

REFLECTIONS ON E-DESIGN: THE E- STUDIO EXPERIENCE

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1. Introduction

The influence of digital media and information technology on architectural design education and practice is increasingly evident. The practice and learning of architecture is increasingly aided by and dependant on digital media. Digital technologies not only provide new production methods, but also expand our abilities to create, explore, manipulate and compose space.

In contemporary design education, there is a continuous demand to deliver new skills in digital media and to rethink architectural design education in the light of the new developments in digital technology. During the academic years 2001-2003, I had the chance to lead the efforts to promote an effective use of digital media for design education at Department of Architecture, Jordan University of Science and Technology (JUST). Architectural curriculum at JUST dedicated much time for teaching

computing skills. However, in this curriculum, digital media was taught in the form of "software use" education. In this context, digital media is perceived and used mainly as a presentation tool. Furthermore, Computer Aided Architectural Design and architectural design are taught in separate courses without interactions between the two.

In an effort to move from "software use" education toward integrating digital media into the design studio, the "Digital Media Integration Initiative" (DMII) was proposed by the author and adopted by Department of Architecture. Among other issues, the Initiative proposed to establish a digital design studio (the e-studio) in which digital media will be the main tool for creating and exploring design ideas. This paper reports on our experience in the e-studio experiments and discusses the pedagogical implications of the studio.

2. E-Studio Experiments

E-studio is part of an effort to integrate digital media in the design studio and to raise the quality of studio instruction. The primary goal of the e-studio is to teach students how to think and design using mainly digital media. In this studio, students learn how to go beyond the tools by shifting their attention from the tools themselves to their effective use in architectural design. The main media used in the studio include 3DS Max as well as other supporting packages such as AutoCAD and adobe Photoshop. Digital media were used not only as a presentation tool but also as a tool for design generation and exploration.

Beside exploring the digital medium as a design tool, the e-studio promoted new design agenda. Students were encouraged to rethink the conventional architectural design processes and conventional design products. The aim was to develop a pedagogical model that emphasizes e-design practice and theory. Beside exposing students to various ways of using digital media in architectural design and enabling them to develop skills in this regard, it was hoped that the e-studio would provide a valuable opportunity to critically evaluate current design discourse and to reconsider current understandings of design studio and digital design practices.

The e-studio was offered once a year and it was a compulsory studio for architecture students. A third year design studio, ARCH 312-Architectural Design 4, was chosen for implementing the e-studio model. It was expected that third year design students reached an acceptable design maturity that enabled them to experiment and deal with advanced design issues. The prerequisites for this studio included a digital media course in which students

take AutoCAD, 3DS Max, and Adobe Photoshop. Most students also undertake an elective media course which covers advanced topics in digital media including the above mentioned packages. Thus, students enrolled in the e-studio already had a good efficacy in using the tools.

3. Reflections on the E-Design Process

The digital media offer an opportunity to architectural design education, not only as a convenient design environment, but also as a means of inquiry into the nature of architectural design. Digital technology is often perceived as a mechanical replacement to old processes, or a means by which manual processes become more efficient. In the recent past, Computer Aided Architectural Design was seen as "automation" of the manual design processes. We learned from the e-studio that it is a very simplistic view to assume that computing is just automating or extending existing manual procedures. The e-studio provides some evidence that computers and digital technology are not just augmenting or extending manual procedures but also transforming and changing them.

It seems that e-studio students are involved in a reflection-in-action design process such as that described by Donald Schön (1987). Schön and Wiggins (1992) described designing as "a conversation with materials, conducted in the medium of drawing and crucially dependent on seeing." According to them, designing is a kind of dialogue with the design situation. In the e-studio, students seem to engage in a similar interaction or dialogue with the digital medium. A student constantly reviews his position, reacting to all new information and conditions. However, one can characterize main differences between the e-design process and the traditional design process as described by Schön.

All students tend to design in three dimensions from the beginning of the design process. Students went beyond the conventional design process in which they work using abstract conventions (2D plans, sections etc) and started to explore, manipulate and articulate space in 3D or even 4D, using movement in both time and space. Designing in 3D has several advantages among which greater fidelity to reality which permits the student to think more naturally. A modeling and animation software, such as 3DS Max, allowed students to explore and examine space, form, texture, lighting, and color, as they explore spatial and temporal movement.

