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The Evaluation of Architectural Education in the Scope of Sustainable Architecture

İzzet Yüksek^{a*}

^a*Kırklareli University, Faculty of Technical Education, Kavaklı Campus, Kavaklı, Kırklareli, 39060, Turkey*

Abstract

In this study, examining the course contents (syllables) in undergraduate and graduate degrees in the departments of architecture at universities in Turkey, the extent they give place to the sustainability issues has been determined. A literature survey dealing with the topic was made, the studies carried out were analysed, and the current situation was compared with the results of these studies. In conclusion, the courses of “sustainable architecture” content in the course syllabuses have increased, but this improvement has been quite incomplete.

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1. Introduction

The way of our and future generations’ sustaining life conditions in the natural balance of nature or at least protecting the present day situation passes through increasing our environmental sensitivity. The building sector, which consumes a significant part of the world’s existing sources, should also be a pioneer to other disciplines.

The architect who designs the artificial sites we will live in the future should consider building as a part of the natural environment not as a single component. The qualities of the sites we live in are affected by the environmental factors surrounding them. Therefore, it is necessary to make designs that take the natural environment in architectural implementations into account.

Architects face different kinds of user demands in the rapidly developing world in every aspect. Giving the desired replies to the changing demands depends upon the architect’s knowledge and experience. The institutions where the vocational knowledge of an architect is taught are the universities. However, the responsibility of the architects is not only to meet the user desires in the best way but also to be responsible for the social life and local/regional/global issues as an intellectual. In particular, the environmental problems whose increase is triggered considerably by the building activities must be of special interest to the architects. While meeting the user needs, it is also possible to protect the natural sources of the earth and contribute to the protection of the environment. For

* Corresponding author: İzzet Yüksek.
E-mail address: izzetyuksekg@gmail.com

this, it is adequate that the preferences are environmental impact oriented in design and practice. The ability of the architect to make “sustainable” designs that have environmental sensitivity is closely dealt with obtaining knowledge, skill, and capabilities about this subject during the education process.

Therefore, in the education of building environment disciplines, the topic of sustainability with its sociocultural, economic, and environmental aspects is a basic priority while mentioning the dramatic hardships people confront. Today, those who have graduated from the architectural disciplines need multidisciplinary skills, knowledge, and capabilities in the wide range from creative design to detailed theoretical and technical specialty. By researching, implementing, and expanding the new pedagogical methods and proficiency criteria, which will catch up with the distance between sustainability “sciences” and the architectural design, the agenda of architectural education must be reorganized in a way to answer the current problems (Altomonte, 2011).

To improve the comprehension of sustainable approach in environmental design, beyond the technical issues dealt with energy consumption and carbon emission, the principles of resource management, carrying capacity of the planet, cultural and biological variety, and equality between generations are necessary to be adopted in a socially, economically, and ethically applicable design process. Such kinds of values must penetrate into every aspect of architecture job ranging from the idea, building, and management stages of a construction (Altomonte, 2011).

So that the graduates who have started architecture practice can have the necessary skills to be able to answer the market expectations, it seems that the value of adopting the environmental sustainability as an obligatory condition in the syllabus of higher education and vocational proficiency frames seems to be increasing across the world day by day (Altomonte, 2011).

The architectural education has two basic goals:

- To grow the man of future,
- To grow the architect of future.

For this reason, the issue of “sustainability” needs to be adopted as a philosophy of life not as a matter that is mandatory to be handled in the syllabus (Esin, 2011).

In the architectural education, there are various studies that handle sustainability from different aspects (Altomonte, 2011; Esin, 2011; Oktay, 2011; Ciravoğlu, 2011; Karaosman, 2011; Gökmen, Sayar, & Stier, 2007; Bala, 2009; Esin, Coşgun & Oral, 2007). In this study, within the architectural education in Turkey, the extent by which the sustainability topics have been given place in undergraduate and graduate degrees was determined and compared with the previous studies. For this purpose, in the higher education institutions in Turkey, the undergraduate and graduate programs of architecture departments that have students under the body of a different faculty were analyzed in terms of sustainability contented courses. Besides, the graduate theses of sustainability content, which were made in the field of architecture, were analyzed numerically. In interpreting the analyses made, the position of sustainability in architectural education tried to be ascertained.

2. Analysis of architectural education in Turkey in relation to sustainability

In Turkey, the architectural education is given at four-year undergraduate and graduate (master and doctorate) levels. On evaluating master and doctorate education separately, graduate education is composed of 21-credit course, seminars, and thesis study. Although the courses change according to the universities, they are mostly elective courses depending on the student’s interest and thesis study.

