US-China Education Review, ISSN 1548-6613
May 2011, Vol. 8, No. 5, 637-658

The Integration of Interior Architecture Education With Digital Design Approaches

Deniz Ayşe Yazıcıoğlu
Kadir Has University, Istanbul, Turkey

It is inevitable that as a result of progress in technology and the changes in the ways with which design is conceived, interior architecture schools should be updated according to these requirements and that new educational processes should be tried out. It is for this reason that the scope and aim of this study have been determined as being the formulation of a hybrid educational model for the integration of digital approaches to design within the interior architecture education system. Within the chosen scope and aim of this study, and as a methodology, various algorithmic and parametric approaches have been applied in various practical applications as digital design instruments, and conclusions have been reached concerning the advantages they offer within the design process. The advantages and disadvantages, concerning interior architecture education, of digital approaches to design over the traditional design method, have been presented on the basis of results found during practical applications of digital design, the information found in publications about this subject. A hybrid educational model for the restructuring with digital design instruments of interior architecture education and design studios as experimental areas has been presented. Thanks to this proposed model, the establishment of a computer formatted analytic design system in the guise of dynamic systems will get easier and, the opportunity of restructuring the process and conception of design will also present itself. As the effects of this method are reflected on the products, new geometric approaches and typologies will appear, with the result that designs and digital instruments will constantly be developed and will evolve. In conclusion, educating the designers of the future according to the essence of these approaches will make it possible to train professionals who correctly use and understand the technologies being developed, who have a critical stance, and who can produce renewable designs.

Keywords: digital design, interior design education, algorithmic approach, parametric approaches

Introduction

In our times, information and the new circumstances created by communication and information technologies within interior design activities signal a change in paradigm. It is doubtless that as a result of developments in technology and changes in design processes, the need has appeared for new ways of thinking both in practice and education that go beyond the interdisciplinary approach (Sheil, 2008). At this point, the fact that "existing educational systems in the field of interior architecture may not be responding to this kind of expectations" is something that we have to consider seriously. It is for this reason that with the aim of understanding up to what point present day educational systems are satisfactory and correctly defining eventual problems, the contents of the compulsory courses within the four-year degree programs of the interior

Deniz Ayşe Yazıcıoğlu, Ph.D., assistant professor, Interior and Environmental Design Department, Kadir Has University.

architecture departments of 33 universities were subjected to a comparative study, and the results in Table 1 are obtained. For the purposes of this study, courses with different names, but similar content were classified within a single title. The reason for this is that from the point of view of this study it is the contents of courses that are important but not their titles.

Table 1

Comparison of the Compulsory Courses of the Interior Design Departments of Different Universities, From the Perspective of the Contents of the Courses

		University																																
		Pratt Institute (Pratt Institute, 2010 April)	The University of Cincinnati (UC, 2010 April)	Academy of Art University (Academy Art, 2010 April)	Florence Design Academy (Florence Design Academy, 2010 April)	Parsons Academy (Parsons Academy, 2010 April)	University of Nevada, Reno (URN, 2010 April)	Lorenz ode' Medici (Lorenz ode' Medici, 2010 April)	Istitut od' arte Applicatae Design (Istitut od' arte Applicatae Design, 2010 April)	RhodeIsl and School of Art (RISD, 2010 April)	School of the Art Institute of Chicago (SAIC, 2010 April)	University of Oregon (UO, 2010 April)	Fashion Institute of Technology State University of New York (FIT, 2010 April)	New York Institute of Technology (NYIT, 2010 April)	Maltepe University (Maltepe University, 2010 April)	Yasar University (Yasar University, 2010 April)	Isık University (Isik University, 2010 April)	Okan University (Okan University, 2010 April)	Istanbul Technical University (ITU, 2010 April)	Mimar Sinan Fine Art University (MSGSU, 2010 April)	Karadeniz Technical University (KTU, 2010 April)	Halic University (Halic University, 2010 April)	International Cyprus University (CIU, 2010 April)	Kadir Has University (KHAS, 2010 April)	Near East University (Near East University, 2010 April)	Dogus University (Dogus University, 2010 April)	Kocaeli University (Kocaeli University, 2010 April)	Arel University (Arel University, 2010 April)	Cankaya University (Cankaya University, 2010 April)	Bahcesehir University (Bahcesehir University, 2010 April)	Izmir Economy University (Izmir Economy University, 2010 April)	Culture University (Culture University, 2010 April)	Hacettepe University (Hacettepe University, 2010 April)	University of Anatolia (University of Anatolia, 2010 April)
Course	Interior Design Studio	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Environmental Design																							■						■	■		■	
	Basics of Furniture Design	■			■	■	■		■		■	■	■	■	■	■		■	■	■		■	■	■	■	■		■	■	■	■	■	■	■
	Computer Aided Design							■		■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■		■	■	■	■	■	■	■
	Principles of Design with Color	■								■		■	■	■	■	■		■			■													■
	Principles of Product Design			■				■	■																				■					
	Materials Exploration	■						■		■		■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■		■
	Principles of Interior Lighting	■							■	■	■		■	■	■		■	■		■	■			■			■							
	Exhibition Design						■																											
	Light/Sound/Motion												■																					
	Interior Textiles						■									■		■																■
	Basic Design			■	■	■	■	■	■					■	■	■		■		■	■	■	■	■	■		■	■	■	■		■	■	■
	Ecology and Built Environment			■							■		■			■									■					■	■		■	■
	Residential Interior						■						■																					
	Human Factors									■				■		■		■			■			■				■		■				■
	Const. Management /Finance						■			■		■	■	■	■			■	■	■		■	■	■	■	■			■	■	■		■	
	Two Dimensional Design																■	■																
	Three Dimensional Design																■	■											■					
	Basic Photograph														■		■	■																
	Acoustic																				■								■			■		
	Building Physic															■			■				■			■	■		■					

(to be continued)

Course	Model Making
	Portfolio Preparation
	Presentation Techniques
	Technical Drawing
	Freehand Drawing
	Perspective
	Geometry of Designers
	Visual Culture of Art and Design
	Contemporary Design
	History of Interior Design
	History of Architecture
	History of Art
	Liberal Arts
	Interior Design Problems
	Design Communication
	Interior Const. Contracts
	Interior Const. and Detailing
	Principles of Accessories
	Social Science/Philosophy
	Mathematics
	Academic English
	Installation
	Restoration
	Design Culture
	Legal Issues
	Ergonomics
	Art Sociology
	Interior Design Theory
	Introduction to Turkish
	History of Turkish Republic

Upon studying the contents of the curricula of internal decoration departments of different universities, it has been observed that these consisting of studio courses provided for the purpose of shaping the students' identities as designers and developing their creativities, and also theoretical courses for the purpose of providing them with professional knowledge. It has also been observed that in the more advanced stages of studies, the percentages of theoretical lessons diminish, while that of studio courses increase.

Upon studying the contents of all courses, it has been observed that these contents are structured according to a traditional conception of design and training. A good example is given by the experimental manual work by students for the Basic Design Course (see Figure 1).

Currently, the fact that computer software should be an absolutely necessary element of design is beyond discussion. This notwithstanding, a study of existing interior architecture training programs has shown that very little time is being allocated for computer supported design courses. As for the contents of these courses, it has been discovered that the only programs being taught are those like AutoCAD (computer aided design) and 3Ds Max, which have the purpose of creating the shape in a digital environment. In addition to this, it has been observed that instead of encouraging the use of computer programs in the design and presentation of projects, courses like Presentation Techniques, Freehand Drawing and Perspective that lead students to use means like paper and pencil are being preferred.

Figure 1. The students' works for Basic Design Course (Anılanmert, 2010).

It is doubtless that knowledge of materials is the basis of design. In other words, a designer who does not have deep knowledge about the physical characteristics of materials cannot exercise his or her profession in a competent way. However, a study of the contents of courses related to the use of materials within the curricula of interior architecture departments has shown that the most space within these courses is given to the materials like wood, metal, glass and ceramics, the use of which goes back to a remote past. This is unfortunate, because in parallel to the progress of our times, many new materials are being introduced, but these materials, which are not within the scope of courses, make up the essence of present day designs.

In interior architecture, it is very important for a designer to be knowledgeable about production systems as well as materials. A study of the contents of the courses on this subject within the existing educational system has shown that traditionally known production systems are being taught. Instead, it is extremely important to teach students new production methods that will bring new perspectives to the quest for forms in design, rather than limit their knowledge to older systems.

The profession of interior architecture is an area of experimentation and it is for this reason that a student is expected to execute as many applications as possible during the process of training. However, a study of the existing educational systems has shown that within many programs, some courses like Principles of Design with Color and Principles of Interior Lighting, which should be carried out both theoretically and practically, are being delivered solely at a theoretical level.

In other words, the conclusion has been reached that the structure of present-day interior architecture education has not changed substantially from that of many years ago and that if it remains like this, it cannot provide answers to present-day expectations.

