture education in the context of sustainability concepts.
The influence of the design studio/atelier education on the awareness of sustainability among students will be investigated.
During the survey please consider your design studio in previous year.

The questionnaire should take approximately 10 minutes to complete. Your personal information (name, phone number, e-mail) will not be requested and your responses are completely anonymous.
Please give the appropriate answers for you to the study's objectivity. This survey is used for my master thesis in the architecture department at METU.

General Information

1. Please select your gender.
◯ Female ◯ Male

2. Please select your age.
◯ 18-22 ◯ 22-26 ◯ >26

3. Which degree program are you in?
◯ Bachelor of Architecture Degree Program
◯ MS in Architecture

4. Which year are you attending now?
◯ 1st year of Bachelor Degree
◯ 2nd year of Bachelor Degree
◯ 3rd year of Bachelor Degree
◯ 4th year of Bachelor Degree
◯ 1st year of Master Degree
◯ 2nd year of Master Degree

5. Please write your current Atelier/Studios and Teacher's name. _____

Your experience on sustainability in your previous design studios (From last year)

For this part please consider your design studio in previous year. (If you are enrolled in Arch 401, you should be filling the questionnaire for the Arch 301/302 courses.)

6. What are your opinions on the relation between the theoretical courses related to sustainability (i.e. building physics, environmental systems) and the design studio education?

	1	2	3	4	5	
IRRELEVANT	◯	◯	◯	◯	◯	MOSTLY RELEVANT

7. To what extent have the theoretical courses helped your projects in the design studios?

	1	2	3	4	5	
IRRELEVANT	◯	◯	◯	◯	◯	MOSTLY RELEVANT

8. Within your design studios at Middle East Technical University (METU), have you received any theoretical lectures and have you carried out any projects related to sustainability?
◯ Yes ◯ No

8.1. If yes; Please write/describe shortly which type of projects you have carried out related to sustainability concepts. (For example; Urban scale, District scale, Building scale, Material etc..) _____

8.2. If yes; Please select which aspects of sustainability. (Multiple choices possible)

	1	2	3	4	5
• Social sustainability	◯	◯	◯	◯	◯
• Environmental sustainability	◯	◯	◯	◯	◯
• Economic sustainability	◯	◯	◯	◯	◯

9. What is/was your opinion about the study on sustainability concepts BEFORE you carried out a project related to sustainability?

	1	2	3	4	5	
NEGATIVE	◯	◯	◯	◯	◯	POSITIVE

9.1. How was the sustainability concept of the projects in the design studios you have been conducting previously? (If you don't have any projects about sustainability, you can skip this question)

	1	2	3	4	5
• It was a requirement in the studio	◯	◯	◯	◯	◯
• It was added by my own contribution	◯	◯	◯	◯	◯

9.2. What is your opinion on sustainability AFTER you carried out a design project related to sustainability? (If you don't have any projects about the sustainability, you can skip this question)

	1	2	3	4	5	
NEGATIVE	◯	◯	◯	◯	◯	POSITIVE

9.2.1. Which aspect of sustainability was more difficult to implement in your design projects? (Multiple choices possible)

	1	2	3	4	5
• Social sustainability	◯	◯	◯	◯	◯
• Environmental sustainability	◯	◯	◯	◯	◯
• Economic sustainability	◯	◯	◯	◯	◯

9.2.2. Please write/describe shortly how did the project develop in implementing sustainability concepts.

9.2.3. Please write/describe shortly what were the difficulties in implementing sustainability concepts to your design project. _____

_____

10. Which phase was the integration between sustainability and design studio projects in your previous design studio programs? (Multiple choices possible)

	1	2	3	4	5
• Initial/ Ideation Phase	○	○	○	○	○
• Design Development Phase	○	○	○	○	○
• Architecture Detailing Phase	○	○	○	○	○

11. To what extent did your design studios integrate sustainability concepts?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

12.1. Did you learn the principles of sustainability in your previous design studios (knowledge on sustainability)?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

12.2. Have you ever used the principles of sustainability in your design projects (design skills on sustainability)?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

12.3. Have you achieved an awareness of the of sustainability with your design projects (awareness on sustainability)?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

13. Did your previous design work/experiences prepare you for applying sustainability concepts in your future architectural design processes?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

14. To what extent was the concept of sustainability instructed by means of seminars, lectures etc. during the design studios?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

14.1. To what extent were sustainability concepts discussed in the context of your design during the design studios?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

14.2. To what extent did the design studio effectively support the learning of sustainability concepts?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

15. To what extent are sustainability concepts covered in the architecture curriculum of METU?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

15.1. Please explain which topics should be addressed in more detail. _____

_____

Your experience on sustainability at Middle East Technical University (METU)

For this part please consider your experiences at the university in general.

