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Information and Communication Technologies in Design Studio: New Tools, Strategies and Techniques at Work

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Abstract:
The latest technological innovations in ICT led to a paradigm shift from mechanical to digital resulting in a remarkable change in design conception and its application. The architecture of information age is varied, and this variation is a potent source for teaching and research. The evolving free form vocabularies [and the techniques to generate and realize them] contribute to the breakdown between disciplines: the software tools to develop these forms are shared by a variety of disciplines, thus blurring the boundaries between specialized professional practices. This paper aims to discuss the use of integrated methods and approaches in architectural design process through various approaches and models which are implemented and tested in ITU Faculty of Architecture.

ICT in Design Studio: A Brief History

Starting from the use of first algorithms for generating building layouts (Whitehead, 1965), first integrated packages for building performance appraisal and first computer perspective drawings were generated in the following ten years. Preliminary work on "computer aided architectural design" was related with simulation of function. The so-called "oil-crisis" around 1970 provided a stimulus to software developments which sought to appraise design schemes in relation to their energy-efficiency (Maver, 2002). Development of robust drafting systems, dynamic energy models, design decision support systems, integrated packages for building performance appraisal and photorealistic rendering engines affected architectural design education irreversibly.

The integration of ICT into architectural design education became a subject of debate in 1970's and 1980's, starting with William Mitchell (1974), Tom Maver (1979), John Gero (1980), Charles Eastman (1981), Alan Bridges (1983), Ömer Akın (1985), Ulrich Flemming (1985), and Malcolm McCullough (1989). Latter publications were focusing on pedagogical and technological potentials of using ICT in design studio while earlier ones highlighted "new" design computing graduate programs founded in their departments.

Since the publication of the proceedings of the 1989 CAAD Futures conference as "The Electronic Design Studio", experiments about using computers in studio became widespread (Gross and Do, 1999). ICT has started to be integrated to undergraduate design studios. The paradigms for computational design pedagogy were: representation based, design-process based and design product based (Akin, 1989). Representation based paradigms were accepted by William Mitchell whereas design product based paradigms were accepted by Ulrich Flemming and Gerhard Schmitt.

During the 1990's, ICT have changed rapidly enabling the development of advanced representation environments and complex interconnected networks. The computation performance has increased more than ten times in ten years (Brenner, 1996). Different kinds of commercial interfaces have been developed and computer aided manufacturing technologies have improved and became more precise. Architects used these technologies for the design, evaluation and management of complex architectures following a new process called "file to factory". This digitally mediated design and manufacturing process ended up with new products which are named as "blobs", "hyper-surfaces" or "non-standard architectures".

Architectural Design Education Now

The rise of the paradigm shift of an information society has clear and present challenges for the future of architectural education, including the importance of innovative practices, changes in the way buildings are conceived and constructed, and demands for better compliance within contemporary dynamics. The emergence of a domain of *bits* on par with that of *atoms* has radically resituated the way in which the concept of value is understood. Thus a real-virtuality has been constructed, in which immaterial bit-based networks, processors, workstations and storage facilities have become interlinked with physical artifacts, logistical systems, workplaces and warehouses. As McQuillan states, the rise of a virtual world in no way supplants the physical world; rather, it extends, augments and amplifies it (McQuillan, 2005).

But the change is not limited to the process and the product: the complexity of architecture has increased exponentially. In an information society, the practice of architecture must be re-evaluated in the light of innovation. It is no longer a situation where the precision of the design depends upon the knowledge and the skill of the craftsmen and his ability to translate ideas into built forms given the tools of craft and within the limitations of the materials available. Hence, the architect needs to understand and re-evaluate this new relationship between tool, material, structure and form.