At this point, a study of related publications has been carried out to determine whether or not studies for the reform according to present-day circumstances of existing interior architecture training systems had been conducted, so as to be able to determine with more precision the scope and aim of this study. As a result of this study of publications, it has been observed that there had been many studies proposing the introduction within the educational system of digital approaches to design. Within these studies, Cinici (2009) stated that the integration of digital approaches to design into the educational system would lead design offices active in the market and construction companies to enter into intense cooperation with universities, and that this situation will create new opportunities for students within this sector. As for Szalapaj (2005), he stated that the use within the training process of technologies with calculations based on mathematics and logic aiming to solve the complex nature of design, would make it possible for dynamic, relation-based and generic designs to be created. Hennessy, Patterson and David (2003) stressed the fact that up to now the institutions offering digital design practices were international institutions offering post-graduate research opportunities, but now that the design process was beginning to be shaped by new developments, these kinds of approaches had to be integrated at the undergraduate studies level. Wang and Duarte (2002) proposed that digital instruments be used to transform modern design training studios into areas of experimentation and play, and this kind of transformation would raise the creativity of students to the highest level. In their study, Gurbuz and Cagdas (2009) stated that the positive effects of algorithms as a productive material on creativity were certain beyond discussion. In addition to this, in the same study it was also stated that by intervening with various codes and texts in digital design instruments, it would be possible to benefit from the environment's productive process and potentials at the highest level, and in this way it would be possible to create borderless environment of original design. Karalis (1997) stated that a designer expressed himself or herself by means of drawings and that the practicability of a design was correlated to how well it was expressed. He also stressed the fact that the use of digital design instruments would increase the expressiveness and applicability of designs with a complex geometry. Rocha (2004) supported this view and stated that thanks to digital design instruments it would be possible to create and produce much more complex geometries. In her study, Cinici (2009) stated that in 1919-1933, the Bauhaus School wanted to introduce practical-productive skills into the educational environment, and that, as a result of the fast progress of calculus based on technologies, this had become inevitable for universities to provide design training. Thanks to these instruments, design would become a process, the production of which could be tested and reviewed on the basis of the information obtained from these tests (Sheil, 2008). The integration of correct software into the thought processes as a part of training, and experimentation with alternative overtures through various script languages would be important from the point of view of the creation of contemporary conceptions of design (Curl, 2000). In other words, digital design manifested itself as a design method that presenting many layers of information, in a way where they were all related among each other (Belek, 2009). For example, the "Gorilla House" and the "Penguin Pool" designed by Berthold Lubetkin for the London Zoo are among the earliest examples demonstrating this kind of superiority of digital design practices (Cinici, 2009). Kolarevic (2003) stated that with the use of digital technologies in design training, it would become possible to create simulated environment by means of photo-realistic visual instruments, and support the interactive process of design training by distant command digital technologies like the internet and the intranet. He also stated that for the purpose of raising the quality of education and carrying it over to international platforms, it was by now necessary to carry out the design in a digital environment. Derinboga (2009) stated that by using digital design instruments it would become possible to follow a way through which the whole was reached by means of various production technologies, and that in this way, it would become possible to produce intelligent-interactive designs, the production of which was not possible by means of traditional design methods. Digital design instruments also made it possible to be knowledgeable about the design limits of materials and use these limits as design variables (D. Harris & S. Harris, 2007). Sener and Tosun (2009) stated that one of the ways of creating original synergies in present-day circumstances was to use computer programs within the design process would underline the natural capacities of materials and the production processes. He also stated that digital design was a multi-faceted design medium, since it facilitated and accelerated oral, numeric and visual communication among customers-designers, teachers-students and similar groups within the design process, and it also documented what was going on thus making it possible to follow and question processes, and use time in the most effective way.

As a result of these studies of related publications, a lot of information about proposals for the use within the educational system of digital approaches to design and the advantages of this have been found. However, no proposal for the restructuring of the interior architecture educational system with digital design instruments has been found in these studies.

Purpose

The scope and aim of this study have been determined as being to propose a hybrid educational model for the integration of digital approaches to design into the internal architecture educational system.

Methodology

Within this determined scope and aim, the study's methodology requirement for the first stage was to study within the context of various applications of the algorithmic and parametric approaches as digital design instruments, and come to conclusions about the advantages brought to the design process. In the next stage of the study, the advantages and disadvantages of digital approaches to design in comparison to traditional design methods in internal architecture, in the light of the results obtained from digital design applications, and also the information found during the study of related publications carried out at the beginning of the study, would be put forward. As for the last stage of the study, a proposal would be made for a hybrid educational model aiming to restructure internal architecture education and design studios as areas of experimentation with digital design instruments.

A Study of Digital Approaches to Design on the Basis of Examples of Applications

While parametric design, one of the digital approaches to design, was a technique that ensures the holistic control and management of objects, the algorithmic design, is a method by which simple components are used to obtain complex shapes and structures (Terzidis, 2006; Meredith, Lasch, & Sasaki, 2008). The instruments that make possible algorithmic and parametric design approaches or that created them were scripting languages found in 3B modeling packages (like Mel-Maya, 3DMaxScript and RhinoScript) and relational and modeling environments like GC (generative components) (Hırschberg, Sokmenoglu, Gurbuz, Aslan, & Cagdas, 2009). It is possible to use these programs made up of typologies based on rule-based logic, structural codes and language, to obtain spaces and shapes. In other words, digital design turns the computer environment into a design-research environment where analytical thought is taken up (Gun, 2009). As for the approaches concerning the use of digital design instruments, they can be classified under three main headings. They are (Hight & Perry, 2006):

(1) The use of technology in the initial stages of design with the aim of creating forms;

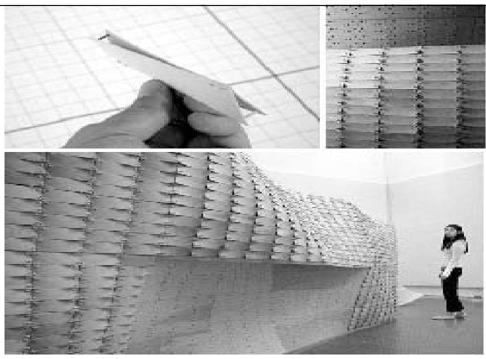
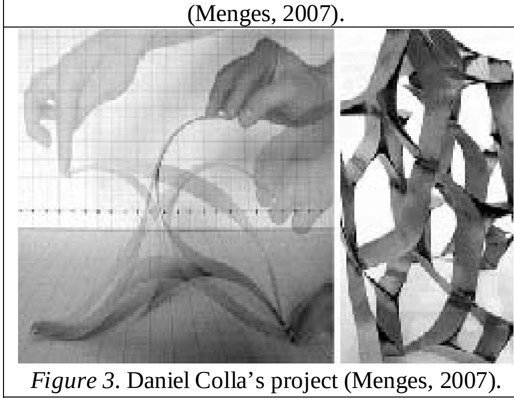
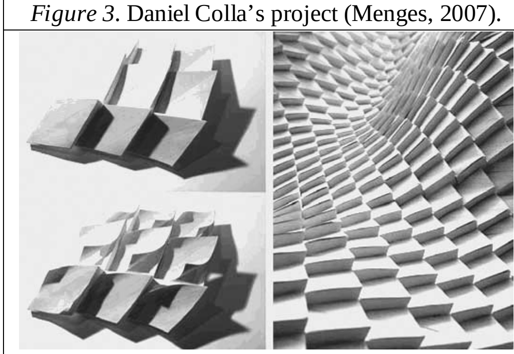
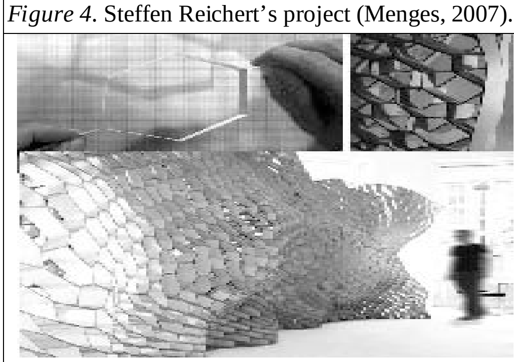
(2) The detailed testing of the product at the stage of developing the design, by means of various modeling software;

(3) The production of design through the representation by means of analytical and dynamic models of design parameters and various factors.

