UNDERSTANDING THE EMPLOYMENT OF DIGITAL DESIGN TOOLS IN ARCHITECTURAL EDUCATION IN TURKEY

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ABSTRACT

With the Global developments and technological advances in the rapidly changing world, some alterations to the higher education system are inevitable. In Turkey, there has been a fast transformation in the higher education system with the establishment of foundation universities and spending of the significant amount of resources. In particular, as of 2013, there are eighty-three design schools offering bachelor of architecture degree in Turkey. There is no evidence of whether those schools offer up-to-date curriculum, which complies with the international standards and contemporary education models. We also do not know how the information and communication technologies, which have the growing impact on architectural education worldwide, are implemented in the curricula. The aim of the paper is: to understand the current architectural curricula in Turkey, to investigate the changing trends in education and to understand the role of advance information and communication technologies in architectural design education. The results of the project can be used to develop models for the future program developments.

Key words: Architectural education, digital tools, digital design environments

1. INTRODUCTION

In the past twenty years, the information and communication technologies have become affordable in all segments of the building sector. Architecture-Construction-Engineering industries push the boundaries further to facilitate design and communication in order to have efficient working environments. There is a trend towards using advanced integrated virtual building information systems (BIM and other virtual environments) (Rajala and Penttila, 2006) in the design profession. With the recent developments on computer technology, working without CAD is hardly possible any more (Nordic, 2002). Although most of the architectural work is still documented in CAD-based 2D documents, the evolutionary trend in developing digital CAD-drawings towards more augmented visual representation with data management capabilities has extended increasingly during the last ten to fifteen years (Gül, et al. 2007). Computer technology has been increasing its expressive

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and,geometric power to enable the design process in which a digital model can be used throughout the whole process for realising the design (Achten and Joosen, 2003). In these new design processes, the digital models are considered as new design representations that have a consistency and long life-span which does not require continuing reconstruction, in contrast to sketches and physical models, which involve considerable redrawing, tracing and scale-model-making (Achten and Joosen, 2003).

Parallel to the developments in the practice, a change, which is the integration of communication and information technologies into architectural curricula, is observed in the academia all over the world. This integration offers substantial possibilities for architecture schools within their capacity to enable designing and communication in the new learning and teaching environments, enhancing research and developments in learning theories (Gül, et al. 2007).

In line with the developments and technological advances experienced worldwide in the recent decades, the higher education in Turkey saw substantial changes in its structure. In parallel with the growing number of foundation universities, significant amount of resources have been canalised into the tertiary education in Turkey. As of 2013, there are eighty-three architecture schools in Turkey. Despite this spectacular increase in the number of architectural schools in Turkey, there is no data available whether those intuitions follow the international standards, contemporary education models or using advanced design technologies.

In this paper, we discuss the existing content of architectural curriculum in Turkey. We, in particular, are interested in the employment of the advanced digital tools in architecture schools. In order to analyse the changing trends and situation of the architectural education, a thorough investigation of the curricula of the architecture schools has been performed together with an online and face-to-face surveys with the students and teaching staff of the universities. We focused on the following three areas:

- The identification of the curriculum contents;
- The investigation of the role of the advanced digital tools and techniques in design education; and
- The perception of the students and the academics towards to education and the role of advanced digital tools.

Twenty-five architecture schools out of thirty-seven that have the call are volunteer to participate in the survey study. We present the results of the survey and discuss the role of the information and communication technologies in design education. The findings of the research summarised in this article aims to offer a base for the further research on the architectural education, in particular with the interests of the adaptation of information and communication technologies in the existing education system.