2.1. Architectural education and sustainability in undergraduate degree in Turkey

In Turkey, architectural education at undergraduate degree is carried out in 67 universities according to the 2012 data of SSPC (OSYM) (OSYM, 2012). In a study made in 2011, this number was determined as 42. In one-year period, there has been an increase of more than 50% in the number of architectural departments.

The undergraduate education is 8 semesters and composed of compulsory and optional courses. The proportion of optional course hours was determined as 8% to all course hours (Gökmen et al., 2007). The classification of the courses given in architectural undergraduate education was made as such by Gökmen et al. (2007);

1. General Information: Basic Sciences (Mathematics, Computer, Physics, Chemistry, etc.), Social Sciences (Economy, Psychology, Sociology, Anthropology, History, Research Methods, etc.), and Language Sciences (English, Turkish, etc.)

2. Constructional Sciences and technology: Building systems, construction materials, construction physics (lighting and air conditioning)

3. Design Information: Architectural design, indoor design, presentation techniques

4. History, Theory, Culture, and Art: Art history, city history, architecture history and theories, typology, and structure history

5. Environment and City: Urban environment, urban design, historical design, historical environment, protection-restoration, natural environment-natural catastrophes, environment control, landscape, ecology, and topography.

6. Vocational Studies, Management, and Economy: Constructional economy, management, and laws.

The rates of these courses in the program according to the course hours are as follows (Gökmen et al., 2007):

Table 1. The rates of the courses in architecture undergraduate program according to groups in total course hour.

	General average	Middle East Technical University	Istanbul Technical University	Yıldız Technical University	Dokuz Eylül University
Course hours	206	235	198	225	198
Number of courses	55	50	49	63	60
General knowledge	13%	16%	14%	15%	15%
Building science	18%	12%	20%	23%	26%
Design science	41%	44%	37%	35%	36%
History, theory, culture, and art	9%	6%	4%	11%	9%
Environment, city	8%	8%	7%	3%	6%
Professional studies	3%	1%	3%	3%	3%
Elective courses	8%	13%	15%	10%	5%

The table above belongs to 2007, according to the data; the proportion of the environment content courses evaluated within the scope of sustainability and urban content courses in the total course hours is at a quite low level. Examining the data of 2012 of the same universities, it was seen that 9 Eylül University did not have environment content compulsory course but only had elective courses. In the Middle East Technical University, Yıldız Technical University, and Istanbul Technical University, it was seen that there were various elective courses as well as 8- to 9-hour compulsory courses. For example, there is a possibility of choosing 7 separate courses of 21 hours in total at Istanbul Technical University. However, in Yıldız Technical University, one can choose 10 different courses of 21 hours in total. In Dokuz Eylül University, there are 4 separate elective courses of 8 hours in total. As a result of the comparison of the data of 2012 with those of 2007, it can be mentioned that there has been a proportional increase in environment content courses. In evaluating the compulsory courses in undergraduate classes throughout Turkey, there was no environment content course in 10 of 67 architectural departments whose analyses were made. The number of departments that has two or three hours of single course is 13. About 25% of the universities spare 8 or 9 hours in total for environment content courses (Table 2). The number of courses at these levels is not enough. In addition, in looking at the content of these courses, we find courses where information related with indoor comfort conditions is taught under the names of “Building Physics” or “Physical Environment Control.”

In undergraduate education programs, the topics directly related to “sustainability architecture” are mostly found in the category of elective courses. According to the analysis results of 67 university programs, the elective courses of 11 universities could not be reached from the related universities’ Web sites. In 10 universities, however, no course was found related with the topic. In 29 universities, the related courses are between 2 and 6 hours. The number of universities that have 8 hours or more of elective courses is 17. Particularly, in Mimar Sinan Fine Art University, Okan University, YTÜ, İTÜ, Selçuk University, Trakya University, Eskişehir Osmangazi University, Dicle University, Karabük University, and Gediz University, the number and hour of courses of sustainable architecture content are more than those of other universities (Table 3).

Table 2. Undergraduate courses in sustainability content in architecture department in Turkish universities