16. Where did you hear/learn sustainability concepts? (Multiple choices possible)

- ○ Within a design studio
- ○ Within a must course
- ○ Within an elective course
- ○ Through extracurricular activities within the university
- ○ Outside the university
- ○ Other _____

17. Have you taken any courses related to sustainability at METU? If yes; Please write the course code, name and year.

○ Yes ○ No _____ _____

18. Have you attended any lectures, conferences or workshops related to sustainability at METU or elsewhere? If yes; Please write the titles/year.

○ Yes ○ No _____ _____

19.Have you prepared any paper/essay/final test/thesis about the sustainability in the bachelor/master degree at METU? If yes; Please write how many of them in total?

○ Yes ○ No _____

About the future

20. In your future professional practices as an architect, do you want to design projects integrated with sustainability concepts?

	1	2	3	4	5	
NOT AT ALL	○	○	○	○	○	VERY MUCH

20.1. Please select which aspects of sustainability.

	1	2	3	4	5
• Social sustainability	○	○	○	○	○
• Environmental sustainability	○	○	○	○	○
• Economic sustainability	○	○	○	○	○

Thank you for sharing your time.
If you have any questions or concerns about the survey, please contact me: aycanilufercalikusu@gmail.com

Ayça Nilüfer Çalıkuşu

C. The Survey Permission of Applied Ethics Research Center of METU

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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11 ARALIK 2018

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Dr.Öğretim Üyesi İpek Gürsel DİNO

Danışmanlığını yaptığınız Ayça Nilüfer ÇALIKUŞU'nun "**Sustainability in Architecture Education: The Impact of Design Studio Education on Perceptions of Sustainability"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2018-FEN-067** protokol numarası ile araştırma yapması onaylanmıştır.

Saygılarımla bilgilerinize sunarım.

Prof. Dr. Tülin GENÇÖZ
Başkan

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

Prof.Dr. Yaşar KONDAKÇI (4.)
Üye

Doç.Dr. Üyesi Ali Emre TURGUT
Üye

Doç. Dr. Emre SELÇUK
Üye

Doç.Dr. Üyesi Pınar KAYGAN
Üye

D. The Interview Questions at METU

SUSTAINABILITY IN ARCHITECTURE EDUCATION: THE IMPACT OF EDUCATION ON PERCEPTIONS OF SUSTAINABILITY

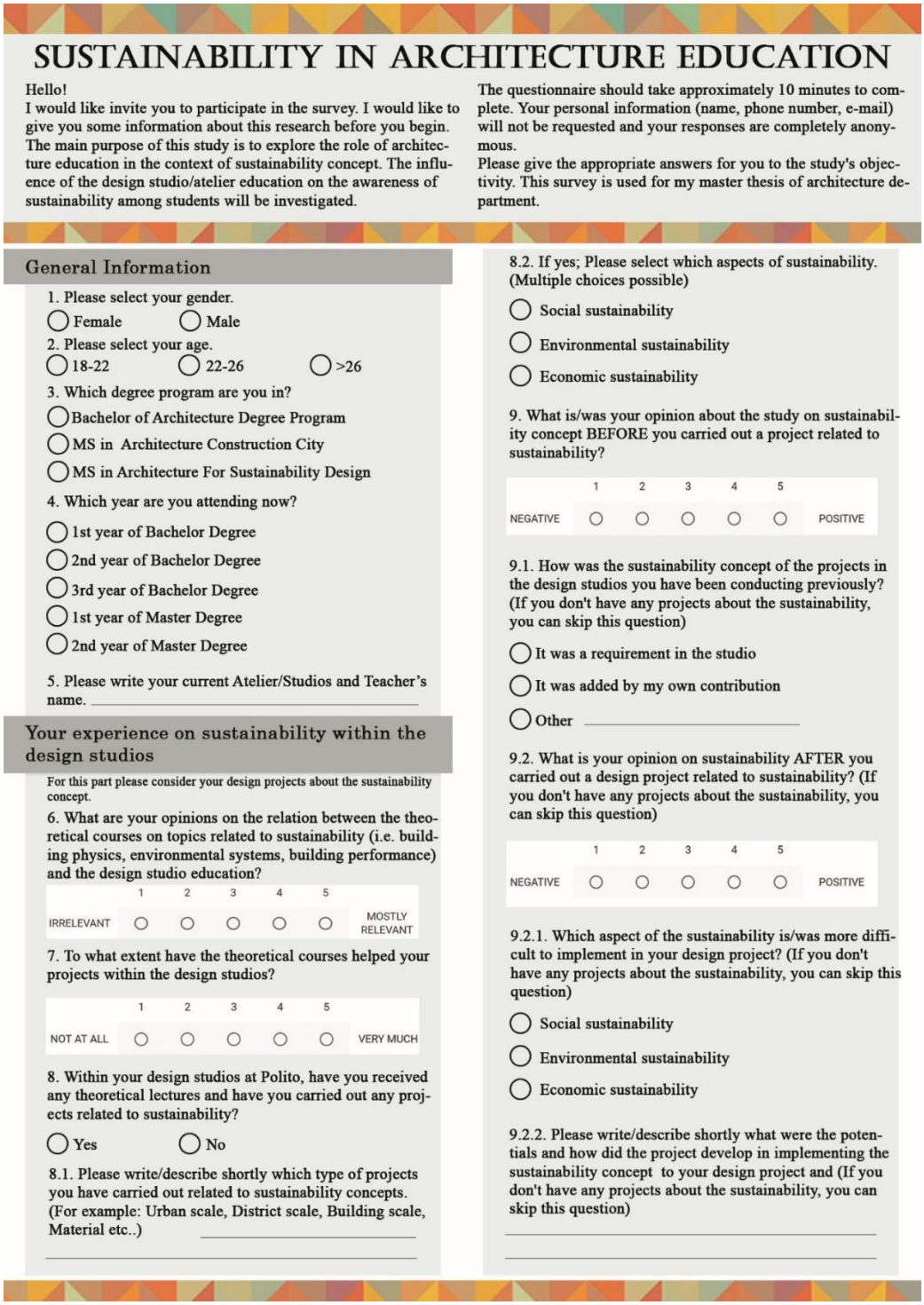
1. What is/was the subject and the scope of the design studios conducted by you in this year and last year?
2.
    - Within your design studios at Middle East Technical University (METU), did you or another lecturer give any theoretical lectures related to sustainability in the previous years?
    - Did you conduct any projects in the design studios related to sustainability? (If yes; Could you please mention about the project (subject/scope)?
3.
    - What is your opinion about the relationship between design studios and sustainability?
    - How do you interpret this relationship in your design studios?