New ICT Tools, Strategies and Techniques at Work:

This article aims to discuss the potentials of integrated methods and approaches in architectural design teaching. The objective is to clarify the cons and pros of the new digital design tools while exploring ways of integrating them to new design education paradigms. Experimenting with new tools and techniques is vital for education: it is experimental architects' use of innovative techniques to generate new organizational processes that enables them to understand the possibilities contained with the design process. As a consequence, the deterministic notions of causality are replaced with nonlinear, bottom-up systemic processes which produce emergent effects. It is essential to develop theoretical frameworks and

computational environments to relate computational thinking to design process. The approach adopted through the experiments will highlight integration of short term digital workshops to the design studio curriculum. The aim is to focus on the potentials of a certain digital design tool relevant to the problem at hand. The primary objective is not to limit the tools to be applied to that of representation, but to introduce different tools relevant to the problem at hand. Therefore, all of the experiments to be discussed require the participants to isolate a design problem with constraints defined a-priori, and tackle it with a relevant tool. In order to explicitly discuss the cons and pros of new tools at work, various techniques were implemented to integrate ICT to design education through short term workshops at ITU Faculty of Architecture.

Case 1: the virtual museum/fluxxoid

Experimenting in the digital media also has the effect of moving the work away from material limitations and restrictions thus allowing for interaction with dynamic processes that contribute to rapid generation of creative design alternatives that are void of material restraints. These new computational tools/techniques lead to creation of innovative, free form, discrete structures. Experimenting with design of virtual environments of dynamic information exchange also possess potentials to trigger creativity. In the virtual museum/fluxxoid experiment, the aim is to shift emphasis away from structure as a static material object [museum: an enclosure to exhibit artifacts for informative purposes] towards the temporal and dynamic organization of mobile relations through space [virtual museum: a dynamic medium of information exchange and interaction].

Fluxxoid is a virtual medium created by Ozener & Pak in 2001 as an interactive model containing physical space representations and cyberspace structures. The main function is to create alternative discourse for parallel universe while enabling virtual existence in custom designed dimension. Through the experiment, fifteen undergraduate architectural design studio students were asked to design the dynamic virtual museums to enable the specific information exchange function of their choice.

During the first stages of the work the participating students were quite hesitant and conservative in re-thinking the museum typology, and the studio was supported with lengthy discussions on the conventional museums and how should their virtual counterparts be. Through the later stages the resistance was broken and remarkable outputs such as museums of empathy, sound, color and moving image were created.