University	Undergraduate Courses	Hours T/A/T	Undergraduate Courses (Elective)	Hours T/A/T
Abant İzzet Baysal University	Building physics and environmental control	1 2 3	Environmental design & Ecological architecture	3 0 3
			Environment and human	3 0 3
Anadolu Univ.	Nonexistent		Nonexistent	
Akdeniz University	Sustainable architecture	2 0 2	Ecological architectural design	2 0 2
			Ecology in architecture	2 0 2
Atılım University	Environmental control systems I	2 2 4	Nonexistent	
Avrasya Univ.	Environment - behavior knowledge	2 0 2	Energy efficiency design in architecture	3 0 3
Bahçeşehir University	Environmental control systems I	3 0 3	Interaction between nature & architecture	2 0 2
	Environmental control systems II	3 0 3	Energy efficient construction	2 0 2
Balıkesir University	Building physics	3 1 4	Heat and humidity control	3 0 3
			Energy efficient building design	3 0 3
Başkent University	Environmental control systems I	3 0 3	Solar control space	1 2 3
	Environmental control systems II	3 0 3		
	Environmental sensitivity design	1 2 3		
Bozok University	Physical environmental control	2 0 2	Ecology	2 0 2
	Environmental control	2 2 4	Solar energy applications in building	2 0 2
	Building physics	2 0 2		
Beykent University	Environmental Systems I	2 2 4	Could not be reached elective courses	
	Environmental System II	2 2 4		
Bursa Orhangazi University	Building physics	2 0 2	Architecture and ecology	3 0 3
	Building science and environment	2 0 2	Energy efficient building design	3 0 3
			Sustainable construction technologies	3 0 3
Çankaya University	Building Physics I	3 0 3	Nonexistent	
	Building Physics II	3 0 3		
	Building Physics III	3 0 3		
Canik Başarı Univ.	Could not be reached courses		Could not be reached elective courses	
Çukurova University	Physical environmental control I	2 0 2	Environmental impact assessment	2 0 2
	Physical environmental control II	2 0 2	Ecological architecture	2 0 2
Dicle University	Nonexistent		Architectural design and environment relations	2 0 2
			Physical environmental control	2 0 2
			Building physics I	2 0 2
			Architecture and ecological planning	2 0 2
			Solar energy applications in buildings	2 0 2
			Building physics II	2 0 2
			City and environment	2 0 2
Doğuş University	Building science and environment	3 0 3	Ecology and architecture	2 0 2
	Building physics I	1 2 3	Environment-driven building design	2 0 2
	Building physics II	1 2 3		
Dokuz Eylül University	Nonexistent		Sustainable architecture	2 0 2
			Ecological architecture	2 0 2
			Orientation in architecture and solar control	2 0 2
			The use of solar energy and architecture	2 0 2
Erciyes University	Building Knowledge I	2 0 2	Solar houses	2 0 2
			Ecological architecture	2 0 2
Eskişehir Osmangazi University	Building physics	2 2 4	Sustainable architecture	3 0 3
	Building physics II 224	2 2 4	Thermal Behavior and Indoor Comfort of Buildings	3 0 3
			Introduction building performance simulation	3 0 3
			Building performance simulation	3 2 5
Fatih Sultan Mehmet Univ.	Physics of architecture and building be	2 2 4	Sustainable design	2 0 2
	Building and environmental control	2 2 4	Disaster-environment and energy	2 0 2
Gazi University	Physical environmental control I	3 0 3	Solar energy applications in buildings	2 0 2
	Physical environmental cont. studio I	2 1 3		
	Physical environmental control III	2 1 3		
Gaziantep Univ.	Environmental design I	3 0 3	Could not be reached elective courses	
Gazikent Univ.	Building physics I	3 0 3	Sustainable building technologies	3 0 3
	Building physics II	3 0 3	Energy and sustainable building production	3 0 3

Table 2. Undergraduate courses in sustainability content in architecture department in Turkish universities (continue)