2. ARCHITECTURAL EDUCATION

In general, the educational approaches for design disciplines consist of the following models: (1) coming from a fine-arts background and broadly adapting a studio-based Beaux-Arts educational model; (2) evolving from a technology framework and mainly following an applied science educational model; and (3) those who have sought alternative hybrid approaches, generally being combinations of Beaux-Arts and scientific models (Gül, et al. 2008).
Since the Bauhaus experiments of the 1920s in Germany and their "migration" to America in the post-war years, there has been an interest in alternative design educational approaches throughout the world. The "Reflective Practitioner" philosophy of Donald Schön [1983] of the University of Wisconsin (Milwaukee, USA), had an emphasis particularly on architectural and engineering education, was adapted from Bauhaus principles and led initially to the introduction of "Problem-Based Learning" by Donald Woods (1985) of McMaster University (Hamilton, Ontario, Canada) for undergraduate engineering design education. Woods' approach was a form of experiential learning focused on integration of diverse knowledge and skills, and problem-solving praxis to meet "real world" relevance expected by employers, all brought together through reflection (Gül, et al. 2008).
A variation on a combination of Schön's and Woods' themes was a "cognitive apprentice" model (also called "Problem-Based Learning") developed by Howard Barrows (1986)' for medical education. This, in turn, was further adapted to architectural and other design education domains, including particularly a "Block" model in architecture and related design programmes at TUDelft (Westrik, J. & De Graaff, E. 1994), Netherlands and an "Integrated Learning" model and a "Research-Based Learning" model in architecture at the University of Newcastle (Maitland, 1985), Australia. The outstanding success and acceptance of Woods', Schön's, Barrows', Delft's and Newcastle's models led to further adaptations across a wide range of design education disciplines (Gül, et al. 2008).
Many design educators reacted against these innovations and entrenched themselves in "scientific" design education approaches based on rigorous analytical design routines. A majority, however, adopted various combinations of scientific and studio-based approaches, with studio-based tutorials and master classes for some parts of their programmes, and analytical, procedural approaches for the other parts, often using parts of Schön's and Woods' theories to justify existing conventional studio-based tutorial and master-class design teaching practices (Gül, et al. 2008).

2.1. Architectural Education In Turkey

The art and architectural education starts with the establishment of the 'Sanayi-i Nefise Mektebi' in Turkey. The school established in 1882 by Osman Hamdi Bey who was an art historian, archaeologist, painter and museologist. The school which had the department of architecture, department of painting, department of sculpture and engraving arts was given the name of the fine Arts Academy in 1928. The school was converted into an university, Mimar Sinan University, in 1982 and lastly it was

named as Mimar Sinan Fine Arts University in 2004. In the department of architecture, the school adapted the Ecolé des Beaux-Arts approach in which the atelier or the studio were at the heart of the system. Each atelier operated under the supervision of a patron who was a master architect expected to be knowledgeable in the arts and sciences of architecture, but also to be able to model the intellectual and social qualities required of an architect (Ostwald, MJ and Williams, A, 2008). This dimension is very significant because it recognises that architectural education has always involved a mixture of education and enculturation (Ostwald, MJ and Williams, A, 2008).

Another important school of architecture in Turkey is the Istanbul Technical University, first established as an engineering school (Bahr-ı Hümayun) in 1773. In 1844, with the additional architectural subjects into the engineering curriculum, the school started to educate engineers with architectural background. With the establishment of the Law of Higher Education dated 1944, it became an architectural education institution delivering the 10 semester long curriculum, named as the Istanbul Technical University (ITU). Established by Walter Gropius in 1919, Bauhaus model was adapted in ITU (Aliçavuşoğlu and Artun, 2014). According to the Bauhaus model, workshops where unify the artist and craftsmen together in a partnership of equality are the backbone of the system (Harimurti et al., 2011). The main objective is to train and produce partners for the world of industry and handicraft producing the standard products for the industrial purposes (Harimurti et al., 2011).

2.2. Digital Environments in Design Education

Integration of digital tools into design curricula offers significant potentials for design schools, through their capacity to facilitate design learning through the simulation of design context and situations. Perkins (1991) classified constructivist paraphernalia that are information banks, symbol pads, construction kits and task managers. In this view, digital environments serve as the new learning platform that includes all necessary learning materials. Such digital environments facilitate human memory and intelligence to interpret experience to refine their mental model.

There are a series of potential areas in which digital activities expand design education. Following are some ways in which can contribute to design learning (Williams et al., 2011):

Distant Learning: 3D virtual worlds are the cutting-edge form of distant learning environments. Previously, the most common tools for distance learning are web-page-based platforms such as Blackboard and WebCT. These learning platforms are basically networked databases that have a collection of course materials (lecture notes and assessments). Users access the databases through a graphical interface similar to a web page. They are most useful for recapturing what have happened in the physical learning environments.

Collaborative Learning: Collaborative virtual environments used for educational reasons are often named as Learning Virtual Environments (LVEs) or Educational Virtual Environments (EVEs). 3D virtual worlds evidently have the capacities to facilitate innovative and effective education, including debate, simulation, role-play,

discussion, problem solving and decision-making in a group content, etc. Many researchers have pointed out the importance of collaboration and communication and experiment with currently available communication and information technologies.
Virtual Design Studios: Since mid 1990s, Virtual Design Studios have been established by architecture and design schools around the world aiming to provide a shared "place" where distant design collaboration especially synchronised communications can occur. The forms of virtual design studios differ from the initial approach of digital design data sharing to the more recent 3D virtual world approach where the design artefact and the designers/learner are simulated and represented in the virtual worlds. Kvan (2001) argues that while design education has traditionally focused on the product, virtual design studios allow students to learn more about the design process. Dickey (2005) suggests 3D virtual environments can provide "experiential" and "situated" learning. Clark and Maher (2005) examine the role of place in 3D virtual learning environments that encourage "collaboration and constructivism". Wyeld et al. (2006) assess the use of 3D virtual learning environments for supporting social awareness among design students and focus on the cultural aspect in virtual learning environments where students from different backgrounds design and learn collaboratively.