4. Do you have any suggestions to improve sustainability awareness and knowledge among architecture students?

Thank you for sharing your time…

Ayça Nilüfer Çalıkuşu

E. The Survey Study at Polito



SUSTAINABILITY IN ARCHITECTURE EDUCATION

Hello!
I would like invite you to participate in the survey. I would like to give you some information about this research before you begin. The main purpose of this study is to explore the role of architecture education in the context of sustainability concept. The influence of the design studio/atelier education on the awareness of sustainability among students will be investigated.

The questionnaire should take approximately 10 minutes to complete. Your personal information (name, phone number, e-mail) will not be requested and your responses are completely anonymous.
Please give the appropriate answers for you to the study's objectivity. This survey is used for my master thesis of architecture department.

General Information

1. Please select your gender.
◯ Female ◯ Male

2. Please select your age.
◯ 18-22 ◯ 22-26 ◯ >26

3. Which degree program are you in?
◯ Bachelor of Architecture Degree Program
◯ MS in Architecture Construction City
◯ MS in Architecture For Sustainability Design

4. Which year are you attending now?
◯ 1st year of Bachelor Degree
◯ 2nd year of Bachelor Degree
◯ 3rd year of Bachelor Degree
◯ 1st year of Master Degree
◯ 2nd year of Master Degree

5. Please write your current Atelier/Studios and Teacher's name. _____

Your experience on sustainability within the design studios

For this part please consider your design projects about the sustainability concept.

6. What are your opinions on the relation between the theoretical courses on topics related to sustainability (i.e. building physics, environmental systems, building performance) and the design studio education?

	1	2	3	4	5	
IRRELEVANT	◯	◯	◯	◯	◯	MOSTLY RELEVANT

7. To what extent have the theoretical courses helped your projects within the design studios?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

8. Within your design studios at Polito, have you received any theoretical lectures and have you carried out any projects related to sustainability?
◯ Yes ◯ No

8.1. Please write/describe shortly which type of projects you have carried out related to sustainability concepts. (For example: Urban scale, District scale, Building scale, Material etc..) _____

8.2. If yes; Please select which aspects of sustainability. (Multiple choices possible)
◯ Social sustainability
◯ Environmental sustainability
◯ Economic sustainability

9. What is/was your opinion about the study on sustainability concept BEFORE you carried out a project related to sustainability?