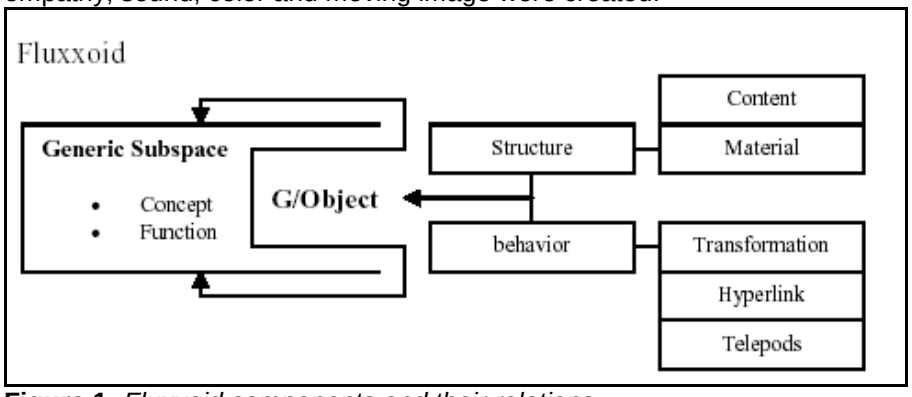

Figure 1: *Fluxxoid components and their relations*

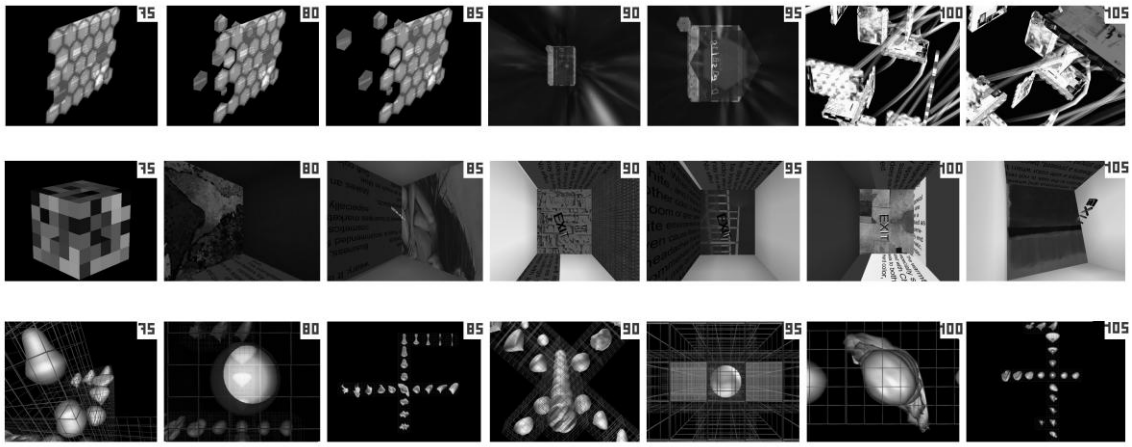

Figure 2: *Snap shots from virtual museum projects*

Case 2: Cocoon

Architecture endorsed with new technologies goes through a potential metamorphosis: the passage from abstract to concrete does not necessarily need to be phased. The integration of CAD CAM processes enabled a smooth path from idea to object. Until recently, general use of the computer has been demoted to the world of virtual in addition to analysis. Recent advances in IT, like the rapid prototyping tools, allow the users to move directly from a drawing to real life model or object. Consequently, the distance between virtual architectural hypotheses and the physical test of making is eliminated.

In the cocoon experiment the participating graduate students were asked design an individual shelter for the future. The aim is to experience a design process completely realized in the digital medium. The proposed integrated model was based on a definition of the design process in which conception and development are realized in a 3d modeling environment. The proposed environment was supported by manufacturing modules to enable the physical models to obtain feedback and thus transform design. The model was tested in an architectural design studio by 20 graduate students at Istanbul Technical University, Department of Architecture. Through the course of the studio, 3d modeling and manufacturing environments are interpreted as a design medium rather than tools for representation. The students were required to limit their design activity within the boundaries of the proposed medium.

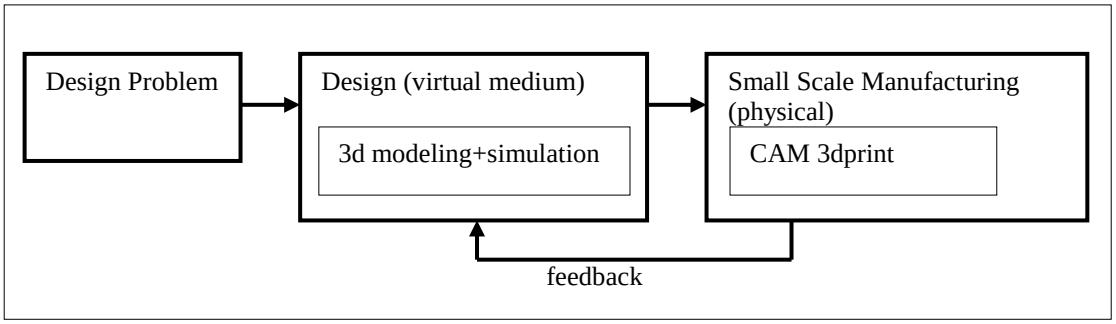

Figure 3: *The proposed model*

Figure 4: *Examples from the student works*

Case 3: da351

Recent applications of genetic algorithms in architecture to generate new funky forms shows promise for the computer as an active creative partner in design. The aim is to use generative design tools to aid in achieving a balance between aesthetic intrigue, efficiency and innovation in new structural forms (Shea, 2005).