University	Undergraduate Courses	Hours T/A/T	Undergraduate Courses (Elective)	Hours T/A/T
Gebze High Inst. Technology	Theories of Sustainable Design	2 0 2	Ecological planning: The future of architecture	3 0 3
	Physical environmental control	2 0 2		
Gedik Univ.	Ecological architecture	2 2 4	Could not be reached elective courses	
Gediz University	Environmental Control Systems	2 2 4	Ecology	2 0 2
			Environmental Law and Policies I 202	2 0 2
			Environmental Law and Policies II 202	2 0 2
			Energy Efficient Buildings	1 2 3
			Sustainable Building Materials	1 2 3
Haliç University	Physical environmental problems	2 0 2	Conservation of buildings in terms of building physics	2 0 2
			Building physics	2 0 2
Bilkent University	Environmental Technology I	3 0 3	Nonexistent	
	Environmental Technology II	3 0 3		
Işık University	Could not be reached courses		Could not be reached elective courses	
İst. Arel Univ.	Environmental Control	2 2 4	Nonexistent	
İst. Aydın Univ.	Environment and human factors	3 0 3	Nonexistent	
İst. Gelişim Univ.	Could not be reached courses		Could not be reached elective courses	
İst. Knowledge University	Physical environmental control	2 4 6	Natural systems I	3 0 3
			Representations of nature	3 0 3
İst. Kemerburgaz University	Environmental systems in buildings I	2 0 2	Human, space and environment	3 0 3
	Environmental systems in buildings II	2 0 2		3 0 3
İstanbul Culture University	Physical environmental control I	2 0 2	Ecology and architecture	3 0 3
	Physical environmental control II	2 0 2	Solar control	3 0 3
			Sustainability and architectural ve heritage	3 0 3
İst. S. Zaim Univ.	Physical environmental control	2 2 4	Could not be reached elective courses	
İstanbul Technical University	Environmental control studio	2 6 8	Climatic Performance Evaluation in artificial surrounding	3 0 3
			Solar architecture	3 0 3
			Energy Efficient Housing	3 0 3
			Generating Livable Environments	3 0 3
			Solar control	3 0 3
			Energy conservation legislation and applications	3 0 3
İzmir Econ. Univ.	Environmental control systems for architecture	3 0 3	Sustainability in architecture	3 0 3
İzmir University	Nonexistent		Man and Environment	3 0 3
			Solar control in architecture	3 0 3
			Environmental Design	3 0 3
İzmir High Inst. Technology	Building physics I	2 2 4	Ecological Approaches in Architecture	3 0 3
	Building physics II	2 2 4	Lighting analysis of building physics	3 0 3
Kadir Has Univ.	Environmental sustainability	3 0 3	Could not be reached elective courses	
Karabük University	Physical environmental control I	2 0 2	Solar houses	2 0 2
	Physical environmental control. II	2 0 2	Nature and design studio	1 2 3
	Urban and environmental law	2 0 2	Climate-Based Design Studio	1 2 3
			Ecological architecture design studio	1 2 3
			Old Buildings New Function Proposals Studio	1 2 3
Black Sea Technical Univ.	Environment-behavior knowledge	4 0 4	Ecology and architecture	2 0 2
	Physical environment knowledge	4 0 4		
Kocaeli University	Physical environmental control	4 0 4	Nonexistent	
Maltepe Üniversitesi	Physical environmental control	4 0 4	Ecological planing and architecture	2 0 2
			Ecology	2 0 2
M. Artuklu Univ.	Nonexistent		Could not be reached elective courses	
Mersin Univ.	Environmental control I	2 0 2	Architecture and nature	3 0 3
Melikşah Univ.	Could not be reached courses		Could not be reached elective courses	

Table 2. Undergraduate courses in sustainability content in architecture department in Turkish universities (continue)

University	Undergraduate Courses	Hours T/A/T	Undergraduate Courses (Elective)	Hours T/A/T
Mimar Sinan Fine Arts University	Physical environmental control	2 2 4	Local learning: The principles of sustainable environment	2 0 2
	Environmental design	2 0 2	Physical environmental control II	2 0 2
			livable environment and environmental psychology	2 0 2
			Ecological building project	2 0 2
			Environmental awareness in architectural design	2 0 2
			Ecological materials	2 0 2
			Livable environment and environmental psychology	2 0 2
			Strategy and methods of ecological environmental design	2 0 2
			Use of sun and atmosphere effects	2 0 2
			Energy efficient design in architecture	2 0 2
			Sustainable building technology	2 0 2
			Natural environment factors in the formation of architecture	2 0 2
			Human and environment	2 0 2
			Energy Efficient Buildings	2 0 2
			Passive air conditioning principles of architecture	2 0 2
		Building biology and ecology	2 0 2	
		Natural lighting and architecture	2 0 2	
Mustafa Kemal University	Physical environmental control I	2 0 2	Sustainable architecture	3 0 3
	Physical environmental control II	2 0 2		
Nuh Naci Yazgan University	Building physics I	2 0 2	Could not be reached elective courses	
	Building physics II	2 0 2		
Okan University	Sustainable Design	3 0 3	Sustainable approaches in urban design	3 0 3
	Environmental Control I	3 0 3	Thermal problems&heat insulation in buildings	3 0 3
	Environmental Control II	3 0 3	Research methods in environment and behaviour	3 0 3
			Sustainable buildings	3 0 3
			Ecology and architecture	3 0 3
			Green project management	3 0 3
			LEED AP Preparation	3 0 3
		Research topics in architecture: Ageing environment	3 0 3	
Middle East Technical University	Principles of built environment	3 0 3	Integration of building systems in architectural design for environmental control	3 0 3
	Environmental and building systems	3 0 3	Energy considerations in architecture I	3 0 3
	Environmental control technologies	3 0 3	Energy considerations in architecture II	3 0 3
Özyeğin Univ.	Physical environmental control	1 3 4	Nonexistent	
Selçuk University	Building physics and Environmental Control	2 2 4	Environmental analysis in the process of architectural design	2 0 2
			Ecological design	2 0 2
			Energy efficient design	2 0 2
			Energy effective building practices	2 0 2
			Energy efficient building applications	2 0 2
			Solar control techniques	2 0 2
			Using renewable energy in building sector	2 0 2
			Natural lighting in building	2 0 2
Reneeable energy using in building sector	2 0 2			
Süleyman D. Univ.	Nonexistent		Could not be reached elective courses	
TED University	Nonexistent		Sustainable architecture theories	3 0 3
TOBB Univ.	Nonexistent		Sustainable architecture	2 0 2
Toros University	Physical environmental control I		Nonexistent	
	Environmental control II			
	Environmental control III			
Trakya University	Building physics	2 1 3	Environmental analysis in architectural design	2 0 2
			Sustainability and architecture relations	2 0 2
			Passive heating systems	2 0 2
			Energy conservation in buildings	2 0 2
			Architecture and ecology	3 0 3
			Alternative energy usage in architecture	3 0 3
Sustainability in building production	3 0 3			