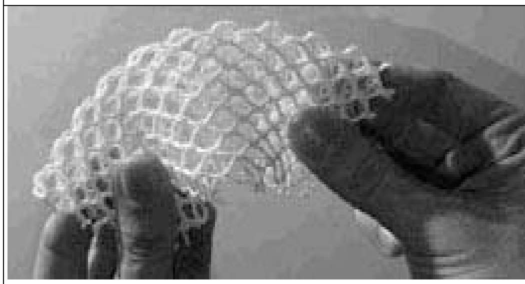
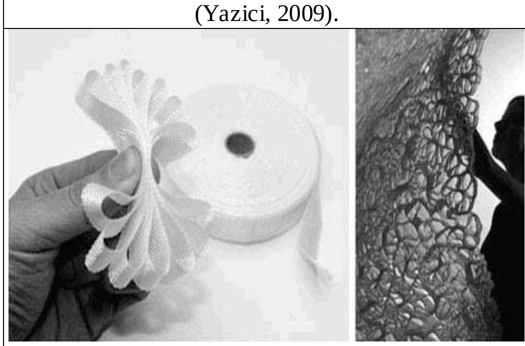
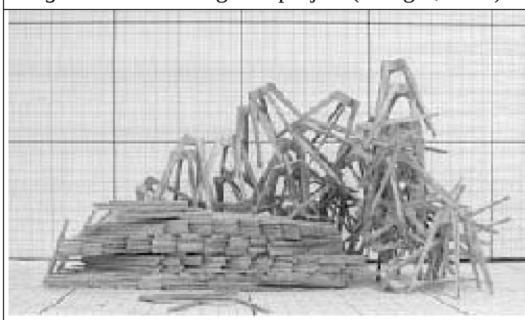
Some of the practices carried out on the basis of one or more of these approaches and the advantages provided by digital design instruments in the case of these practices can be defined as seen in Table 2.

Table 2

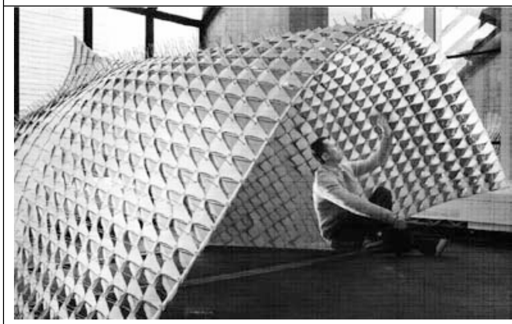
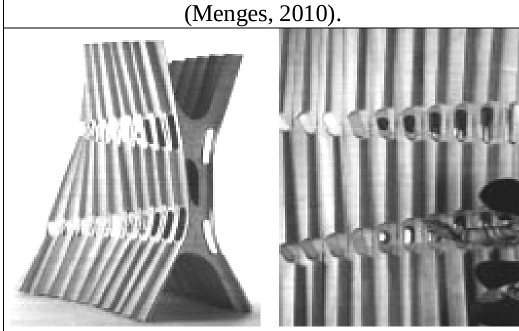
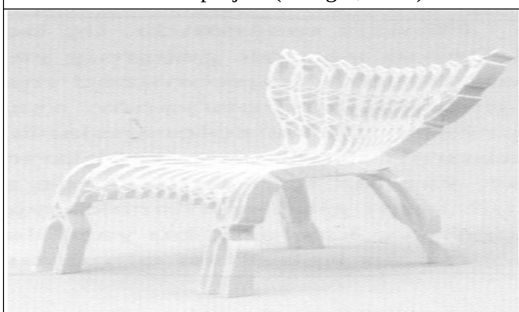
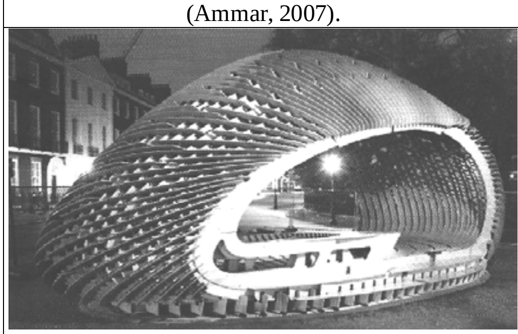
Results Obtained From Projects Concerning the Advantages of Digital Design Instruments

Project	Contents of the project	Results
 *Figure 2*. Joseph Kellner and Dave Newton's project (Menges, 2007).	In Joseph Kellner and Dave Newton's "Metapatch Project", 48 equivalent patches, 1,920 similar elements and 7,680 screws were used to form a surface. At first, this surface was completely flat and flexible. Following the installation, the screws were activated with data communicated from the computer, with the result that it became self-supportive, and gained a design balance with its concave and convex surfaces (Menges, 2007; Yazici, 2009).	This project proved that it was possible to create complex systems with simple elements and that a complex form could be produced without errors.
 *Figure 3*. Daniel Colla's project (Menges, 2007).	In this project by Daniel Colla, three steel panes were attached to each other by their corners, and the data about this product, its structural behavior and geometric limitations, were turned into a parametric system by means of experimental design instruments. The structural behavior of the system, and its interaction with light, had differentiated the single elements at a local level and the groups of elements had been affected by this in their entirety (Menges, 2007; Yazici, 2009).	Realized with the aim of increasing the system's performance, this project showed us that it was possible to approach the principles of high functionality and integration in nature in a much more basic way.
 *Figure 4*. Steffen Reichert's project (Menges, 2007).	In this project by Steffen Reichert, the moisture absorbing characteristic of wood was taken as a basis, and a shell system with a performance was created by means of digital design. In this system, it was observed that even though the structure remained static, the material reacted dynamically to the environmental factors, with the result that it changed the morphology of the design (Menges, 2010; Yazici, 2009).	This project showed us that the highest degree of control over the physical characteristics of materials was possible.
 *Figure 5*. Andress Kudless' project (Yazici, 2009).	In Andrew Kudless' project, the hexagonal shape of honeycombs was transferred into the digital environment. The dimensions, shapes and inclinations of the cells were changed by regulating them within a digital model, with the result that the design was formed (Menges, 2007; Yazici, 2009).	This project showed us that each single component can be changed in connection to various mathematical algorithms and in a way where they all complemented each other.

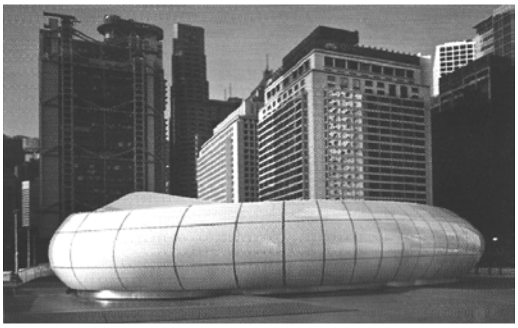
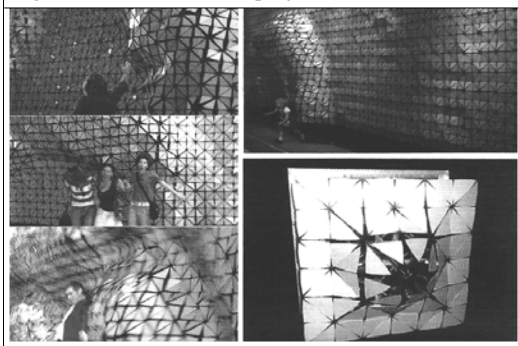
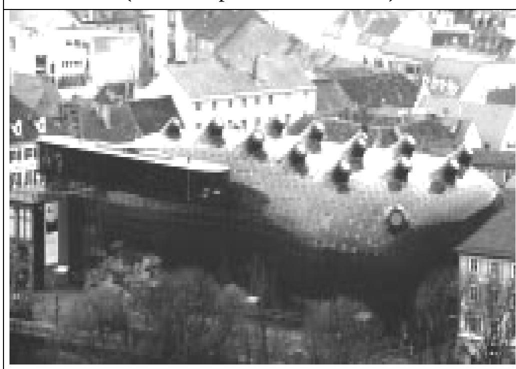
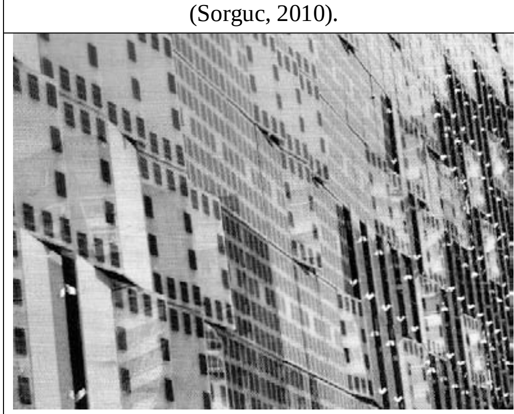
(to be continued)

There was no figure of the project.	In Müge Belk's "Sesmekan" project, the parameters of sound deriving from its physical characteristics defined the variables of the differential equation. These parameters were the intensity of the sound, its speed in different environments, and the rhythm of the sounds produced (Belek, 2009).	This project showed us that the sound could be transformed in its entirety into a concrete object in space.
 *Figure 6*. Nico Reinhardt's project (Menges, 2007).	Nico Reinhardt's project contained the method of establishing local control in a continuous system. The systems of materials were made to organize themselves when subjected to certain forces and directives (Menges, 2007).	This project showed us that the local deformations of a system could be pushed forward without the morphology of the entirety changing.
 *Figure 7*. Architectural Association's project (Yazici, 2009).	In this project, 600 different components and 150 membranes were used. The membranes afforded complete protection from the rain, and decreased the pressure of wind thanks to the voids in them (Yazici, 2009).	This project showed us that the reaction towards environmental conditions of a shell system formed after having done analyses of structure, solar light, wind and rain, could be made to become strategic.
 *Figure 8*. Elena Burgraf's project (Menges, 2007).	Elena Burgraf's project was shaped by means of folding and merging tapes of glass fiber. Stress analyses were carried out by means of a model with parametric calculations, and this data was reflected by means of a projection method developed especially for physical form studies (Menges, 2007; DeLanda, 2004; Yazici, 2009).	This project showed us that during the design process the geometric certainty concept could be turned into a shape that could be rethought.
 *Figure 9*. Anne Hawkins and Catie Newell's project (Yazici, 2009).	In Anne Hawkins and Catie Newell's project, the behavioral inclinations, capacity to organize itself and usage probabilities of the friable aggregate system have been studied (Menges, 2007; Landa, 2010; Yazici, 2009).	This project showed us that the highest degree of control over the physical characteristics of materials was possible.