Experimental generator (XpGEN) is a plug-in that allows user to interact with computer for experimental, intuitive and inspirational assistance at preliminary phases by randomly generating multiple design alternatives according to the limitations defined by the user a priori (Pak, Ozener, Erdem, 2003). The random directedness allowed by the tool also enables an experimental medium to question the physical limits of the design process at hand. The da 351 is a short term workshop integrated into first year architectural design studio. Ten first year undergraduate students contributed to the workshop. The primary objective is to propose is to obtain random alternatives of a digitally generated form or structure within the limits of rules and constraints set a priori. Aims of the workshop can be summarized as to explore the potentials of digital tools for creating architectural input, to implement a digital tool to support design studio, to enhance architectural projects with still and animated inputs and to observe how students use basic digital tools in design studio.

Case 4: PG.W [the box]

Recent applications of genetic algorithms in architecture to generate new funky forms depend on the definition of the potential performance. As Elin Diamond states, *'…the study of performance is not to focus on complete forms, but to become aware of performance as itself a contested space…'* (Hensel, Sotoma, 2002). Performativity is another subject of contemporary discourse. It might be essential to clarify that performativity gives primacy to formation over gestalt, to dynamic multiplicity over finite totality. In this respect, performance can be defined as the interaction between the designed dynamic object and the potential subject. The behavior of the potential occupant in the entity is governed by the form of the medium, thus defining a specific performance. PG.W is a workshop organized at Istanbul Technical University, Faculty of Architecture in 2004. The workshop aims to

focus on possible implementations of 3d modeling methods widely used in entertainment industry while designing an environment for a defined performance. The design problem is stated as to propose an exhibition space within a pre-defined box enabling a certain performance. It is essential to define a performance or series of actions rather than a form. By integrating 3d modeling means to the design environment, it is possible to enhance creativity and record design history, in other words, document and evaluate all stages of development independent of chronological time.