Table 2. Undergraduate courses in sustainability content in architecture department in Turkish universities (continue)

University	Undergraduate Courses	Hours T/A/T	Undergraduate Courses (Elective)	Hours T/A/T
Uludağ University	Building physics	2 0 2	Ecology and architecture	2 0 2
			Sun and architecture	2 0 2
			Physical environmental control	2 0 2
			Sustainability and architecture	2 0 2
			Sust. urban development and housing areas	2 0 2
Yaşar University	Nonexistent		Physical environmental control I	2 0 2
			Physical environmental control II	2 0 2
			Bioclimatic architecture	3 0 3
			Sustainable architecture	3 0 3
Yeditepe University	Building physics	3 0 3	Sustainable architecture	3 0 3
			Environmental control	3 0 3
Yeni Yüzyıl University	Physical environmental control I	2 2 4	Regional and envir. conditions in architecture	2 0 2
	Physical environmental control II	2 2 4	Env. and environmental effects in architecture	2 0 2
Yıldız Technical University	Building physics 1	2 2 4	Building-health relations	2 0 2
	Building physics 2	2 2 4	Ecology in architecture	2 0 2
			Ecology in housing design	2 0 2
			Alternative energy usage in architecture	2 0 2
			Relationship design and environment relations	2 0 2
			Passive heating systems	2 0 2
			Physical environmental control	2 0 2
			Solar arrangement	2 0 2
			Climate-balanced designs	2 0 2
			Light of day	2 0 2
Yüzüncü yıl University	Building physics 1	1 2 3	Ecology in architecture	2 0 2
	Building physics 2	1 2 3		
	The relationship between design-environmental problems	1 2 3		
Zirve University	Nonexistent		Nonexistent	

2.2. Architectural education and sustainability in graduate degree in Turkey

Searching the Internet sites of universities, it was found that 39 universities in Turkey provide graduate education in architecture. In the graduate programs of 36 universities except from 3 universities whose necessary information could not be accessed, the courses of sustainable content were analysed. With this analysis, it was found that there is no course dealt with the study subject in 5 universities, and there are 3 and fewer courses in three universities. However, in the 18 universities left, there are courses between 4 and 22. Especially, the sustainable architecture content course range of ITU, YTU, MSFAU, IKU, and Maltepe University is quite wide. They provide students with different alternatives that they can choose in this field. ITU, YTU, MSFAU, and Maltepe University accommodate different program alternatives such as Environment Control Construction Technologies, Energy Efficient Buildings, Building Physics, Building Research, and Planning in the body of Architecture department. It would be useful for these programs to be multiplied especially around the title of “Sustainable Design in Architecture” as in the case of “Building Research and Planning Program.”

Table 3. Graduate courses in sustainability content in architecture department in Turkish universities