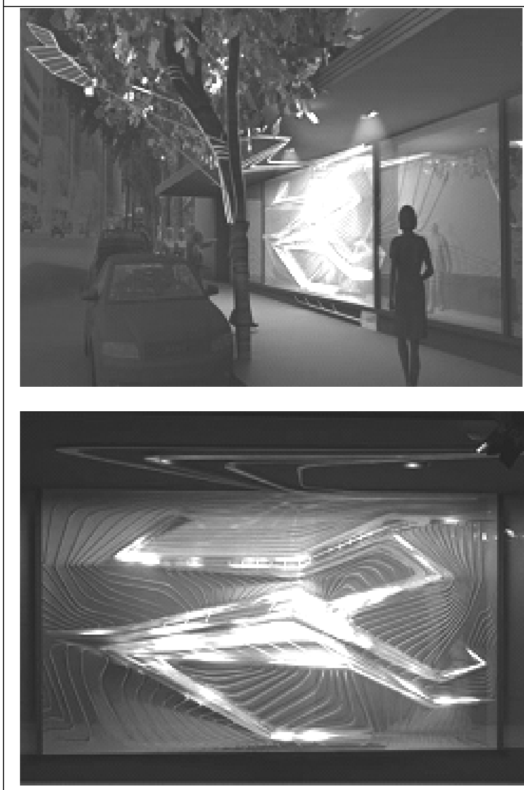
(to be continued)

There is no figure of the project	In Deniz A. Yazicioglu's project a connection has been established between a three dimensional model and cost, thus creating a design where the product and the cost were interactive (Yazicioglu, 2009).	This project shows us that the cost variable could be made to affect the design at its every stage.
 *Figure 10*. Jian Huang and Minhwan Park's project (Menges, 2010).	In Jian Huang and Minhwan Park's project, a curved form has been created by means of wooden pieces increased incrementally and transformed. Partial surfaces, which at the very beginning were straight and flexible, were turned into a mathematical model with convex and concave surfaces, by using numerical calculation methods (Menges, 2010).	This project showed us that it was possible to obtain polymeric systems by means of the interaction between the capacity of materials and environmental effects and forces.
 *Figure 11*. Marco Baur, Fred Emst and Max Vomhof's project (Menges, 2010).	This project of Marco Baur, Fred Emst and Max Vomhof, consisted of a self-supported surface consisting of repeated elements of laminated wood material (DeLanda, 2004).	This project showed us that new production systems could be produced.
 *Figure 12*. Ammar Eloueini's project (Ammar, 2007).	Ammar Eloueini's parametric chair with infinite alternatives was designed with numeric methods, and produced with a three dimensional printer (Sorguc, 2010).	This project showed us that a prototype could also be the final product, and also that numeric design, production technologies and the ways that materials typical of these technologies were inserted into the design were definable.
 *Figure 13*. Alan Dempsey and Alvin Huang's project (Dempsey & Huang, 2008).	In Alan Dempsey and Alvin Huang's C-Space project, 13 mm concrete panels reinforced with fiber, which were generally used as coating material, were used. Another difference within the scope of the project and particular to the way the concrete is used, is the fact that C-Space is a temporary pavilion (Sorguc, 2010).	This project showed us the active role that numeric design instruments could play in the innovative and optimum use of traditional materials within the scope of the design-production-material trio in the sustainability debate.

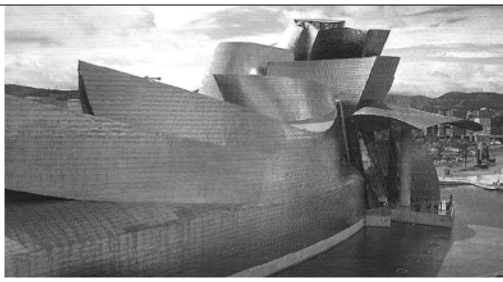
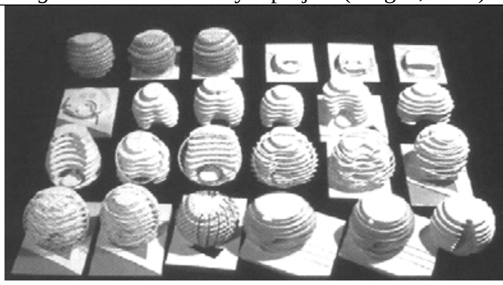
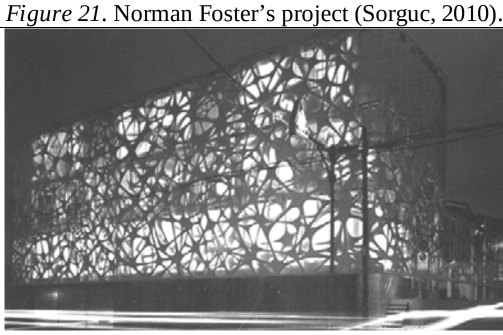
(to be continued)

 *Figure 14*. Zaha Hadid's project (Nikiomahe, 2008).	Zaha Hadid's "Mobile Art Pavilion" project consisted of a mobile container, where organic forms inspired by nature are parametrically transferred into a digital environment, and where form and structure are designed and produced numerically. The covering of the façade, where a different series of arch structures was used, was produced with no errors (Sorguc, 2010).	This project showed us that the space could be supported and turned into a modular state also at the level of structure.
 *Figure 15*. Mark Goulthorpe and Deconi's project (Goulthorpe & Decoi, 2003).	Mark Goulthorpe and Deconi's "Hyposurface" project has produced a surface that interacts with metal modular kinetic systems. Here, the whole surface presented a dynamic behavior (Sorguc, 2010).	This project showed us that interactive and intelligent designs could be produced.
 *Figure 16*. Peter Cook and Colin Fournier's project (Sorguc, 2010).	In Peter Cook and Colin Fournier's "Kunsthause" project, Plexiglas and neon lamps have been put together as if they had been a single material, and the hybridized surface has been modeled with numeric technologies, creating a communicative interface (Sorguc, 2010).	This project showed us that hybrid materials and production systems could be produced.
 *Figure 17*. Simone Giostra's project (Sorguc, 2010).	In Simone Giostra's "Solar Media Wall" project, a glass screen was covered with led lights fed by photovoltaic cells (Menges, 2010).	This project showed us that in an environmentalist structure, hybrid systems could be formed and the technologies necessary for their production defined.

(to be continued)

 *Figure 18.* Tom Wiscombe's project (Emergent, 2010).	In Tom Wiscombe's "Yeosu Oceanic Pavilion" project, the designer has used the forms as design solutions, according to their performance, and having re-evaluated the supporting capacity of shapes he has created three dimensional models. In this project, he has taken color related decisions on the basis of mathematical models (Emergent, April 2010).	This project showed us that the supportive qualities of shapes could be rediscovered and that color can be added into the design by means of mathematical algorithms.
 *Figure 19.* Tom Wiscombe's project (Emergent, 2010).	Tom Wiscombe's project was an aquarium-like bioreactor inserted into the façade of the building, which contains green algae colonies that produced oil through photosynthesis. The aquarium was made of thick transparent acrylic, molded to create the intricate relief on the front. This relief tracked along with and supported an internal lighting armature which was based on the Bio-feedback Algae Controller, invented by Origin Oil in Los Angeles in July of 2009. This new type of bioreactor uses tuned LED lights which varied in color and intensity to support algae growth at different stages of development, maximizing output. According to Origin Oil, "This is a true bio-feedback system… the algae lets the LED controller know what it needs as it needs it, creating a self-adjusting growth system". At night, when this system intensified, it generated a simultaneously urban and jungle affect: glittery reflections on acrylic combined with an eerie élan vital of glowing algae (Emergent, April 2010).	This project showed us that light could be transformed into a material form.
There is no figure of the project.	Jason Payne has studied the way digital design instruments can be used to catch feelings and their effects on form. By calling this study "softspace", he has specified both the spaces between the structures and humans and those between machines and the body. While studying this kind of experience feelings, the designer has followed a way through which the whole can be reached by means of production strategies (Gun, 2009).	This project shows us that interactive designs are possible.