Integration is another distinguishing feature of e-design. In contrast to the conventional reflection-in-action process in which the design act is

segmented into several abstract views, e-design seems to be more integrative in the sense that design acts and decisions are represented in one digital model that can be seen and evaluated from various points of view at any point of time. Visualization tools, that include advanced modeling and animation capabilities, provide an integrative environment which enables students to represent, test and evaluate the various spatial and formal aspects of their design concurrently and from several points of view. This represents a holistic and organic design approach that provides students with simultaneous understanding and integral awareness of the design situation. For example, students are able to create and manipulate solids and voids while at the same time evaluating texture, lighting, color scheme, proportion and other anthropometric relations of the proposed solution.

Another aspect of e-design is **interactivity** or responsiveness. E-design seems to be more interactive in the sense that choices are being infinite and the results are ever more immediate. Using advanced modeling and animation tool such as 3DS Max, students interactively manipulate and explore their design artifacts. The effect of design transformation and change is seen instantly. According to Schön theory, the "reflective conversation" with the design situation involves actions such as externalizing design ideas through drawing, interpreting the consequences of the drawing act, and making moves to a new design situation. In e-design, the feedback in the conversation with the design situation is more immediate. The transformation of the "digital artifacts", the movement to a new design situation and the "back-talk" of the situation are more instant. In contrast, tactile media provide a passive or less interactive environment in the sense that changing representation and feedback on the consequences of a design decision take time.

Another characteristic of the e-design process is the degree of involvement or **immersion** in the process. Observations revealed that e-design is immersive in dual senses. On one hand, advanced parametric modeling tools provided a work environment similar to desktop-VR where students are able to interactively explore and navigate their digital model. In this environment, students immerse themselves in a designed space in a manner similar to the way in which it would be used. The feeling of immersion was improved through LCD projection on a large screen. On the other hand, the numerous and versatile design and visualization capabilities of the digital environment provided unlimited choices for design creation which put the student in a complete immersion state. For example, design student is immersed in a virtual simulation that allowed him to model, articulate, and animate movement throughout the design process. The involvement is very personal and indescribable mental state - almost

immersive. Several students were engaged in creative processes that few others could comprehend.

Thus, one can say that e-design represents a new model of design that is immersive and dynamic (reflective, integrative and interactive). This model brings dramatic changes to the conventional/tactile design process and questions several values associated with it.

Since e-studio students already have the basic skills in using the software and know how to design, one may expect instant efficiency in e-design. Our observations showed the opposite. Efficiency in e-design did not appear immediately. A significant amount of time is needed to develop skills and techniques in e-design. At the beginning of the e-studio, many students found difficulty starting design. The first week or so was hard for many students. They were kind of confused how to start.

One explanation for this “time lapse” is that students seem to switch mode from the conventional/tactile design mode to the e-design mode. In previous design studios, students attained and developed conventional design skills in which they used to work using abstract conventions such as 2D sketches, plans, sections, etc. This process or mode of design is different in several aspects from the dynamic and immersive e-design mode. Difficulty and time required to switch to the e-design mode differed from student to another, depending on personal traits and learning style.

Since e-design process tends to be different from the conventional design, it would be interesting to examine if e-design applies and creates different forms of tacit and propositional knowledge. Although each student has developed his own e-design working method, e-studio students did not become experts in e-design. Through time and practice, it is expected that students will develop skills and techniques in e-design and thus it is possible for an intuitive e-design procedures to appear. Through familiarity, the most apparent tools (mouse and keyboard) will tend to disappear and e-design becomes the core experience. It would be interesting to examine if such e-design experts use and operate with a design cognition that is different from those who design using conventional/tactile technologies.

It is clear that the e-design is different from the conventional design in several aspects. Thus, there is a need to reconsider our understandings of digital design practice which is still dominated by the prevailing conventional/tactile paradigm. Proper understanding of the e-design process requires a new perspective that goes beyond the discourse of the current paradigm. Dealing with e-design from the current conventional design perspective puts great constraints on our understanding of the new media and limits the questions that can be asked.