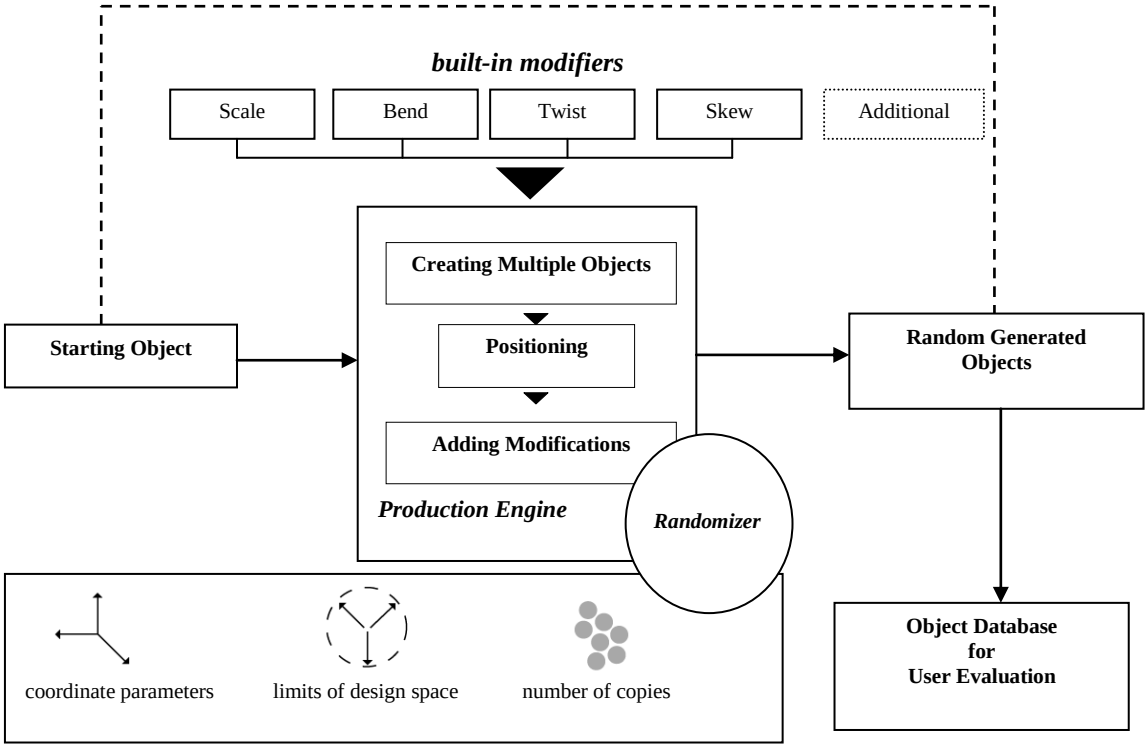

Figure 4: *XpGEN modules and flow diagram*

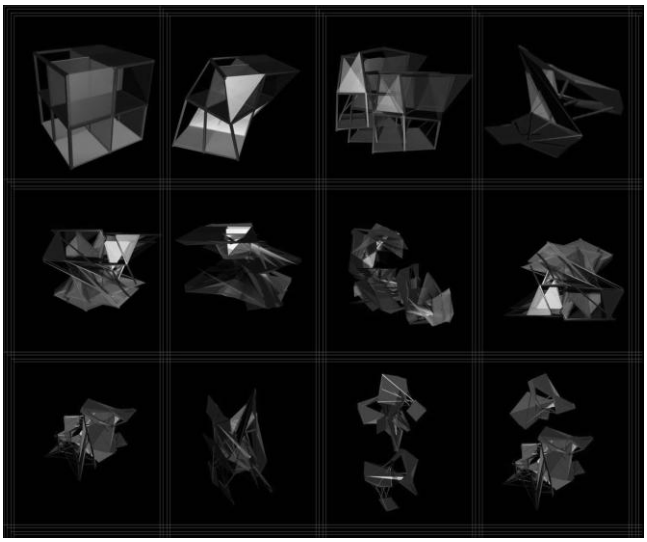

Figure 5: *Structures generated with XpGEN*

Conclusions

Beginning with the 1970's, the integration of ICT to design education became the subject of a global debate. Changes of working patterns in the architectural profession have impacts on the contemporary architectural design education. Consequently, changes in the architectural practice, introduction of new tools for design conception and implementation and contemporary demands of the construction industry have raised questions regarding the 'content' of a contemporary architectural design education. It is argued that computing is part of the working environment in which both education and practice exist and that

the content of education needs to be reinterpreted in the context of this new environment. The designers of the future are expected to be familiar, even competent, with new technologies and tools. Short term workshops, introducing ICT tools and environments to future designers, not only provide means to experiment with new technologies but also possess the potentials to fill the gap in the architectural design curriculum. Through these workshops, students experience a dynamic design medium which has not been conditioned by Cartesian coordinates, where it is possible to record and document all sequences of an individual's design process.