(to be continued)

 *Figure 20*. Frank Gehry's project (Sorguc, 2010).	Frank Gehry's Guggenheim Museum, which was completed in 1997, could be considered to be the beginning of a new period in the use of numeric design and production technologies in architectural design. This project consists of a building where flowing forms are integrated with titanium glass and plaster stone (Sorguc, 2010).	This project showed us that that the tectonics, design processes and production methods of designs could be changed.
 *Figure 21*. Norman Foster's project (Sorguc, 2010).	CAD/CAM technologies were used in the designing stage of Norman Foster's Greater London Authority Headquarters building (Sorguc, 2010).	This project showed us that the design could be tried out with a high degree of sensitivity together with the design process and that it could be viewed over a three dimensional model of it.
 *Figure 22*.Thom Faulders' project (Faulders, 2007).	In Thom Faulders' project for a residence in Tokyo numeric design instruments have been used to design a metal facade (Sorguc, 2010).	This project shows us that numeric design instruments can be used not just to integrate natural and artificial light, but also obtain by calculation the web that would collect rain water from the facade.

The examples listed in Table 2 are just a few of the numeric design applications studied within the scope of this study. In addition to these, Tom Wiscombe's Thermo Strut-Los Angeles 2009, Tracery Glass-Los Angeles 2009, Lizard Panel-Los Angeles 2009, Perth Photobioreactor-Perth 2009, Garak Fish Market-Seoul 2009, Sundsvall Performing Arts Theater-Sundvall 2008, Taipei Performing Arts Center-Taipei 2008, Huaxi Urban Centre Tower-Guiyang 2008, Batwing-Matters of Sensation Exhibition Artist Space 2008, Cheongna City Tower-Incheon 2008, Mersey Observation Deck-Liverpool 2008, European Solidarity Center-Gdansk 2007, Novosibirsk Summer Pavilion-Novosibirsk 2007, Shenzhen Museum of Contemporary Art-Shenzhen 2007, Dragonfly-SCI Art Gallery 2007, National Library of the Czech Republic-Prague 2007, Stockholm City Library-Stockholm 2007 and Paris Courthouse-Paris 2006 projects (Emergent, April 2010); Syskowitz Kowalski's New Terraces Hamburg-Hambury 2008 and Humatic Headquarter-Graz 2007 projects (Sykowitz Kowalski, April 2010) and Buro Happold's Voussoir Alexandra Arch-Singapore 2009 and The Rensselaer Polytechnic Institute 2008 projects (Buro Happold, April 2010) have been studied, and at the end of all these studies it has been observed that the use of numeric design instruments provides the opportunity of following and making flexible the process of design, and having set it up parametrically to be able to make small changes without ruining the whole system. It also has been observed that it made it possible for the experience design and space far from the limitations of the physical world during design training, and that it provided the opportunity to set up new kinds of organizations for the sharing of information.

The digital environment is not just a platform where designs can be produced, tried out and developed visually, but also something that makes it possible to redesign design. In addition, it makes it possible to create a virtual design studio where, independently of time and place, designers in different geographical locations can share the same space. Within this context, it is obvious that the aims, processes and acts of designing something with digital design instruments for the real world, will be different from traditional methods.

The Presentation of the Advantages and Disadvantages of the Digital Approaches to Design in Comparison to the Traditional Methods of Design in Interior Architecture Education

Contrary to what happens in digital environments of a traditional kind of design education, the instructor and the students will be facing each other, interacting. In this method, the production of design is done mostly by means of technical drawings on paper or physical models. In other words, the processes and results of design training are different in the case of digital design and traditional design. It is for this reason that at this stage of the study, the advantages and disadvantages of digital approaches to design in comparison to the traditional design method within interior architecture education, have been presented in the light of the results obtained from numerical design applications, and also the information obtained during the study of relevant publications conducted at the beginning of the study (see Table 3).

Table 3

Comparison Between Digital Approaches to Design and the Traditional Approach to Design

	Comparison between digital approaches to design and the traditional approaches to design
Advantages	1. All of the information, data and limitations of design could be taken up at the same moment, and dynamic designs, which have a complex geometry where many layers of information can be used in interconnection, can be created (Yıldırım & Ozen, 2008).
	2. The principles of the high functionality and integration level in nature can be approached in a much more basic way.
	3. Systems established by means of hierarchical and/or geometric relations can make it possible to produce and evaluate many designs prepared on the basis of the same idea (Gun, 2009).
	4. An area of “thought-practice” can be created by producing and trying out material prototypes in design solutions (Sheil, 2008; Cinici, 2009).
	5. The way materials typical of numerical design and production technologies are placed within designs can be defined.
	6. Original design environments can be created by generating patches by means of various “script languages” (Cagdas, 2005).
	7. Conceptual thoughts can be made to be interconnected within the framework of rules determined by the designer (Derinboga, 2009).
	8. Organized hierarchical order can be established by means of sub-systems that have been multiplied and transformed (Kolarevic, 2003).
	9. The designer’s knowledge of the materials’ physical characteristics can be raised to the highest level. The design limits of materials can be used as design variables (D. Harris & S. Harris, 2007).
	10. The material’s can be used to generate polymeric systems obtained by the interaction of external environmental effects and forces (Colakoglu &Yazar, 2009).
	11. The compound logic of shaping and material choice encoded in computerized calculation methods can be used to define hybrid materials and production systems.
	12. The supportiveness of shapes can be rediscovered.
	13. In sustainability debates, the innovative and optimum use of materials within the design-production-material trio can be ensured.
	14. In design, it might become possible to join processes like design decisions and production techniques that function in different ways and create connections among them. In this way, no matter how complex the final product is, its expression and practicability might be possible (Menges, 2010).
	15. The shape repertoire can be expanded by means of curved linear surfaces and biomorphic shapes (Menges, 2007).
	16. Interactive materials and systems can be created.
	17. The space can be made to be mobile and modular at the structural level.

(to be continued)

	18. Designs that can be processed and reproduced with parameters can be attained. In addition to this, the testing of the designs produced by means of performance criteria integrated into the systems can become possible (Belek, 2009).
	19. Local deformations that do not change the morphology of the design's entirety can become possible.
	20. Multi-faceted contributions that speed up the oral, numeric and visual communication between different disciplines within the design process and that make following possible thanks to documentation become possible.
	21. In the produced course materials, the mistakes can be minimized and archiving and accessibility can be attained (Karalis, 1997; Spiller, 2006).
	22. A cooperation platform can be created for team work, and the potential of this environment can be analyzed (CurI, 2000)
	23. Experimental design instruments can be used to produce many systems with a potential for development. The degree of complexity of such systems can be increased with many parameters and they can be made to acquire characteristics that make it possible to respond to different requests and performance needs.
	24. Developments in digital design and the new opportunities arising from the fact that this was reflected on the other areas of engineering (intelligent materials, programmable objects, etc.) may make it possible in the future to obtain designs that can organize themselves (Gurbuz & Cagdas, 2009).
	25. The development of the students' individual processes might be triggered by encouraging pluralistic approaches.
	26. A parametric model based on geometric relations, joined with the material limitations of computer supported production means, makes it possible for every digitally defined system to be produced (DeLanda, 2004).
	27. Once digital technologies begin to be used in design training, students will be able to carry out their exercises on two-dimensional drawings, and three dimensional models. Simulation environments might be created with computer supported photo-realistic visual instruments (Kolarevic, 2003).
	28. Coding in the interface of programs might make it possible for users to produce additional instruments and to have these instruments used for specific designs (Colakoglu & Yazar, 2009).
Disadvantages	1. Since each experimental design instrument incorporates a different and complex way of conceptualization and understanding, it requires time and effort. It is for this reason that integrating information and communication technologies with the design education and design process will require not just the information about the usage probabilities of these new technologies in the design process, but also the information about the methods and techniques related to the way that the design will be supported, to be transferred to students (Yildirim &Yavuz, 2010).
	2. The cost of the equipment and software needed to create the working environment of the designer is high.
	3. Due to the dynamism of the computer world, ongoing progress might quickly make absolutely all the opportunities provided to students (Yildirim & Ozen, 2008).
	4. For the design training to be in harmony with technology, both the contents of courses and the knowledge of students and professors have to be constantly updated (Spiller, 2006).
	5. In case coding work becomes necessary, the greatest difficulty will be to instill a logic of abstraction that is much different from design. The fact that coding does not admit error might lead many students to abstain. All of these difficulties might be overcome with individual critics and technical works done with the students (Meredith et al., 2008).

At the end of all these studies, and thanks to the digital design instruments, a designer will, contrary to the traditional method of design, acquire an identity whereby, he or she will design algorithmically (morphogenesis), carry out digital modeling (fast prototyping), construct robotically (new tectonics/designs), live interactively (intelligent spaces), communicate instantly (pantopicon: the state of being in more than one place at the same time), be totally informed (flowing designs), socialize without being local (areas that are not local) and transfer virtuality into reality (being beyond space). Within this context, it is thought that integrating digital design instruments into the internal architecture education system will make it possible to train designers with superior capacities. It is for this reason that in the next phase of this study, we shall make various proposals concerning the integration of digital design instruments into the internal architecture education system and in this way, an attempt will be made to create a new model for the internal architecture education.