4. Design Studio Praxis

Initially, the e-studio followed the same general lines of the traditional studio: each student is to develop a unique solution for a design problem, recording results in drawings and models. At intervals throughout the project, the instructor holds individual or group reviews with students. At the end of the project, a final jury is held by the instructor and a group of outside critics. However, a critical analysis of the e-studio practices during two academic years revealed major differences between e-studio practices and conventional studio practices

The e-studio, for example, required larger amount of one to one contact with students. Students tend to produce more work with larger amount of information and complexity which demand more time from the instructor to examine and discuss with students. This tendency applies to both design and pre-design stages.

The e-studio, in contrast to the conventional studio, has no classical drawing boards. Each student has a desktop computer only with extra desk space for A3 sketch paper. One characteristic of the digital medium is its intangibility. Digital media are intangible to us except through the aid of technology such as keyboard, monitor or plotter. Initially, digital design is created and viewed on a computer monitor. To view the digital design there is an extra step of outputting design material. To present their work for desk critique or for formal/informal reviews, students used varied formats: soft copy (on computer screen or projected on large screen), hard copy (paper prints) or hybrid of both. The dilemma of which presentation format to use is one characteristic of the e-studio that is not found in the conventional studio. Each presentation format has its own rituals and constraints.

Using soft copy alone, whether on computer screen or projected on large screen, has its own limitations, such as the serial nature of the presentation, which make cross referencing and moving back and forth among various representations a difficult task. Also, students' work cannot be left on the "wall" so that other students can look at it for comparison and evaluation. In hard copy presentations, 2D images of the 3D model as well as sections through the model are presented. In hybrid presentations, 3D animations as well as hard copies of the digital model are used to demonstrate different parts of the design. Projecting animations or interactive models on large screen provided students with an immersive effect.

I usually ask students to have a printout during a desk critique so that I can mark out my comments. Outputting e-design is a demanding process that requires planning and time. Students have to render various views of the

model, make sections through it, edit these images and use other applications to compile and print them out. Furthermore, the fact that what a student sees on the monitor is not necessarily what he gets on paper means that the student may re-print his work more than once. Thus, in e-design, it is difficult to conduct spontaneous pinup reviews or desk critiques. Enough time for outputting and editing design material should be allowed before a formal or informal review.

In the e-studio it is easy to identify the difficulties associated with tracking previous ideas during design development. Digital media enable students to create a large amount of design artifacts in a very short time. During the interactive e-design process, several artifacts are created and then destroyed or lost in a very short time. Some artifacts take a physical form for a very short time before they are destroyed or lost. Other artifacts are more instrumental for the design work and thus tend to stay for longer time before being lost. Students were encouraged to document the design process by keeping a record of important artifacts. Students tend to capture and save decisive ideas for future reference. However, during the design process, several students have lost record of important stages of their design. Observations revealed that this process is a demanding and not well organized process. Students' ability to move back and forth between design ideas/representations at different stages, whether for brainstorming, design development, communicating with others, or for other reasons is negatively affected by this limitation.

Digital media also change other aspects of the conventional design studio. Digital media, for example, redefine the boundaries of the studio. E-studio students are more outward looking. They engage with sources of learning beyond the studio boundaries such as the WWW. Some students tend to use pre-made elements or models available on the Web. This situation has legal, ethical and methodological implications. Also, compared with the conventional studio, there is more peer interactions in the e-studio. The students wander around the studio to discuss shared problems and solutions, to evaluate designs and how they did things, and some times to see what other students are doing. These practices reveal the importance of the social aspects of studio learning, where learning is created and changed by the social context. More research is needed to examine the relative importance of this aspect of the e-studio.

Furthermore, e-studio students tend to delay the contact time for the desk critique. One explanation for this phenomenon is that the integrative 3D environment enables the student to visualize his design and its problems and deficiencies better and thus he tends to be engaged in a continuous effort to develop and refine his work. Another possible explanation is media

invisibility. To visualize the invisible design artifacts, the student needs extra time for editing and outputting design material in form of prints, screen captures, or as projection on large screen, each of which requires more planning and time management.