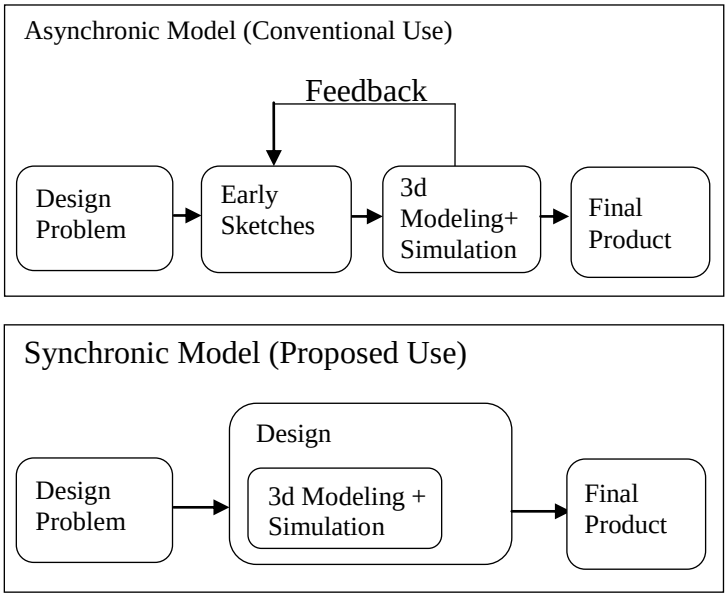

Figure 6. *The Proposed model*

Furthermore the dynamics of the digital design medium allow time-independent and non-linear processes, thus enabling real-time and flashback critics by the tutors. In all of these experiments, through design history recorded in the modeling software and detailed study of periodically saved files it is possible to analyze the contributing designers' past actions systematically. The analysis also enables a thorough evaluation of the problems that are encountered through the process. Both qualitative and quantitative measures are adopted for the evaluation of the product and process.

Figure 7. *Example A from the work of the students*

The findings recorded during the design experiment, enable a comparative evaluation of the pros and cons of integrating complex technologies to architectural design education.

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Tasarım Stüdyosunda Enformasyon ve İletişim Teknolojileri: Yeni Araçlar Stratejiler ve Tekniklerin Uygulaması

Enformasyon teknolojilerinin doğrudan insan, mekan ve zamana ilişkin yepyeni koşullar ortaya koyuyor olmaları, etkileşim alanlarının genişliği, özgün, değişken, dinamik ve esnek yapıları bu teknolojileri günümüz dünyasının en önemli unsurları haline getirmektedir. Konu zaman, mekan ve insan olduğunda enformasyon teknolojilerinin mimarlık disiplini çerçevesinde de ele alınması gerekliliği ortaya çıkar. Mimarlık disiplini gerek meslek pratiği gerekse eğitim bağlamında enformasyon ve iletişim teknolojilerinin etkileri ile son derece hızlı ve ciddi dönüşümler yaşamaktadır.

Enformasyon ve iletişim teknolojilerindeki gelişmeler mekanikten dijitale bir paradigma kayması yaratarak tasarım ve uygulama süreçlerini ciddi biçimde dönüştürmektedir. Enformasyon çağının mimarlığı çeşitlenerek eğitim ve araştırma

için potansiyel bir kaynak oluşturmaktadır. Enformasyonun yapısal bileşen olarak ele alındığı yapı önerileri kadar, kısmen ya da bütünleşik olarak tasarım ve üretimin dijital ortamda gerçekleştiği önermeler de mimarlık söyleminde yer bulmaktadır. Günümüzde etkileşim, iletişim, arayüz, gömülü çevreler ya da tepkimeli yapı bileşenleri kavramları mimarlık nesnesini betimleyen kavramlar olarak ön plana çıkmaktadır. Dijital teknolojiler, geleneksel mimarlığın bünyesinde bulunmayan etkenleri mimarlık mesleğine empoze ederek, tasarımlarda statik ortamın sınırlarını aşma olanağını yaratmaktadırlar. Dijital teknolojilerin fiziksel dünyadaki potansiyel etkileşimleri, fiziksel ve sanal ortamlar arasındaki anlaşılabilir sınırlar, etkileşim sonucu tanımlanan hiperyüzey, tepkimeli, akıllı, etkileşimli, sinir sistemli mekan ve yapı bileşenleri, tasarım ortamının zaman boyutu değişen dinamik yapısı, bilgi bileşenin ön planda olduğu esnek ve dinamik mimarlığın potansiyeli ve temsili üzerine araştırmaları ön plana çıkarmaktadır. Evrimleşen serbest form dağarcığı ve onları üretmek için kullanılan teknikler disiplinler arasındaki izolasyonun kalkmasına katkıda bulunmuştur. Bu formların geliştirildiği yazılım ortamları değişik disiplinler tarafından ortak olarak kullanılmış ve daha önce kesin sınırlarla ayrılan tasarım disiplinleri, sınırların belirsizleşmesiyle benzer özellikler taşır hale gelmişlerdir.