University	Graduate Courses	Hours T/A/T	University	Graduate Courses	Hours T/A/T		
Anadolu University	Ecological planning and design	3 0 3	İstanbul Aydın University	Sustainable green urban development: A conceptual framework and application examples	3 0 3		
	Building envelope design in energy efficient buildings	3 0 3		Technology in green architecture and material selection	3 0 3		
	Sustainable architecture	3 0 3					
Atılım University	Climate-compatible building design	3 0 3	İst. Knowledge University	Nature, technology and landscape	3 0 3		
	Ecological design principles and techniques	3 0 3		Physical environment control	3 0 3		
	Using alternative energy sources in architectural design	3 0 3					
	Green building design	3 0 3					
Bahçeşehir Uni.	Nonexistent						
Beykent University	Design principles of building physics	3 0 3	İstanbul Culture University	Sustainability and environment based design	3 0 3		
	Environmental factors and risk management	3 0 3		Certification process for sustainable spaces	3 0 3		
	Environmental design and planning	3 0 3		Ecological housing	3 0 3		
	Solar energy and passive design	3 0 3		Sustainable design and life cycle assessment	3 0 3		
	Sustainable architecture	3 0 3		Energy conservation in artificial environment	3 0 3		
	Building energy simulation methods	3 0 3		Optimization of energy sources	3 0 3		
	Design process and environmental quality	3 0 3		Building envelope design	3 0 3		
	Architectural design and indoor air quality (IAQ)	3 0 3		Sustainable building materials	3 0 3		
Bursa Orhangazi University	Ecology, sustainability and artificial environment	3 0 3		Environmental control systems	3 0 3		
	Energy efficiency in artificial environment	3 0 3		Energy management in lighting	3 0 3		
	Environmental assessment in buildings	3 0 3	Solar radiation and building design	3 0 3			
	Building energy simulation methods	3 0 3	Solar Architecture	3 0 3			
	Building materials and environmental impact	3 0 3	System design in natural lighting	3 0 3			
Çukurova University	Quality in artificial environment I	3 0 3					
	Quality in artificial environment II	3 0 3					
	Solar energy architecture	3 0 3					
Dicle University	Artificial environment-architectural design relations	2 0 2	İstanbul Technical University	Masters Degree in Environmental Control Building Technologies Courses			
	Environmental factors in architectural design	2 0 2		Sunlighting in Architecture	3 0 3		
	Investigation of the natural environment data in the process of architectural design	2 0 2		Active and passive systems in utilization of sun	3 0 3		
	Ecology-design relation	2 0 2		Building Design which low energy cost	3 0 3		
	Sustainable architecture	3 0 3		Energy efficiency in artificial environment	3 0 3		
	Regional and environmental conditions in the context of building	2 0 2		Climate and building envelope design	3 0 3		
	Ecological architecture	3 0 3		Ecological building materials	3 0 3		
Doğuş University	Regional-environmental factors in building	3 0 3					
	Analysis and evaluation of physical environment	2 2 4					
	Sustainable architecture	3 0 3					
	Ecology, sustainability and landscape	3 0 3					
	Environmental assessment in building	3 0 3					
Dokuz Eylül University	Analysis and evaluation of the physical environment	2 0 2	İzmir Econ.Univ	Nonexistent			
	Energy problems in building design	2 0 2					
	Alternative energy sources and nuclear power plants	2 0 2					
	Environment protection	2 0 2					
	Integration of solar technologies into architecture	2 0 2					
Erciyes Univer.	Environmental performance seminar of buildings	2 0 2		İzmir High Technology Institute	Principles of building physics	2 2 4	
	Microclimate in energy efficient design	3 0 3			Sustainable architecture	3 0 3	
Fatih Sultan Mehmet University	Sustainability in architecture	3 0 3					
	Human - environment studies	3 0 3					
Gazi University	Ecological materials	3 0 3					
	Energy efficient building design	3 0 3					
	Ecological architecture	3 0 3					
Gebze High Technology Institute	Design criteria in lighting with daylight	3 0 3	Karabük Univ.		Performance simulation usage in energy efficient building design	3 0 3	
	Building biology and ecology	3 0 3			Green building technology based on energy and environmental systems	3 0 3	
	Sustainable architecture	3 0 3			Environmental impact of building materials	3 0 3	
	Building and human health	3 0 3					
	Ecological building materials	3 0 3	Black Sea Technical University	Energy efficient building design in context of sustainable architecture	3 0 3		
	Energy efficient building design methods	3 0 3		Building biology and ecology	3 0 3		
Haliç University	Reuse and recycling potentials of building materials	3 0 3	Kocaeli University	Energy efficient design in architecture	3 0 3		
	Humidity and heat problems in buildings	3 0 3		Ecology design relations	3 0 3		
	Physical and ecological environment in architecture	3 0 3		Energy efficient design in architecture	3 0 3		
İst. Arel Univ.	Environmental law in the context of environmental awareness architecture	3 0 3					
	Nonexistent						
				Planning approaches to sustainable development	3 0 3		

Table 3. Graduate courses in sustainability content in architecture department in Turkish universities (continue)