3. UNDERSTANDING THE CHANGING TREND IN ARCHITECTURAL EDUCATION IN TURKEY

In order to understand the changing trend in architectural education in Turkey, we conducted a comprehensive research, which includes quantitative and qualitative data. The quantitative data of the study includes the architecture schools' profiles and programmes: The curricula of the schools that are accessible in their websites have been investigated. The qualitative data of the study includes surveys and interviews of the academics and the students. With the completion of the collection of the data, the surveys and programmes are investigated and the data is analysed. The results of the study is presented into three sections as follows:

- Scope and limitations,
- Mapping curriculum content, and
- The assessment of the role of digital tools in design education.

3.1. Scope and Limitations

A series of important developments have occurred in the higher education during the last few years in Turkey. Since the foundation of the first foundation university in 1984, there is a large number of universities established; by 2013, 83 schools of architecture both public and foundation exist in Turkey. In this study, having the graduates of architecture is the key to make a call for participation. Thus the research is focused on only 37 schools of architecture out of 83 who have the graduates.
In order to gather information on the preferences and the employment of digital environments/tools in architectural education, a set of separate surveys (of the students and the academics) were conducted. In general having enough response to the survey calls is the main difficulty in the qualitative research. To overcome this

problem, we conducted two types of surveys: face-to-face and online surveys. 25 out of 37 schools of architecture accepted to participate in the study. Table 1 shows the number of the students and academic staff who participated in the surveys.

Table 3 Participation to the study

University	Academic S.	Student
9 Eylül	6	-
Abant İzzet Baysal	-	4
E Anadolu	2	10
Bahçeşehir	1	-
Balıkesir	1	-
Beykent	1	-
Çukurova	5	15
Doğuş	-	9
E Osmangazi	8	19
Gazi	5	21
Gebze Yüksek Teknoloji	7	29
Haliç	5	10
İTÜ	6	22
İzmir Ekonomi	5	-
İzmir Yüksek Teknoloji	-	7
Karabük	1	-
Koca□li	8	5
Kültür	-	4
Maltepe	2	-
MSÜ	6	13
ODTÜ	2	9
Selçuk	4	18
Uludağ	6	30
Yaşar	3	7
Yıldız	5	-
Non-identified	9	20
Total	**98**	**252**

The student participants of the study (64.8% female) were not freshman students; only 3.2% of them were the first year students. The 41.4% of them were second year, 20.3% of them were third year and 35.1% of them were final year students. The academic staff who participated in the study was mainly female (80%). The 32% of the academics were studying in the post-graduate level (PhD, graduate students or attending a course).

3.2. Mapping Curriculum Content

Architecture schools report their curriculum content in a range of forums and formats. Although the terms and the terminology change over the institutions, it is possible to classify the key components of the architecture curriculum and to quantify the weighting of the components. Six study areas adopted for the current analysis are design, technology, history-theory, communication-presentation,

practise-management and environment. In addition to those areas, elective subjects also exist, as shown in Table 2.

Table 4 The study areas of architecture curriculum

Design:	Includes all of the compulsory and elective design related courses;
Technology:	Includes building technology, material, construction and building services and building science;
History-Theory:	Includes architectural and urban history, and theory;
Communication-Presentation	Includes all kind of architectural and verbal presentation techniques, computer-based drafting, presentation and documentation skills;
Practice–Management	Includes project management, building management and economics, building codes and regulations;
Environment	Includes sustainability, ecology, landscape and energy;
Electives	Includes all kinds of elective subjects

The Figure 1 shows the percentages of the quantifying the weighting of the six study areas in the architecture curricula (only the architecture departments complied with the criteria of the study are chosen). The total hours per week of each study area are calculated and the average weighting is determined. As expected, the design studios consistently occupy the largest time slot of the curricula, followed by technology, history-theory, and communication related subjects. Elective subjects keep almost 10% of the time in the curricula studied.