Dijital ortamın tasarım ortamı olarak öngörüldüğü ilk örneklere bakıldığında plan şeması üretmeyi hedefleyen ilk algoritmalardan sonraki on yıl içerisinde, bina performans analizi yapmaya yönelik bütünleşik sistemlerin ve perspektif çizimleri hazırlayan programların gündeme geldiği izlenebilir (Whitehead, 1965). Bilgisayar destekli tasarım alanındaki öncü çalışmalar tasarımı bütün olarak ele almaktan çok farklı işlevlerin simulasyonu üzerine kurgulanan yaklaşımlardır. Yetmişli yıllarda yaşanan enerji krizi, önerilecek yapıların enerji kullanım etkinliği üzerine uzmanlaşmış ve enerji sakınımını arttırmayı amaçlayan plan kurguları üreten yazılımların geliştirilmesini hızlandırır (Maver, 2002). Yeni gelişmeler ışığında üretilen çizim programları, dinamik enerji modelleri, tasarım süreçlerini destekleyici yazılımlar, performans analizi yazılımları kadar foto-gerçekci render motorları da tasarım eğitimi etkilemeye başlamıştır.

Enformasyon teknolojilerinin mimarlık eğitiminde nasıl ve hangi boyutta yer alması gerektiği tartışması 1970 ve 80'lerde önem kazanır. William Mitchell (1974)'ın MIT'de başlattığı çalışmalar, ve sonrasında Tom Maver (1979), John Gero (1980), Charles Eastman (1981), Alan Bridges (1983), Ömer Akın (1985), Ulrich Flemming (1985), ve Malcolm McCullough (1989)'ın çalışmaları; akademik çevrelerin enformasyon teknolojileri ve tasarım eğitimi ilişkisi üzerine bakışını yansıtan önemli çalışmalardır. Bu çalışmalarda enformasyon teknolojileri ve mimari tasarım arakesitinde uzmanlaşmış programların kapsamı ve içeriği kadar, bu arakesitte belirlenen yeni durumun pedagojik ve teknolojik potansiyelleri de ön plana çıkmaktadır.

1989 CAAD Futures konferansı bildirilerinin 'The Electronic Design Studio' başlığı ile basılmasının ardından tasarım stüdyolarında bilgisayarların kullanılması yaygınlaşır (Gross and Do, 1999). Bilgisayar desteği ile gerçekleşen tasarım stüdyoları pedagojik bağlamda temsil temelli, süreç temelli ve ürün temelli yaklaşımlar olarak sınıflandırılabilirler (Akin, 1989).

1990'larda enformasyon teknolojileri ve ilgili alanlardaki değişimin gittikçe hız kazanması ile gelişmiş temsil ortamları ve karmaşık ilişkileri içeren örüntüler gündeme gelir. Dosyadan-fabrikaya bilgi akışının gerçekleşmesi karmaşık mimari nesnelerin tasarım, değerlendirme ve yönetimini olanaklı kılar.

Günümüze gelindiğinde dijital tasarım teknolojileri, parametrik tasarım, üretken tasarım, yapay zeka ve uzman sistemler, evrimsel sistemler, animasyon teknikleri ile tasarım, diyagrama dayalı tasarım, performansa dayalı tasarım, bilgisayar destekli üretim teknolojileri ve bütünleşik tasarım yaklaşımları gibi oldukça geniş açılımlı bir yelpaze ile uygulanma olanağı bulmaktadır. Dijital ortam, temsilden çok sürecin ön plana çıktığı, temsil-ürün ilişkisinin yeniden anlam kazandığı dinamik bir tasarım ortamına dönüşmektedir.