The above mentioned issues are clear anomaly and cannot be explained by or resolved from a conventional studio paradigm. The digital technology transforms the conventional studio and brings deep changes to its basic assumptions and practices. The e-studio experiments revealed the need to reconsider our traditional understanding of the design studio culture. The e-studio will remain experimental and discretionary to the extent to which we conduct it within, and think about it in terms of, the prevailing design studio practices.

5. E-design and Students Domain of Skills

To better understand how digital media affect and change the design process, it is beneficial to examine the effect of three independent variables on the e-design process: 1) manual artistic/presentation skills, 2) CAAD computing skills and 3) conventional design skills.

An evaluation survey was distributed after each e-studio and the results of the survey will be reported in another paper. However, some preliminary observations are worth mentioning here. The survey data showed that, in general, e-studio students feel better about their design skills. They express that parametric modeling and animation tools, such as 3DS Max, offer them a very convenient design environment.

Although digital media have proved to be useful in creating and presenting architecture, however, sometimes it was a source of “distraction”. While students with good architectural knowledge in terms of conventional design and manual presentation did very well in e-design, naive students with limited design and artistic skills tend to misuse the tool. Mislead or beguiled by the gimmicks of the digital media, they tend to rely on the art of “distracting”. This uncritical attitude of such students resulted in very poor designs. Their products show very little assimilation or understanding of the underlying form. Such practices contribute to the anti-media sentiment that one may find among conventional design advocates.

Observations also showed that design students skilled in freehand drawing and tactile presentation methods, were less than enthusiastic for the e-studio experiment. Initially, it seems that there is little evidence to encourage them to use or explore the tool. However, later on they worked with the tool very well.

To examine the above observations, a co-relation test was conducted between students' performance in e-design and their skills in conventional design, manual presentation, and CAAD computing as reflected in their final grades in corresponding courses. In case there is more than one course representing the skill (as in conventional design and manual presentation skills), the average grade of these courses was used. The results of the correlation test ($n=33$) are as follows: Design skills and e-design $r=0.83$, artistic skills and e-design $r=0.60$, and CAAD computing and e-design $r=0.31$.

The low correlation between CAAD computing skills and e-design performance shows that computing knowledge alone is not enough to produce good design. Digital media cannot convert a bad designer into a good one. The high correlation between e-design performance and conventional design skills, and also between e-design and manual presentation skills, indicates the importance of basic architectural knowledge. Students who have good architectural craftsmanship (in terms of design and presentation skills) seem to be better equipped to extensively explore the medium and pursue its potential. In contrast, digital media seem to beguile and rock the focus of students with limited architectural knowledge. The final products of such students clearly offset the design content in favor of the image. The basic architectural knowledge tends to provide necessary constraints in a digital environment that appear to have no limitations. Thus, the basic studio and presentation skills, in terms of composition, materials, lighting, and color, tend to make all the difference in efficient e-design.

6. Media Limitations and Opportunities

The digital medium, as any other material, provides a medium with its own constraints, potentials, and aesthetic values. To enable students to explore the limitations and potentials of the new medium and to enable them to discover what the medium can do for them, two types of projects are offered in each e-studio. In the first type, the "Imaginative Leap", students are given a design project with flexible program. In the second type, the "Contextual Constraints", students are given a design project with specific constraints in terms of program and context.

The first project usually encourages students to think creatively and to discover innovative solutions. It also assigns a particular importance for rethinking and questioning the design process and the architectural form. In these types of projects students tend to create complex forms using complex operations such as several layers of modifiers, sub-object

operations, and using NURBS modeling. They used these operations to generate various formal transformations that reflect their particular interest or conditions. These sophisticated modeling operations are used not only in design presentation but also in its generation and in questioning the various assumptions about design and architectural form.

These types of projects proved to be valuable to maintain the intrigue and investigation required to uncover the potentials of the new design environment. It was fascinating for students, who found it an opportunity to automat design generation and testing and to access the magical universe of complex forms. Some of the created forms transcended several essential issues such as constructionability, materiality, or the cultural and economical context. The complexity of the created forms questions the role of orthogonal abstraction conventions as a tool for architectural design representation.