Proposal for a Hybrid Educational Model Aiming for the Integration of Digital Approaches to Design Into the Internal Architecture Education System

Rather than transferring the traditional creative process into a digital environment, it seems more rational to design a new design process with digital design instruments for the internal architecture education environment (Akcadogan, 2006). This is the reason why it is thought that the internal education model that will be proposed within this study will be a hybrid model integrating digital design methods with the traditional design process. The general structure of this model is indicated in Table 4. As this model is being produced, the courses in the 33 separate universities in Table 1 are taken into consideration and a proposal is made to change the contents of some of these courses so as to make it possible for them to be integrated into digital design instruments (see Table 4).

Table 4
The General Structure of the Educational Model

Year	Course	The purpose of course	The structure of the course	The approach of the course
I	Design grammars studio	It is a studio lesson, the aim of which is to turn the grammar of shape as a way of thinking based on calculation and the logical methods it includes, into knowledge that can be used. In this lesson, the calculus and mathematical phenomena at the base of the shape grammars theory will be explained and applied.	Theoretical/ Practice	Digital design approach
	Design approach studio	The aim of the lesson is to think of digital design in terms of numerical symbols. This lesson will be structured in a way that lets it support the theoretical knowledge concerning digital design, and that teaches students the scripting where this theory is applied. In this lesson, where the knowledge of scripting is taught to students within a constructivist teaching model, the students will be asked to use the grammars learned in the Design Grammars Studio lesson to develop a creative system by using the script in a formal language.	Theoretical/ Practice	Digital design approach
	Computer aided design	The aim of the lesson is to teach programs like AutoCAD and 3ds Max so as to be able to use digital design instruments in a digital environment.	Theoretical/ Practice	Digital design approach
	Interior design studio	The aim of the lesson is to be able, in case of interior space ordering projects, to define the existing spaces, determine the needs, study the elements that will be the data of the design and make a project out of the analysis of all this knowledge. In this lesson, theoretical knowledge concerning digital design will be supported, and the script languages which this theory is applied will be taught to the students.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Basic design	The aim of the lesson is to explain the shape and visual definition of the design, the basic concepts, elements, principles and functions of art and their connections with each other, and to experience in a practical way all this knowledge with digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Basic of furniture design	The aim of the lesson is to analyze the problems arising from the connections between people, space, furniture and design, understand the principles related to application, and develop the students' practical skills in the light of this knowledge. In other words, the aim is to design furniture in the light of all these theoretical knowledge that has been acquired, using digital design instruments, have obtain this furniture in the virtual environment and discuss the problems related to production and usage.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Human factors	The aim of the lesson is to explain the basic knowledge about sociology, social psychology, anthropology, anthropometrics, psychology of perception and ergonomics, with the understanding that all designs should respond to the needs of the user and the expectations of the society.	Theoretical	–

(to be continued)

	Technical drawing	The aim of the lesson is to explain the history, importance and concepts of technical drawing, and the factors and methods concerning the perception and understanding of digital design instruments in technical drawing. In addition, the aim is to understand objects, obtain plans, cross sections and views, organize the sheet of technical drawing, explain the standards of writing, lines, shading, scaling and indication, and apply all of this knowledge with digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Materials exploration	The aim of the lesson is to explain the definition, characteristics, shaping and preservation of materials, and then teach the connection within the design of internal space among shape-material-application, with digital design instruments.	Theoretical/ Practice	Digital design approach
	History of architecture and interior design	The aim of the lesson is to explain the factors that throughout history have affected architecture and interior architecture and their connections with the other branches of the arts, and to explain the historical development of these two professions since ancient times, and the effects on each other.	Theoretical	–
II	Interior design studio	The aim of the lesson is to study in detail and determine the elements that will be the data necessary to explain spaces within design, and having analyzed this data, to prepare projects. During the lesson, students will intervene in the existing software with codes and scripts, thus creating their own design environments and developing new design techniques.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Basic design	The aim of the lesson is to use digital design instruments to design two or three dimensional models in a way that will be the continuation of the first year Basic Design lesson.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Interior construction and detailing	The aim of the lesson is to inform students about the concepts of detailed structure, the elements of detailed structure, the structure of surfaces, covering systems, girded systems, and systems with head pieces, systems with frames and slabs and the construction system. In addition to this, wooden window-frames, rough wooden frames, rough structures, the relations between frames and wings, double wings, fixed panes, windows with central post, lintel, dripper, ledge, sliding system or axis, and insulated windows will make up the contents of the lesson. The students will be asked to draw the theoretical knowledge acquired during the lesson by using digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Theory of design with color	The aim of the lesson is to teach theories of color and the use of color in the design of interior spaces. The students will be asked to apply the theoretical knowledge acquired during the lesson by using digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Principles of interior lighting	The aim of the lesson is to explain the basic knowledge concerning the lighting systems that will provide the ideal circumstances in the interior design. The students will be asked to apply the theoretical knowledge acquired during the lesson by using digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Computer aided design	The aim of the lesson is to make it possible for students to create their own design environments by adding patches to the digital design instruments learned during the first year Computer Aided Design lesson.	Theoretical/ Practice	Digital design approach

(to be continued)

	Building materials exploration	The aim of the lesson is to explain hybrid materials as a continuation of the first year Building Materials Exploration lesson, and make sure that students should be able to take into consideration the physical characteristics of these materials when using digital design instruments.	Theoretical/ Practice	Digital design approach
	History of architecture and interior design	The aim of the lesson is to explain the factors that throughout history have affected architecture and interior architecture and their connections with the other branches of the arts, and explain the historical developments of these two professions since ancient times, and the effects on each other, as a continuation of the first year History of Architecture and Interior Design lesson.	Theoretical	–
III	Interior design studio	The aim of the lesson is to study in detail and determine the elements that will be the data necessary for restoration within design, and having analyzed this data, to prepare restoration projects by using digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Installation	The aim of the lesson is to teach students all about the plumbing, heating and cooling systems that are necessary for a comfortable life in enclosed spaces.	Theoretical	–
	Restoration	At the beginning of the lesson, the history of drawing with scale will be studied. In the applied part of the lesson, the way a drawing with scale is done and its project prepared, will be explained with a practical exercise aided by the digital design instruments. In addition to this, the theory of restoration and the way it is practiced will be studied. Local and international examples of preservation will be studied.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Computer aided design	The aim of the lesson is to make it possible for students to create their own design environments by adding patches to the digital design instruments learned during the second year Computer Aided Design lesson.	Theoretical/ Practice	Digital design approach
	Building materials exploration	Explaining hybrid materials as a continuation of the second year Building Materials Exploration lesson, and making sure that students should be able to take into consideration the physical characteristics of these materials when using digital design instruments.	Theoretical/ Practice	Digital design approach
IV	Interior design studio	The aim of the lesson is to analyze all aspects of projects with a vast program, join this with a creative and original approach and professional attitude, and finalize it with the use of digital design instruments.	Theoretical/ Practice	Digital design approach/Traditional design approach
	Computer aided design	The aim of the lesson is to teach business programs and cost prediction programs.	Theoretical/ Practice	Digital design approach
	Construction management/Finance	During this lesson, concepts like cost and feasibility will be explained, and the students will be expected to prepare the business program and cost accounting of a project by using various programs.	Theoretical/ Practice	Digital design approach
	Ecology and building environment	The aim of the lesson is to explain in connection to interior design the methods known as ecological and sustainable construction criteria, the reduction of the use of limited natural resources, the minimization and optimization of energy use, and the safeguarding of human health.	Theoretical	–
	Legal issues	The aim of the lesson is to explain concepts like copy right, idea and art works law, patent law, brand law, and design law.	Theoretical	–
	Portfolio presentation	The aim of the lesson is to explain the formal choices related to the best and most professional way with which a designer can present himself or herself and his or her work, the concept and importance of portfolio, personal presentation, the establishment of the target group for the portfolio, and the basic principles concerning the presentation of projects in a way that reflect a person's style, and have students prepare their own portfolios with the use of computer programs.	Theoretical/ Practice	Digital design approach/Traditional design approach

The most important requirement concerning the application of this kind of educational system is to be able to explain to students the logic of digital design, and the way by which the equipment should be used. The proposal is to have two separate classes called Design Grammars Studio and Design Approach Studio at the beginning of the education process, with the aim of minimizing this problem. The Design Grammars Studio will be a studio course making it possible for the theoretical developments of shaping grammars as a numeric way of thought and the logical methods it contains to become knowledge that can be used within the design process. As for the Design Approach Studio, it will be a studio course which, contrary to the Design Grammars Studio, makes it possible to carry out digital design while thinking in terms of numeric symbols, and which uses within the design process what has been learned as a discovery activity. In other words, this couple of studio courses organized as Design Grammars and Design Approach will be structured as parallel courses, in which design interpretations with different calculations in the study and practice areas, are taken up together.