There is a degree of overlap between those study areas that can encumber by the interpretation of the data. For example, some of the subjects in the technology such as building science may cover some areas of construction and environment. Similarly, it is also very common to merge some areas into design studios. For example, it is possible to have construction, ecology, drafting and communication related issues discussed in design studio. In fact, this is very common pedagogical approach over the world (Ostwald and Williams, 2008), but it makes the mapping more difficult.

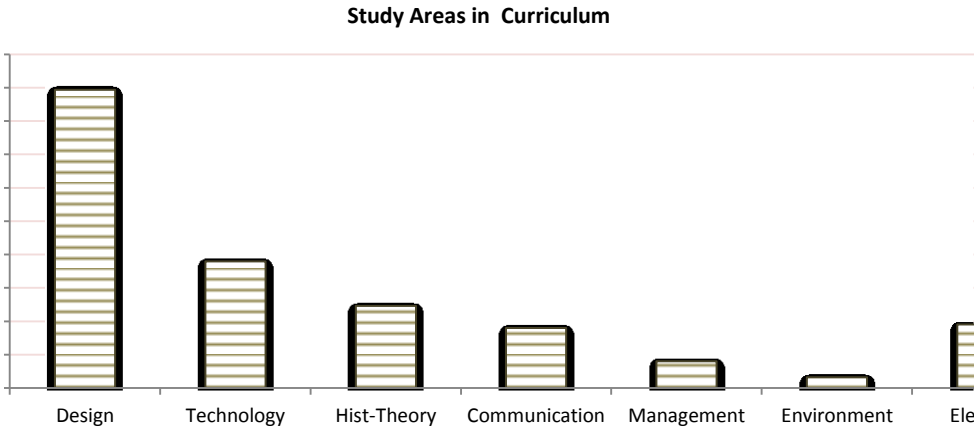

Figure 18 The perception of the average weighting of the study areas

3.3. The assessment of the role of digital tools/environments in design education

In order to understand the perception of digital tools in design education, we asked the students and academic staff to rate the tools in terms of the common use in design education. Figure 2 shows the comparison of the perception of the employment of the digital tools in design education. The 3D modelling tools have the highest percentage followed by the photo-realistic rendering tools and the 2D drafting tools. The consistent awareness across the participants is observed in those three tools. Other three digital tools, which are the communication tools, the collaboration tools and the virtual environments have the highest percentage rate among the academic staff.

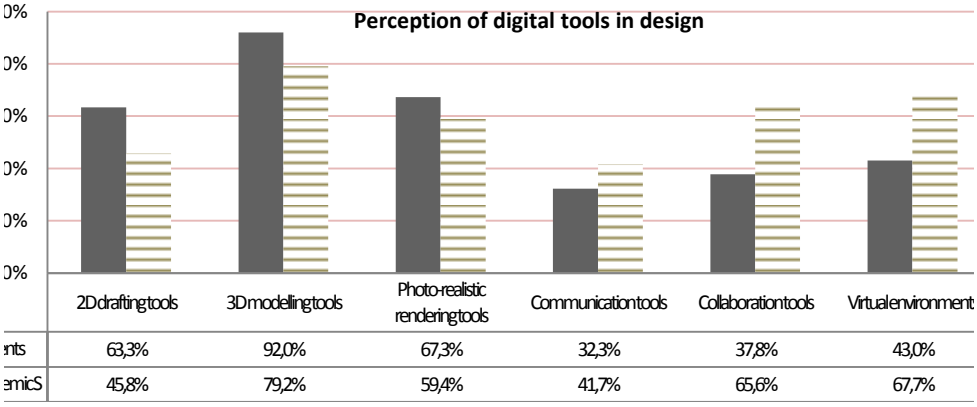

Figure 19 The comparison of the perception of digital design tools

Although, 97,9% of the schools has a computer laboratory, 84% of the students

consider the computer laboratories as insufficient. The most common shortcoming of the laboratories that the students mentioned is the lack of recent technology (insufficient RAM and hard drive capacity, very slow computers etc.), lack of staff and lack of software. Most of the students commented on having not enough time to learn the knowledge and skills of using computer mediated design tools. Some comments are:

'We have the subject in the second year, two hours per week I think…one week was for Photoshop, two weeks were for AutoCAD, three weeks were for Max…it was very much overview approach.'

'We don't have the computer mediated courses in the laboratory; we are taking our own laptops to the class. In general, the instructor teaches the commands, gives us some homework and we apply those knowledge and skills to our homework…I think the hours for that course is not sufficient. They try to squeeze three software in two hours, it is bad.'