After experimenting with the unlimited potential of the tool in the first project, the second project imposes some limitations in terms of program and design context. At the beginning, this was kind of disappointing for students – but later on they discovered that this condition is more likely to be enabling.

In one of the "contextual constraints" projects students were asked to design a "museum and cultural complex" at the Culture Street, Amman. One of the challenges in this project was how to deal with the peculiarities of the context. Creating and representing regional architecture, for example, entails a specific language of forms, expressions and material. Students had to rely on their experience to design and communicate the aesthetic and sensory influences of the physical context. This may be technically complex, but inevitable to represent and communicate regional identity. Particular e-design processes and techniques are needed.

One of the greatest challenges for students in the "contextual constraints" projects is how to impose a unique identity on the resultant digital form. Several students were successful in creating architecture with regional identity. I saw some real innovative approaches to reflect flavors of local/regional architecture. For example, some students used digital images of local stone styles, manipulated them in adobe Photoshop then used them in various channels of the "virtual material". Some students produced projects that jurors complimented as "Did not look like computer generated". Many architectural elements were simulated using "texture mapping" rather than modeling. Several students invented their own techniques. The nature of the project pushed students to seek to simulate the aesthetics and sensory qualities of the real world context. The issue of "material" here is not an issue of presentation; it is part of designing specific qualities of local and

regional architecture. From my experience in teaching design, one can not ask students to produce what they cannot depict or represent on paper. These types of projects enabled me to engage in a deep discussion with students about critical formal and design issues.

On the other hand, some students were not that successful in designing with the contextual constraints of the project. They tended to produce generic forms that reflected a kind of common information-age culture. These forms were in complete contradiction with the context. Other students, however, provided a redefinition of local/regional architecture from a "techno" perspective. Challenges faced students in this project were reflected in their comments in the evaluation survey. One student mentioned that "digital media do not enable one to have his own "touch" or "to reflect his own identity". Another student mentioned that "computer do not provide a sensitive enough working environment to satisfy his particular demands". Another student mentioned that he wanted to reflect the "evocative nature of the place" but he couldn't. Thus, it seems that e-design not only affect and change the process of creating and teaching architecture, but also the qualities of the architectural product itself.

Observations showed that it takes time to realize the limits and opportunities associated with the media. These two types of projects, the "Imaginative Leap" and "Contextual Constraints", provided an appropriate vehicle to explore the new design medium and its potentials and limitations.

7. E-studio as a Locus of Culturalization

Digital technology is not a value free neutral tool that produces objective realities. Previous sections showed that digital media are dramatically changing the way we produce and teach architecture as well as the architectural product and the position of the designer in these processes. They also fundamentally alter the way in which we envision and describe architecture. It is worth examining if digital media and e-design influence students aesthetic values and their perception of the built environment.

Culturalization is the process by which individuals acquire their cultural behavior during the various contacts with the institutions of the groups in which they finds himself. As a result of "the culturalization process the individual assumes a definite set of conventional manners, ideals, knowledge, attitudes and habits." Thus, it seems appropriate to analyze and examine the inevitable outcomes of the e-studio as a culturalization process. It is necessary, for example, to examine how digital media affect new generations of designers and what are the social and cultural implications on

architectural education and the profession as digital media become the dominant mode of designing.

It is often argued that a major disadvantage of digital media is their inability to communicate cultural and symbolic meanings. CAAD systems are usually described as being designed to create and compile value free elements (Al-Qawasmi, 2004). The argument is that CAAD systems and digital technology transform buildings into elements of global exchange and, in this way, support commodification and globalization of cultures. Another criticism is the tendency of digital media and CAAD systems to offset the design "content" in favor of the "image"; that is, the image substitutes the content in documenting and communicating architecture. In the century of globalization, this is a critical issue for developing countries, such as Jordan, where the search for a national identity is very crucial. As Manuel Castells (1997) put it, in a world of global flows of wealth and images, the search for identity - collective or individual - "becomes the fundamental source of social meaning."