	1	2	3	4	5	
NEGATIVE	◯	◯	◯	◯	◯	POSITIVE

9.1. How was the sustainability concept of the projects in the design studios you have been conducting previously? (If you don't have any projects about the sustainability, you can skip this question)
◯ It was a requirement in the studio
◯ It was added by my own contribution
◯ Other _____

9.2. What is your opinion on sustainability AFTER you carried out a design project related to sustainability? (If you don't have any projects about the sustainability, you can skip this question)

	1	2	3	4	5	
NEGATIVE	◯	◯	◯	◯	◯	POSITIVE

9.2.1. Which aspect of the sustainability is/was more difficult to implement in your design project? (If you don't have any projects about the sustainability, you can skip this question)
◯ Social sustainability
◯ Environmental sustainability
◯ Economic sustainability

9.2.2. Please write/describe shortly what were the potentials and how did the project develop in implementing the sustainability concept to your design project and (If you don't have any projects about the sustainability, you can skip this question)
_____
_____

9.2.3. Please write/describe shortly what were the difficulties in implementing the sustainability concept to your design project.(If you don't have any projects about the sustainability, you can skip this question)

_____

_____

10. Which phase is/was the integration between sustainability and design studio projects in your current/previous design studio programs? (Multiple choices possible)

- ◯ Conceptual phase
- ◯ Design Phase
- ◯ Detailed Phase
- ◯ Material Phase
- ◯ None
- ◯ Other _____

11. To what extent did the concepts which you learned/-studied in the design studios integrate with the sustainability?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

12. To what extent have your knowledge and awareness of sustainability concept developed after you carried out design projects about the sustainability concept?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

13. Would you like to apply again and even more the sustainability concepts in your future projects in the design studios?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

14. Do you perceive that you have learned the sustainability concept in a proper way from your design studio education?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

14.1. Do you think the design studio education is suitable for learning the sustainability concept?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

15. Do you think the teaching/studying of the sustainability concept in the architecture curriculum of Polito is enough?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

15.1. Please explain which topics should be addressed in more detail.

_____

_____

Your experience on sustainability at Politecnico di Torino (Polito)

16. How did you hear/learn the sustainability concept? (Multiple choices possible)

- ◯ Within a design studio
- ◯ Within a must course
- ◯ Within an elective course
- ◯ Personal interest
- ◯ Other _____

17. Have you taken any courses related to sustainability in the Politecnico Di Torino?

◯ Yes ◯ No

17.1. If yes; Please write the course name/year.

_____

_____

18. Have you attended any lectures, conferences or workshops related to sustainability in Polito or Outside?

◯ Yes ◯ No

18.1. If yes; Please write the titles/year.

_____

_____

19. Have you prepared any paper/essay/final test/thesis about the sustainability in the bachelor/master degree at Polito?

◯ Yes ◯ No

19.1. If yes; How many of them in total?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ >3
- ◯ Other _____

About the future

20. When you become an architect, do you want to design projects integrated with the sustainability concept?

	1	2	3	4	5	
NOT AT ALL	◯	◯	◯	◯	◯	VERY MUCH

20.1. Please select which aspects of sustainability.

- ◯ Social sustainability
- ◯ Environmental sustainability
- ◯ Economic sustainability

Thank you for sharing your time.
If you have any questions or concerns about the survey, please contact me: aycanilufercalikusu@gmail.com

Ayça Nilüfer Çalıkuşu

F. The Interview Questions at Polito

SUSTAINABILITY IN ARCHITECTURE EDUCATION: THE IMPACT OF EDUCATION ON PERCEPTIONS OF SUSTAINABILITY

1. What is/was the subject and the scope of the design studios/lectures conducted by you in this year and last year? (Please mention briefly)
2.
    - Within your design studios/lectures at Politecnico di Torino, did you or another lecturer give any theoretical lectures/presentations related to sustainability in the previous years?
    - Did you conduct any projects in the design studios related to sustainability? (If yes; Could you please mention about the project (subject/scope)?

3. Which aspect of sustainability do you mention more in your design studios/ lectures?

4. What is your opinion about the relationship between design studios and theoretical courses on sustainability?

5. Do you have any suggestions to improve sustainability awareness and knowledge among architecture students?

Thank you for sharing your time…

Ayça Nilüfer Çalıkuşu

G. The Analysis of Case Study 1: METU

Table 6.4. *Sample characteristics of the participants of METU*

	Female	Male	Total
Count	152	85	237
Age 18-22	99	58	157
Age 22-26	44	24	68
Age >26	9	3	12