The most common used software is AutoCAD, 93% of the students specified that they are knowledgeable about and using this software during their education. The other most commonly used software are (74.5%) Photoshop, (63.5%) SketchUp, (35.8%) 3D Max, (26.7%) ArchiCAD, (23.9%) Revit, (16%) Illustrator, (15.2%) Rhinoceros, (7.4%) Premier, (6.6%) Grasshopper and (5.3%) Corel Draw. The 95.7% of the academic staff identified that the students are allowed to use any kind of digital media and tools in the design studios.
The academic staff commented on the employment of digital tools in design studio which has a great potential to improve the design studio teaching and learning experience. Particularly, the staff emphasised that the employment of digital tools in the conceptual phase of the design process ought to be supported. By using the digital design tools, the free-form exploration and creativity through moving away from the Cartesian forms can be obtained.

'Information and communication technologies are the tools which can be facilitated in the every phases of the design process. A designer should have enough knowledge and skills to employ those tools in the design activity.'

'To employ the digital design tools in the early phases design process, there must be out of the framework of computer-aided design…There is nothing new about using the digital tools for the representation of the design concepts…But we don't have enough infrastructures and resources to do more than that.'

'There could be some problems because of the lack of software that supports the fuzzy phases of the design process. It is very necessary to develop applications that facilitate the liquid mental processes'

The use of the virtual worlds among the academic staff is very low; only 9% of them visited a virtual world before. Those are respectively Active Worlds, Second Life

and Open Sim Grid. The 91% of the academic staff specified that they have never employed a virtual world / virtual environment in their design teaching. In the open-ended questions, we observed that there is confusion about what a virtual world would be. The academic staff mixes the concept of virtual worlds up with the animation and simulation. The 25.7% of the participated students, on the other hand, have visited a virtual world before, that were Active Worlds (26%), Second Life (17%), Club Penguin (14%), Free Realms (5.2%) and Open Sim Grid (3.4%). The curiosity (18%) and gaming (15%) are the most popular two answers given as the reasons of the visit.
The virtual environments (some forms of Web 2.0- social media- blogs, Facebook and local intranet) are used as the communication and discussion media in most of the time (51% of the academic staff). Particularly in design studios, groups employ the social media for the discussions platform and as the storage of shared information. Some comments include:

'Particularly the blog pages are visible and accessible virtual environments so they would be perceived as a stage that enhances the productivity of the students.'
'Of course it depends on what you would share there. In general we share some tutorial materials during the process, in some cases we are sharing some architectural precedents to help them to gain knowledge on the architectural history.'

4. DISCUSSION AND CONCLUSION

In the last decade there has been an increasing demand to establish new universities at every city in Turkey. Mirroring this demand, by 2013, there are 83 architecture schools established, with 5000 students entering the education system to become an architect each year. This research is an early attempt to gather information about the current situation of the architectural education in Turkey. As noted above the research focuses on: The identification of the curriculum contents; the investigation of the role of the advanced digital tools and techniques in design education; and the perception of the students and the academics towards to education and the role of advanced digital tools.
In order to analyse the above points the curricula of the schools are investigated and the detailed surveys are conducted. Based on our observations and the results of the analysis of the collected data, we summarized our findings as follows:
First, while it is very difficult to capture every nuance that exists in the schools' curricula, we collected and characterised the structures of the education programme. Our analysis shows that in terms of the resources and the curricula, the schools are fragmented and competitive. Several hybrid models, which commonly have the architectural design studio in the centre of the education, exist. The academic staff, who qualified in the well-established public schools, generally takes the leading position to establish new foundation schools. In many cases those academic staff could not go beyond what they gained in the public schools in their new roles, thus they have disseminated the smaller replicas of the architectural curricula.
Second, the digital tools are integrated in the design curricula of the schools and mainly used in form of CAD programs for documentation and graphical

representation programs such as AutoCAD and Photoshop. In many schools, the computer laboratories exist although their quantity and quality are not always at desired level.
Third, the virtual environments, virtual reality and collaborative virtual environments are mainly perceived as some kind of social media. Particularly, the employment of those systems in education as the representation and communication tool (for making the movies and documentation of the design concepts) is very common. There are only a limited number of schools which employs those tools and environments for design teaching in the spatial and visual reasoning of the 3D space and design concept, and as a computational/generative design tools.
Finally, the results of the study show that the architectural education in Turkey, similar to the common educational approaches around the world, concentrated to design studio that is the backbone of the curricula. It is also observed that the employment of the advanced digital design tools in education is far behind the level of the world's leading architectural schools. However, we believe that the use of such technologies in architectural education will be enhanced to support new generation of architects in Turkey in near future.

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