University	Graduate Courses	Hours T/A/T	University	Graduate Courses	Hours T/A/T
Maltepe University	Architecture Master Degree Program		Middle East Tech. Univ.	Building Physics I	3 0 3
	Building- environment relations	3 0 3		Energy Analysis of Buildings	3 0 3
	Ecological architectural design	3 0 3	Selçuk University	Ecological approach to architectural design	3 0 3
	Architectural design and sun	3 0 3		Sun control in architecture and orientation	3 0 3
	Architecture Phd Program			Importance of use of clean and renewable energies and application techniques	3 0 3
	Effect of natural environment in the formation of architectural tissue	3 0 3	TED University	Sustainable architecture theories	3 0 3
	Sustainable planing and architectural design	3 0 3	Trakya University	Building biology	3 0 3
	"Energy Efficient Building" Master Degree Program			Solar energy in architecture	3 0 3
	Renewable energy sources	3 0 3		Ecological building design	3 0 3
	Renewable energy technologies	3 0 3		Renewable energy resources and design relations	3 0 3
	Energy performance in building	3 0 3	Uludağ University	Ecological building materials	3 0 3
	Energy performance modeling in buildings	3 0 3		Building physics problems in building	3 0 3
	Climate balanced design	3 0 3	Yaşar Univ.	Nonexistent	
	Solar energy in building	3 0 3	Yeditepe University	Technical service in building	3 0 3
	Energy efficient lighting	3 0 3		Usage natural resources in building	3 0 3
	Natural air conditioning	3 0 3		Sustainability and ecology in architecture	3 0 3
	Heat isolation systems and materials	3 0 3		Building biology	3 0 3
	Ecological planning and architectural aproches	3 0 3		"Building Research and Planning" Master Degree and Phd	
	Sources, sustainability and recycling technology	3 0 3		Energy usage in buildings	3 0 3
	Environmental planning and effect assesment	3 0 3		Sustainable architecture I	3 0 3
	Wind energy and systems	3 0 3		Sustainable architecture II	3 0 3
	Fuel cell technology	3 0 3		Sustainable architecture, Eleştirel Yaklaşım	3 0 3
	Energy storage systems	3 0 3		Yapılı Çevre İçin Yaşam Döngüsünü Değerlendirme Yö	3 0 3
	Energy policy and planning	3 0 3		Yerel Mimaride Ekolojik Çözümler	3 0 3
M. Artuklu Univ	Nonexistent			"Architectural Design" Master Degree and Phd	
	"Architectural design problems" Master Degree Program		Yıldız Technical University	Natural environment - architectural design relations	3 0 3
	Energy efficient design in architecture	2 0 2		Ecology design relations	3 0 3
	Design with nature: green design	2 0 2		"Building" Master Degree and Phd Program	
	Interdisciplinary approach to architectural design process and environmental problems	2 0 2		Building life cycle assessment	2 0 2
	Use of technology in architecture and energy efficient design	2 0 2		Building biology	2 0 2
	"Building Knowledge" Master Degree Program			"Building Physics" Master Degree and Phd Program	
	Sustainable architecture and construction technology	3 0 3		Energy conservation in lighting	2 0 2
	"Building physics" Master Degree Program			Energy efficient design	1 2 3
	Building envelope performance measurement technique	2 0 2		Active heating systems	2 0 2
	Environmental impacts of building physics perspective	2 0 2		Active and passive heating principles	2 0 2
	Thermal problems in building envelope and heat protection	2 0 2		Solar control methods	2 0 2
	Site selection linked climatic impacts and determination criteria of building form	2 0 2		Solar radiation - design relations	2 0 2
	Building biology	2 0 2		Daylight clculation	2 0 2
	Ecological materials	2 0 2		Climate and design İklim ve Tasarım Etkenleri	2 0 2
				Solar energy in architecture	2 2 4
Okan University	Sustainability and Green Building	3 0 3			
	Ecological Urbanism	3 0 3			
	Advanced Studies on Sustainable Architecture	3 0 3			
	Advanced Environmental Control	3 0 3			
	Ecological Design Principles of Housing Settlements	3 0 3			
	Art and Ecology	3 0 3			
	Building Economics and Sustainable Design	3 0 3			

Table 4. The dispersion of PhD theses according to years and universities.

Thesis year	Number of thesis	University (Number of thesis)
2001	2	Gazi University, Yıldız Technical University
2003	2	İzmir High Institute Technology, Karadeniz Technical University
2004	2	İstanbul Technical University, Mimar Sinan Fine Arts University
2005	1	Dokuz Eylül University
2006	5	YTU (2), KTU, MSFAU, Gazi University
2007	3	ITU (2), YTU
2008	2	ITU, Trakya University
2009	1	Trakya University
2010	2	ITU, MSFAU
2011	1	ITU