As new generations of design students are spending more time practicing e-design and participating in digital environments for communication and education, it is unknown as yet, what their aesthetic demands will be. In the e-studio, for example, the design products of the students seem to have different flavor or aesthetic taste compared with the products of the conventional studio. E-design products increasingly include a great deal of generic forms that reflect a kind of global architectural identity. Students tend to produce "techno designs" that transcend local conventions and constraints. Although it is necessary to prepare our students for a fast moving digital culture and to teach them how to respond to the various issues raised by the information society, we should be aware of the ambivalent nature of digital media and the inevitable outcomes of their deployment in architectural education and practice.

It is well known that different media "amplify" or "reduce" phenomena in various ways as a result of their own constraints and limitations. Postman (1993) has reinterpreted McLuhan's statement that "the medium is the message" as meaning that "embedded in every tool is an ideological bias, a predisposition to construct the world as one thing rather than another, to value one thing over another, to amplify one sense or skill or attitude more loudly than another". In the context of the e-studio, this suggests that digital media do not enable us without cost. In other words, some information or aspects of the design experience are becoming more important or relevant while others are becoming unimportant or irrelevant. As discussed before, many aspects of the conventional professional practices are no longer the dominant mode. For example, digital media eliminate the need to use

physical models. The complexity of created forms upstaged the role of orthogonal abstraction conventions as a tool for architectural design representation. Also, students tend to use secondary data available on the Web rather than creating their own models or collecting their primary data, a situation that has profound ethical and methodological implications.

8. Conclusion

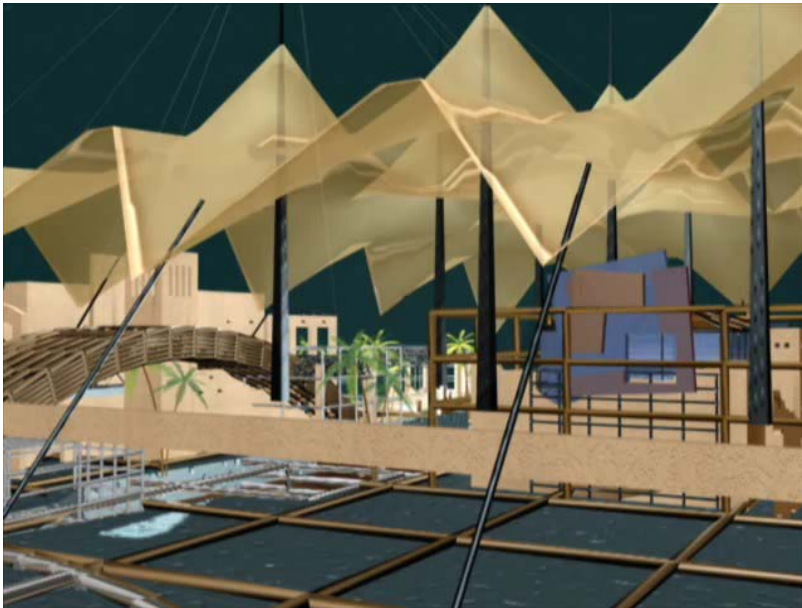
The e-studio provides a valuable opportunity to critically evaluate current design discourse and to reconsider current understandings of the design studio and the digital design practices. It enables us to gain insights into the architectural design process, the design studio praxis, the design outcome, and how digital media affects them.