In the first part of the Computer Aided Design lesson, which will be taught from the the first year and continue for four years, programs like AutoCAD and 3Ds Max, which concern the way digital design instruments are used with the aim of presenting a shape, will be taught. In the following years, the students will be made to add various patches to these programs, thus creating their own design environments.

The Interior Design Studio lesson, which will be taught from the first year and continue for four years, will support theoretical knowledge concerning digital design, and will be structured in a way that makes it possible to teach the students the scripting, with which this theory is applied. In the studio, where the knowledge of scripting will be taught within a constructivist didactic model, the students will be asked to develop as a generating system within one of the existing CAD software programs the grammars including various patterns by using script in a formal language. As for the Interior Design Studio lessons in the following years, the students will be expected to intervene in the software they use with various codes and scripts to create their own design environments. In other words, all the design phases in the Interior Design Studio lessons will be developed with digital design instruments.

The Basic Design lesson, which plays an important role in the shaping of the students' identities as designers and developing their creativity, will be held over two years and digital design instruments will be used in these lessons. In other words, manual experimental work by the students will be produced by means of digital design instruments, and in this way the necessity of including many factors like sound, light and ergonomics into the design process will be shown in a practical way.

As for the Basic of Furniture Design, Technical Drawing, Material Exploration, Interior Construction and Detailing, Principles of Design with Color, Principles of Interior Lighting, Construction Management/Finance and Portfolio Presentation lessons, they will have theoretical and practical aspects. In the theoretical part of the lesson, conceptual information about the subject will be provided, while in the practical part, the students will be made to prepare designs by using digital design instruments appropriate for the content of the course. For example, in the Construction Management/Finance lesson, software for preparing studies over three dimensional models, formulating a proposal submission dossier and preparing a business program will be used, while in the Principles of Interior Lighting lesson, the programs to be used will be those that make it possible for students to experience in virtual reality the visual effects of light in various space designs with various mathematical calculations.

As for the Human Factors, History of Architecture and Interior Design, Legal Issues, Installation, Restoration, Ecology and Building Environment lessons, which will instill professional awareness in students, will be held at a theoretical level.

In conclusion, thanks to this proposed educational model, a hybrid system where digital approaches to design are integrated to the traditional methods will be established.

Results

With the integration of digital design instruments within the internal architecture education system, on the one hand, it will become easier for design to be analytically set up in a computer environment in the shape of dynamic systems, and on the other hand, it will be possible to reshape the process and conception of the design. The effects produced in this way will be reflected in products, new geometrical approaches and typologies will appear, with the result that designs and the digital instruments being developed will constantly evolve. In addition, while with traditional methods it is impossible for a student to understand fully and control all components and parameters, thanks to the digital design instruments, they will be able to take up all data and limitations at the same time, with the result that it will become possible to create designs with a complex geometry, by using many layers of information in an interconnected way. Students will not have even to remain within the limits of algorithmic and parametric approaches, since they will be able to eliminate these limits with the use of various scripts and algorithms, with the result that they will be able to create original work environment that can provide answers for different needs for performance. Training the designers of the future in the light of these approaches will make it possible to train professionals who correctly use and understand the developing technologies, who have a critical stance, and who can create renewable designs.

References

Academyart. (2010). *Academy of Art University: Curriculum of schools of architecture & design department*. Retrieved April 5, 2010, from http://www.academyart.edu/interior-design-school/index.html

Akcadogan, I. (2006). *Basic design education and digital media*. Epsilon Publications, Istanbul.

Arel University. (2010). *Arel University: Undergraduate curriculum of interior design department*. Retrieved April 5, 2010, from http://www.arel.edu.tr/arel/akademik/fakulteler/muhendislik_mimarlik/ic_mimarlik/dersler.html

Bahcesehir University. (2010). *Bahcesehir University: Undergraduate curriculum of interior and environmental design department*. Retrieved April 10, 2010, from http://www.bahcesehir.edu.tr/fakultesayfa/program/act/mimarlik/program/icmimarlik/id/0601

Belek, M. (2009). Design approaches beyond architecture: Sound and space. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 31-33). Istanbul.

Buro, H. (2010). *Projects*. Retrieved April 10, 2010, from http://www.burohappold.com/BH/PRJ_ALL_List.aspx

Cagdas, G. (2005). The reflection of evolutionary process of information technology to the architectural design education. *STUDIO Design Theory Criticism Journal, 2,* 27-31.

Cankaya University. (2010). *Cankaya University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://inar.cankaya.edu.tr/people_set.html

Cinici, S. Y. (2009). Parametric technologies and experience. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 5-7). Istanbul.

CIU. (2010, April). *International Cyprus University: Undergraduate curriculum of interior design department*. Retrieved from http://www.ciu.edu.tr/index.php?Itemid=315&id=129&option=com_content&task=view

Colakoglu, B., & Yazar, T. (2009). New pedagogical design education expansion. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 14-16). Istanbul.

Culture University. (2010). *Culture University: Undergraduate curriculum of interior design department*. Retrieved April 20, 2010, from http://www.iku.edu.tr/TR/text_version/bolum.php?id2=304&p=2&r=2&kategoriNo=105&id=1259&yon1=Fakülteler&yon2=Sanat%20ve%20Tasarım%20Fakültesi&yon3=İç%20Mimarlık%20ve%20Çevre%20Tasarımı&faId=598&row=1&a=1

Curl, J. S. (2000). *"Experimental architecture" a dictionary of architecture and landscape architecture*. Retrieved March 22, 2010, from http://www.encyclopedia.com

DeLanda, M. (2004). *Material complexity in digital techtonics* (p. 21). Chichester: Wiley Academy.

Derinboga, C. A. (2009). *Liquefaction technology*. Istanbul, ITU Publications.

Dogus University. (2010). *Dogus University: Undergraduate curriculum of interior design department* [PDF document]. Retrieved April 10, 2010, from http://www.dogus.edu.tr/pdf/bolum_plan/Dogus_505A.pdf

Emergent. (2010). *Projects*. Retrieved April 17, 2010, from http://www.emergentarchitecture.com/projects.php?id=29

FIT. (2010). *Fashion Institute of Technology State University of New York undergraduate curriculum of interior design department*. Retrieved April 11, 2010, from http://www.fitnyc.edu/2457.asp

Florence Design Academy. (2010). *Florence Design Academy: Undergraduate curriculum of interior design/furniture design department*. Retrieved April 11, 2010, from http://www.florencedesignacademy.com/

Gun, O. Y. (2009). Understanding and explaining digital design. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 8-13). Istanbul.

Gurbuz, E., & Cagdas, G. (2009). Process of digital design and production. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 24-27). Istanbul.

Hacettepe University. (2010, April). *Hacettepe University: Undergraduate curriculum of interior and environmental design department*. Retrieved from http://www.gsf.hacettepe.edu.tr/ict/ogr_lisans.html

Halic University. (2010). *Halic University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://www.halic.edu.tr/mimarlik-fakultesi/ic-mimarlik.program

Harris, D. M., & Harris, S. L. (2007). *Digital design and computer architecture*. Morgan Kaufmann.

Hennessy, J. L., Patterson, D. A., & David, G. D. (2003). *Computer architecture: A quantitative approach*. Morgan Kaufmann.

Hight, C., & Perry, C. (2006). *Collective intelligence in design*. A.D., Wiley-Academy, West Sussex.

Hırschberg, U., Sokmenoglu, A., Gurbuz, E., Aslan, S. A., & Cagdas, G. (2009). Experimental approaches in architectural education: Algoritmich/parametric design workshop. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 20-23). Istanbul.

Isik University. (2010). *Isik University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://www.isikun.edu.tr/akademik/detay_guzelsanatlar_icmimarlik.aspx?SectionID=AbhOEsVNPT4UwOqpEofMg w%3d%3d&ContentId=DDiJURIhIzWs9zy1yP2fDg%3d%3d

Istituto d'arte Applicata e Design. (2010). *Istituto d'arte Applicata e Design: Undergraduate curriculum of interior design department* [PDF document]. Retrieved April 11, 2010, from http://www.iaad.it/n_eng/doc/IAAD_PianoDiStudio_ Interior.pdf

ITU. (2010). *Istanbul Technical University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://icmimarlik.itu.edu.tr/Icerik.aspx?sid=5439

Izmir Economy University. (2010). *Izmir Economy University: Undergraduate curriculum of interior and environmental design department*. Retrieved April 10, 2010, from http://ic.fadf.ieu.edu.tr/index.php/akademik/ders-programi/

Karalis, E. (1997). *Digital design principles and computer architecture*. Michigan Üniversitesi, Prentice Hall.