Table 6.5. *Reliability analysis table of survey data*

Reliability Analysis	
Cronbach's Alpha Value	Number of Variables
0,795	33

- The table of Hypothesis One

Table 6.6. *The Pearson Correlation Test Results*

		4. Which year are you attending now?	**12. Sustainability Understanding of students**
4. Which year are you attending now?	Pearson Correlation	1	,501**
	Sig. (2-tailed)		,000
	N	237	213
12. Sustainability understanding of students	Pearson Correlation	,501**	1
	Sig. (2-tailed)	,000	
	N	213	213

**. Correlation is significant at the 0.01 level (2-tailed).

- **The table of Hypothesis Two**

Table 6.7. *Descriptive Statistics of two variables*

	Mean Score	Std. Deviation
14. To what extent was the concept of sustainability instructed by means of seminars, lectures, etc. during the design studios?	2,21	1,154
Sustainability Understanding of students	7,30	3,404

- **The tables of Hypothesis Three**

Table 6.8. *The descriptive analysis of first-year students for hypothesis three*

	Number	Mean	Std. Deviation
Social sustainability	9	3,00	1,225
Environmental sustainability	9	3,11	1,833
Economic sustainability	9	2,22	1,716

Table 6.9. *The descriptive analysis of second-year students for hypothesis three*

	Number	Mean	Std. Deviation
Social sustainability	15	3,00	1,309
Environmental sustainability	15	3,67	,816
Economic sustainability	15	2,13	1,356

Table 6.10. *The descriptive analysis of third-year students for hypothesis three*

	Number	Mean	Std. Deviation
Social sustainability	25	2,68	1,676
Environmental sustainability	25	3,48	1,005
Economic sustainability	25	2,08	1,631

Table 6.11. *The descriptive analysis of fourth-year students for hypothesis three*

	Number	Mean	Std. Deviation
Social sustainability	25	3,56	1,474
Environmental sustainability	25	4,28	,737
Economic sustainability	25	2,92	1,605

Table 6.12. *The descriptive analysis of master students for hypothesis three*

	Number	Mean	Std. Deviation
Social sustainability	11	3,36	1,120
Environmental sustainability	11	4,09	,701
Economic sustainability	11	3,27	1,009

- **The table of Hypothesis Four**

Table 6.13. *The result of the Independent Samples T-Test*

	t	df	Sig.	Mean Difference
20. In your future professional practices as an architect, do you want to design projects integrated with sustainability concepts?	-2,974	223	**,003**	-,390

H. The Analysis of Case Study 2: Polito

- The table of Hypothesis One

Table 6.14. *The Sample characteristics of Polito*

	Female	Male	Total
Count	82	69	151
Age 18-22	47	24	71 (47%)
Age 22-26	31	43	75(49%)
Age >26	4	2	7(4%)

- The table of Hypothesis Two

Table 6.15. *Pearson Correlation Analysis*

		The Integration of sustainability into the design studios	**Sustainability Understanding of students**
The Integration of sustainability into the design studios	Pearson Correlation	1	,529**
	Sig. (2-tailed)		,000
	N	138	137
Sustainability Understanding of students	Pearson Correlation	,529**	1
	Sig. (2-tailed)	,000	
	N	137	143

**. Correlation is significant at the 0.01 level (2-tailed).

- **The tables of Hypothesis Three**

Table 6.16. *The analysis of the first-year students for hypothesis three at Polito*

	Number (Yes)	Number (No)	Total
Social sustainability	12 (63,2%)	7 (36,8%)	19
Environmental sustainability	16 (84,2%)	3 (15,8%)	19
Economic sustainability	7 (36,8%)	12 (63,2%)	19

Table 6.17. *The analysis of the second-year students for hypothesis three at Polito*

	Number (Yes)	Number (No)	Total
Social sustainability	3 (37,5%)	5 (62,5%)	8
Environmental sustainability	7 (87,5%)	1 (12,5%)	8
Economic sustainability	3 (37,5%)	5 (62,5%)	8

Table 6.18. *The analysis of the third-year students for hypothesis three at Polito*

	Number (Yes)	Number (No)	Total
Social sustainability	5 (62,5%)	3 (37,5%)	8
Environmental sustainability	8 (100%)	-	8
Economic sustainability	4 (50%)	4 (50%)	8

Table 6.19. *The analysis of the master students for hypothesis three at Polito*

	Number (Yes)	Number (No)	Total
Social sustainability	37 (50%)	37 (50%)	74
Environmental sustainability	65 (87,8%)	9(12,2%)	74
Economic sustainability	27 (36,5%)	47 (63,5%)	74

- **The table of Hypothesis Four**

Table 6.20. *The result of the Independent Samples T-Test*

	t	df	Sig.	Mean Difference
20. When you become an architect, do you want to design projects integrated with the sustainability concept?	-,550	60,853	,584	-,070