Table 5. The dispersion of master theses according to years and universities

Thesis year	Number of thesis	University (Number of thesis)
1994	1	ITU
1995	1	YTU
1996	1	Çukurova University
1997	1	Çukurova University
1998	3	ITU, KTU, METU
1999	3	ITU, DEU, Gazi University
2000	2	METU, ITU
2001	3	ITU, METU, Gazi University
2002	5	YTU (2), ITU (2), Selçuk University
2003	19	Gazi University (7), ITU (6), YTU (3), KTU (1), Gebze High Institute Technology (1), Izmir High Institute Technology (1)
2004	19	ITU (8), YTU (7), GHIT (2), DEU (1), METU (1)
2005	11	YTU (3), ITU (2), GHIT (1), DEU (2), MSFAU (1), GU (1), Trakya University (1)
2006	10	ITU (3), YTU (2), TU (2), GHIT (1), KTU (1), MSFAU (1)
2007	11	ITU (7), YTU (1), GHIT (1), METU (1), GU (1)
2008	8	YTU (4), İTU (1), SDU (1), ODTU (1), GU (1)
2009	10	MSFAU (3), GHIT (2), ITU (2), DEU (1), IHIT (1), YTU (1)
2010	33	ITU (12), MSFAU (8), YTU (5), GU (3), DEU (2), Eskişehir Osmangazi University (1), Yeditepe University (1), Haliç University (1)
2011	24	YTU (8), İTU (5), MSFAU (5), KTU (2), GHIT (1), DEU (1), IHIT (1), TU (1), HU (1)
2012	16	YTU (5), ITU (4), Uludağ University (2), DEU (1), MSFAU (1), Kocaeli University (1), GU (1), Yeditepe University (1)

When the data obtained as a result of the analysis of graduate education programs are compared with those of undergraduate education, the courses in graduate education programs in Turkey are more than those in undergraduate education. For the architects who want to specialize in sustainable architecture, different alternatives are provided. Yet, the situation that some universities still remain indifferent to the issue must be questioned.

The most important factor that separates and differentiates graduate education from undergraduate education is thesis. In this study, while making the analysis of graduate education, the thesis topics were not neglected either. In the thesis database of higher education institution, such words as “sustainability,” “ecological,” “green building,” and “constructional environment” were written, and among the results were the theses completed in the Architecture department listed. The theses listed were classified according to years, and the number of thesis and the universities where they were carried out were shown in two tables as graduate and doctorate theses.

In examining the numbers and years of the graduate thesis, it was seen that the number of theses about “sustainable architecture” increased after 2000 and hit the top in 2010 with 35 PhD and master theses. Looking at the universities where the theses have been written, it is seen that such universities as ITU, YTU, and MSGSU where graduate courses are higher than the other universities come to fore. Besides these universities, it has been observed that Gazi University, DEU, and GYTE have made *unignorable* studies.

In analysing the results of both graduate courses and theses, it is seen that “sustainable architecture” topics in the body of graduate education have gained importance in Turkey in recent years. Nevertheless, this situation in a limited number of universities must be expanded to all other universities, and the programs of the universities must be parallel to each other.

Conclusion

To meet the demands posed by the current problems, in fact, sustainability should be seen as a privilege from the beginning of architects’ education. For this, all academic and vocational institutions should accept this privilege by completely encouraging and inspiring the students about the necessities of sustainable development using proper pedagogical methods, tools, and techniques and sparing adequate research, human, finance, and time source (Altomonte, 2011).

The way of our and future generations’ sustaining life conditions in the natural balance of nature or at least protecting the present day situation passes through increasing our environmental sensitivity. The building sector, which consumes a significant part of the world’s existing sources, should also be a pioneer to other disciplines.

Looking at the general frame in our country and in the world, it is observed that, although there has been a considerable improvement in the subjects related to computer and electronic media in architectural schools, it cannot be said that there has been satisfying improvements about design with respect to ecological sensitivity and urban and social environment (Oktay, 2011).

In analysing the architecture programs of the universities in the world, ecological design is usually given as all-inclusive and multidisciplinary programs. The courses provided except from technology- and material-based ones are as follows: “Sustainable Design Technology,” “Ecological Theory,” “Ecological Design Concepts and Strategies,” “Sustainability and Ethics,” “Deep Ecology and Design,” and “System Theory” (Karaosman, 2011).

Specifically in Turkey, in architectural education, among the compulsory courses, especially in the early semesters, “Environment Information” course where basic information about environment is given, global and local environmental problems discussed should be included in the syllabus. In the following semesters, the courses that complete the construction-environment relation and the courses where “Sustainable Architecture” principles are defined with examples should be integrated. In addition, because architecture cannot be provided with a single building scale, the courses where sustainable design principles are gained in urban scale should be provided. Finally, this theoretical information should be turned into practice with a studio and project course.

The architectural education built in the totality of design studio and theoretical courses has given much more importance to sustainable architecture concept in recent years. The things that detailed supporting studio and technical information based on and tried to be taught in the body of compulsory or elective courses are not usually conveyed effectively by students during the process of design. Students have difficulty in integrating the things that are being taught in theoretical and studio courses. The sustainability consciousness necessitates an active learning

and one-to-one experimenting; therefore, the sustainable architecture principles that they have learned passively in the theoretical courses that are part of the design studio are important (Bala, 2009).

Taking both graduate courses and theses into account, it is obvious that in Turkey, sustainable architecture has covered a lot of ground at the graduate level. In the undergraduate level, by giving more places to the related courses, “sustainable architecture” will come to a more effective position in every field of architectural education.

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