KHAS. (2010). *Kadir Has University: Undergraduate curriculum of interior and environmental design department*. Retrieved April 10, 2010, from http://www.khas.edu.tr/tr/akademik/fakulteler/guzel-sanatlar-fakultesi/ic-mimarlik-ve-cevre-tasarimi/ ders-planlari.html

Kocaeli University. (2010). *Kocaeli University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://mtf.kocaeli.edu.tr/mtf2/index.php?alan=icmimarlik

Kolarevic, B. (2003). *Architecture in the digital age: Design and manufacturing*. Taylor & Francis.

KTU. (2010, April). *Karadeniz Technical University: Undergraduate curriculum of interior design department*. Retrieved from http://icmimarlik.ktu.edu.tr/index_lisansprogrami

Lorenzo de' Medici. (2010). *Lorenzo de' Medici: Undergraduate curriculum of interior design department* [PDF document]. Retrieved April 10, 2010, from http://www.lorenzodemedici.it/FCKFiles/File/Interior%20Design%20Fact%20Sheet.pdf

Maltepe University. (2010). *Maltepe University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://mimarlik.maltepe.edu.tr/tr/icm-ders-plani

Menges, A. (2007). Computational morphogenesis-integral form generation and materialization processes. *3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture*, ASCAAD-07, Alexandria, Egypt.

Menges, A. (2010). Digital integrated design and form production. *Architecture & Construction Journal, 15,* 34-37.

Meredith, M., Lasch, A., & Sasaki, M. (2008). *From to design: Parametric/algorithmic architecture*. Barcelona: Actar-D.

MSGSU. (2010). *Mimar Sinan Fine Art University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://www.msgsu.edu.tr/msu/pages/169.aspx

Near East University. (2010). *Near East University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://www.neu.edu.tr/?q=node/294

NYIT. (2010). *New York Institute of Technology: Undergraduate curriculum of interior design department*. Retrieved April 11, 2010, from http://www.nyit.edu/architecture/interior_design/interior_design_curriculum/

Okan University. (2010). *Okan University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://gsf.okan.edu.tr/sayfa/ic-mimarlik-bolumu-ders-programi

Parsons Academy. (2010). *Undergraduate curriculum of parsons academy interior design department*. Retrieved April 11, 2010, from http://www.newschool.edu/parsons/mfa-interior-design/

Pratt Institute. (2010). *Pratt institute: Undergraduate curriculum of interior design department*. Retrieved April 10, 2011, from http://www.pratt.edu/academics/degrees/graduate/interior_design_ms/

RISD. (2010). *Rhode Island School of Art: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://www.risd.edu/interiorarch.cfm

Rocha, A. J. M. (2004). *Architecture theory 1960-1980: Emergence of a computational perspective*. M. I. T., Design and computation program.

SAIC. (2010). *School of the Art Institute of Chicago: Undergraduate curriculum of interior design department*. Retrieved April 11, 2010, from http://www.saic.edu/degrees_resources/gr_degrees/minarc/index.html#courses

Sener, S. M., & Torus, B. (2009). Digital architectural design and modeling. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 34-36). Istanbul.

Sheil, B. (2008). *Proto architecture: Analogue and digital hybrids*. A.D., Wiley-Academy, West Sussex.

Spiller, N. (2006). *Visionary architecture: Blueprints of the modern imagination*. London: Thames & Hudson.

Szalapaj, P. (2005). *Contemporary architecture and the digital design process*. Elsevier.

Szysykowitz.Kowalski. (2010). *Projects*. Retrieved April 17, 2010, from http://www.szy-kow.at/

Terzidis, K. (2006). *Algoritmic architecture*. Oxford: Architectural Press Publications.

UC. (2010). *The University of Cincinnati: Undergraduate curriculum of interior design department*. Retrieved April 11, 2010, from http://daap.uc.edu/said/

University of Anatolia. (2010). *University of Anatolia University: Undergraduate curriculum of interior design department*. Retrieved April 10, 2010, from http://www.anadolu.edu.tr/akademik/fak_gzs/icmimarlikbolumu/program.htm

UO. (2010). *University of Oregon: Undergraduate curriculum of interior architecture department*. Retrieved April 11, 2010, from http://architecture.uoregon.edu/index.cfm?mode=programs&page=courses#iarc

URN. (2010). *University of Nevada Reno: Undergraduate curriculum of interior architecture department* [PDF document]. Retrieved April 12, 2010, from http://architecture.unlv.edu/Interior%20Architecture%20and%20Design%20Courses.pdf

WANG, Y., & Duarte, J. P. (2002). Automatic generation and fabrication of design. *Automation in construction, 11,* 291-302.

Yasar University. (2010). *Yasar University: Undergraduate curriculum of interior design department*. Retrieved April 11, 2010, from http://archintarch.yasar.edu.tr/index.php?s=ders+program%C4%B1

Yazici, S. (2009). Innovative material systems. *Architecture & Construction Journal, 14,* 19-22.

Yazicioglu, D. A. (2009). The improving of digital architectural design process in terms of cost variables. *The Third National Symposium on Computer Aided Design in Architectural Education-Architectural Design-Parametric Design-Experimental Approaches* (pp. 37-40). Istanbul.

Yildirim, A. T., & Ozen, N. I. (2008). The use of internet technologies in architectural design education. *Journal of Information Technology, 2,* 37-45.

Yildirim, N. I., & Yavuz, A. O. (n. d.). *The use of information technologies in architectural design education and its effects* [PDF document]. Retrieved April 12, 2010 from http://ab.org.tr/ab10/bildiri/52.pdf

Figure captions:

Figure 1. Anılanmert, O. (2010). *Basic design course students' works.*

Figure 2. Menges, A. (2007). Computational morphogenesis-integral form generation and materialization processes. *3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture* (pp. 733-734), ASCAAD-07, Alexandria, Egypt.

Figure 3. Menges, A. (2007). Computational morphogenesis-integral form generation and materialization processes. *3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture* (p. 734), ASCAAD-07, Alexandria, Egypt.

Figure 4. Menges, A. (2007). Computational morphogenesis-integral form generation and materialization processes. *3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture* (p. 738), ASCAAD-07, Alexandria, Egypt.

Figure 5. Yazici, S. (2009). Innovative material systems. *Architecture & Construction Journal, 14,* 45.

Figure 6. Menges, A. (2007). Computational morphogenesis-integral form generation and materialization processes. *3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture* (p. 737), ASCAAD-07, Alexandria, Egypt.

Figure 7. Yazici, S. (2009). Innovative material systems. *Architecture & Construction Journal, 14,* 47.

Figure 8. Menges, A. (2007). Computational morphogenesis-integral form generation and materialization processes. *3rd Int'l ASCAAD Conference on Em'body'ing Virtual Architecture,* ASCAAD-07 (p. 741), Alexandria, Egypt.

Figure 9. Yazici, S. (2009). Innovative material systems. *Architecture & Construction Journal, 14,* 47.

Figure 10. Menges, A. (2010). Digital integrated design and form production. *Architecture & Construction Journal, 15,* 34.

Figure 11. Menges, A. (2010). Digital integrated design and form production. *Architecture & Construction Journal, 15,* 36-37.

Figure 12. Ammar, E. (2007). *Infinite optional chair*. Retrieved April 12, 2010, from http://www.moma.org/collection

Figure 13. Dempsey, A., & Huang, A. (2008). *C-Spoce*. Retrived April 16, 2010, from http://www.core.formu-a.com/wp-content/upload/2008/04/2375791252_5dd2c2O7b5_b.jpg

Figure 14. Nikiomahe. (2008). *Mobile art pavilion*. Retrived April 15, 2010, from http://www.nikiomahe.com/architecture-design/chane-contemporary-art-container-by-zaha-hadid/

Figure 15. Goulthorpe, M., & Decoi. (2003). *Hyposurface*. Retrived April 20, 2010, from http://www.Sial.rmit.edu.au/Project/Aegis_Hyposurface.php

Figure 16. Sorguc, A. G. (2010). The usage of parametric technologies in architecture: New techtonics and hybrid materials. *Architecture & Construction Journal, 15,* 45.

Figure 17. Sorguc, A. G. (2010). The usage of parametric technologies in architecture: New techtonics and hybrid materials. *Architecture & Construction Journal, 15,* 42.

Figure 18. Emergent. (2010). *Projects*. Retrieved April 17, 2010, from http://www.emergentarchitecture.com/projects.php?id=29

Figure 19. Emergent. (2010). *Projects*. Retrieved April 17, 2010, from http://www.emergentarchitecture.com/projects.php?id=29

Figure 20. Sorguc, A. G. (2010). The usage of parametric technologies in architecture: New techtonics and hybrid materials. *Architecture & Construction Journal, 15,* 41.

Figure 21. Sorguc, A. G. (2010). The usage of parametric technologies in architecture: New techtonics and hybrid materials. *Architecture & Construction Journal, 15,* 43.

Figure 22. Faulders, T. (2007). *Airspace*. Retrieved April 16, 2010, from http:// faulders-studio.com/proj_airspace.html