Bu makale mimari tasarım sürecinde bütünleşik yöntemler ve yaklaşımları İTÜ Mimarlık Fakültesi'nde, farklı lisans ve yüksek lisans tasarım stüdyolarında

uygulanan değişik kısa süreli deneysel çalışmalar ve modeller çerçevesinde tartışmayı amaçlamaktadır. Tüm çalışmalarda hedeflenen; mimarlık disiplinine özgü ya da farklı disiplinlerden alınan/uyarlanan bir dijital tasarım aracının belli bir problem bağlamında uygulanmasıdır. Altı çizilmesi gereken nokta tümüyle dijital ortamı ön plana çıkaran ve döneme yayılmış bir tasarım sürecinden çok, farklı problemler için farklı araçlar üzerinde kısa süreli yoğunlaşmayı hedefleyen bir stratejik yaklaşımın benimsenmiş olmasıdır.

Bu makalede farklı dijital tasarım araçlarının benimsendiği dört kısa süreli çalışma tartışılacaktır.

Sanal müze/fluxxoid başlıklı ilk çalışmada amaç, fiziksel gerçekliğin dikte ettiği maddesel kısıtlamalardan uzaklaşarak bilinen bir tipolojiyi farklı bir boyutta deneyimlemeyi hedefler. Çalışmada hedeflenen, oldukça statik bir kurguya sahip geleneksel müze tipolojisini tartışmak ve izleyenle izlenen ilişkisinin dinamikleştiği yeni sanal müze kavramına uygun tasarımları gerçekleştirmektir.

Koza/cocoon başlıklı ikinci çalışma, tümüyle dijital ortamda gerçekleşecek bir tasarım deneyimi üzerine kurgulanır. Konu, gelecek için bireysel bir barınak tasarlamaktır. Bu çalışma bilgisayar destekli tasarım ve üretim süreçlerinin bütünleşik olarak kurgulandığı ve hızlı prototip üretmeyi hedefleyen bir yapıya dayanır. Çalışma sonucu seçilen iki önerinin üç boyutlu fiziksel modelleri de dijital çıktı olarak alınmıştır.

Dijital ansızlık/da 351 çalışması bilgisayarın tasarım sürecindeki yaratıcı ortak rolünü deneyimlemek üzerine kurgulanmıştır. Bu çalışmanın amacı, üretken sistemler yolu ile yeni dinamik formları oluşturmak ve keşfetmek olarak da tanımlanabilir. Geliştirilen Xp-Gen plug-in'i ile ön tasarım aşamalarında deneysel, sezgisel ve yaratıcı desteğin sağlanması hedeflenmektedir.

Yapılan dördüncü çalışma PG.W/kutu çalışmasıdır. Bu çalışmada önceki çalışmalardan farklı olarak form belli bir eylemler dizisi veye performans çevresinde kurgulanır. Amaç tanımlanan bir performansın gerekli kıldığı mekansal kurguyu oluşturmaktır. Katılımcılar önceden belirlenmiş katı bir formun içerisinde seçtikleri bir nesnenin izleneceği serbest formdaki sergileme düzeneğini kurgularlar. Bu çalışma bağlamında özellikle eğlence sektörünün kullandığı üç boyutlu modelleme teknikleri tanıtılmakta ve yorumlanmaktadır.

Sonuçta, tartışılan tüm kısa süreli tasarım çalışmalarının farklı dijital tasarım araçları ile ilgili deneyim kazandırmak, sanal ve gerçek arasındaki ilişki ve gerilimi tartışma olanağı sağlamak, farklı disiplinlere özgü araçları yorumlamak ve mimarlığın değişen nesnesi ve problematikleri üzerine düşünme becerisini geliştirmek açısından katkıları olduğu söylenebilir.