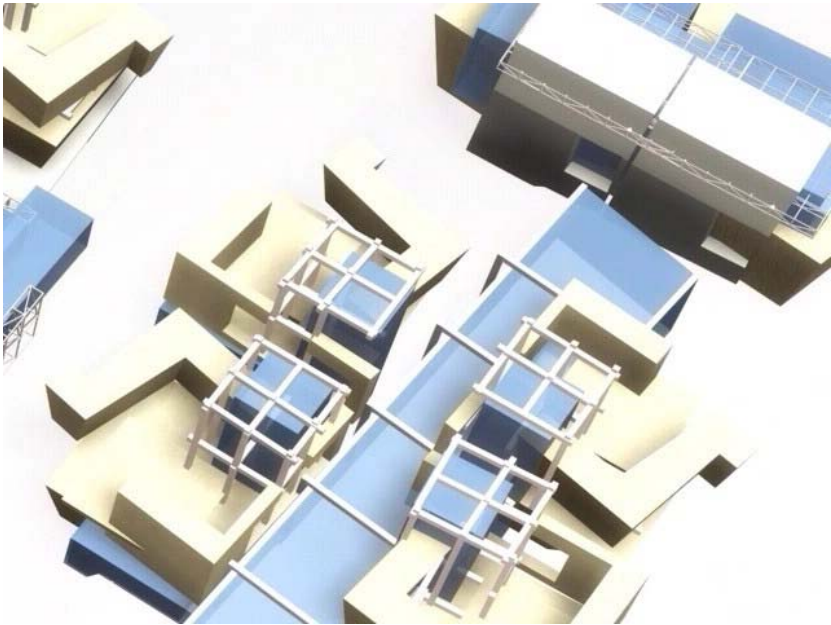
Our observations showed that e-design appear to represent a new model of design that is immersive, reflective, integrative and interactive. This model questions several values associated with the conventional design process and brings dramatic changes to it. The digital technology also transforms the traditional studio and brings changes to its basic assumptions and practices. It introduces new studio practices that cannot be understood, explained or resolved from a conventional studio paradigm.

The e-studio highlighted the need to examine the social and cultural implications of using digital media in architectural education and the profession. There is also a need for more rigorous research to examine whether e-design involves different cognition activities than those used in conventional design.

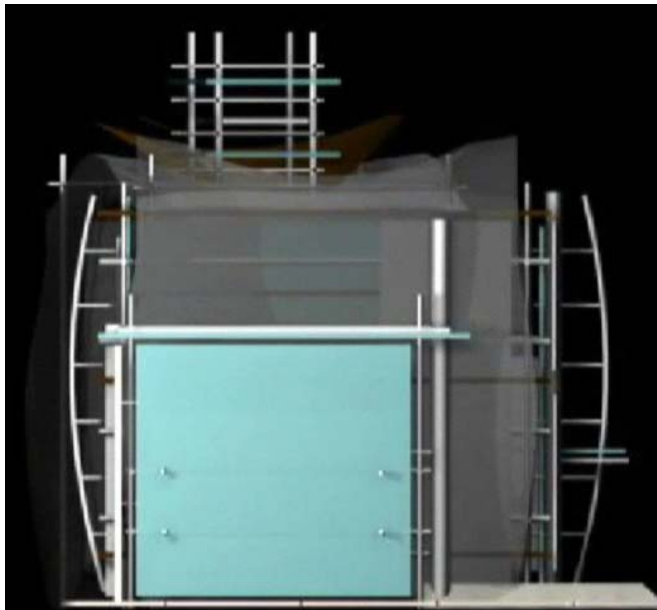
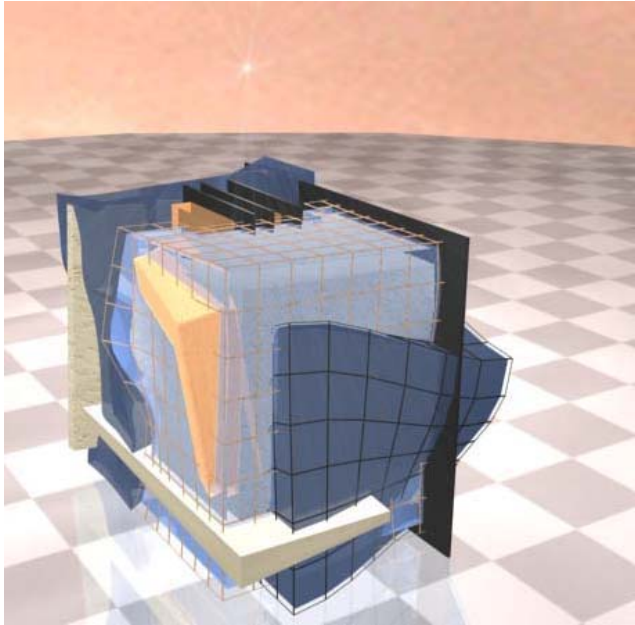
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Examples of Student Work in the E-Studio