A TEACHING MODEL FOR INTEGRATING CONVENTIONAL DESIGN CURRICULUM WITH DIGITAL MEDIA

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Abstract. This paper presents a teaching model called "*e*-Space" for integrating conventional design curriculum with digital media. *e*-Space is composed of a set of exercises that emphasize the use of digital media to enhance spatial sensibility and understanding. Also, *e*-Space explores spatial composition including organization, interpretation, representation, transformation, and logicality. Simultaneously, diverse digital media applications integrated with design-thinking enables students to have conversation with ideas between two design spaces—real and virtual. Finally, we use an introductory digital media course as an example of our model in accompaniment with conventional design studio learning.

1. Introduction

While digital media has been evolving into current design curriculum, most of architectural curriculum, especially design studio, is still in the transition process. To date, there is no clear working solution for design curriculum using total digital media. Therefore, how to apply digital media within the context of conventional design curriculum is the main research issue of this paper. Also to be considered is the fact that the majority of design studio tutors in most architectural schools were educated in the so-called "pre-digital" era. Therefore, how to integrate conventional design thinking and process with digital media is our key problem.

There is some research available that addresses more comprehensive ways to integrate conventional design learning with digital media. Exploring the applications of digital media as representation techniques (Achen, 1996; Kalisperis and Pehlivanidou, 1998) provides an efficient learning

environment for studio design. Interacting design learning in process offers another pedagogical approach for exploring design methodology based on conventional process (Kolarevic, 1998; Papanikolaou, 2001). While working with both methodologies (digital and conventional media), using CAAD curriculums enhances students' motivation to learn particular issues such as computer graphics as a workable pedagogy (Cheng, 1999). In addition, the interactive integration using team-based inspiration techniques such as "role-play" (Chang and Huang, 2002) shows a way to interact integration of both means. In conventional studio teaching, technical knowledge such as structure, lighting, and energy can be integrated into the curriculum using some specialized software (Seebohm, 2001). Most research provides insight into the gradual integration of digital means into conventional design teaching as indicated above.

The role of digital media is not *spatial revolution*, but *spatial evolution*. The disciplines of conventional media (such as sketch drawings, 3D physical model, and real material manipulation) still play an important role to connect spatial sense with physical design space. Applying the evolutionary insights described above, the disciplines of conventional media can also be re-applied onto digital media. Therefore, using the representation techniques of digital media within a pedagogical curriculum provides the foundation of our teaching model unleashed in this paper. For exploring the integration, we propose a teaching model called "*e*-Space" (*e* for evolving) for demonstrating the potential and possible effects of integration. In addition, we use an introductory digital media course as an example of our model in accompaniment with conventional design studio learning.

2. Learning Spatial Composition with Digital Media

Spatial composition is the foremost discipline for students who are just beginning architectural design studio. This discipline is also suitable for learning digital media. It is commonly applied in conventional design curriculum and digital media in most architecture schools. Therefore, by exploring digital media application for learning spatial composition, we propose the integration framework elaborated below.

2.1. SPATIAL COMPOSITION IN CONVENTIONAL DESIGN CURRICULUM

Spatial composition has an important role for teaching students the sensibility and capability of making spaces. It constitutes architectural meaning and conditions by analyzing different combinations between

architectural components and their relationships[1] (Ching, 1996). Therefore, spatial composition is an ideal example for our evolving approach to enhance students' spatial understanding and imagination. For this purpose, the discipline of spatial composition includes spatial organization, interpretation, representation and transformation (seen in the left side of Figure 1). In addition, the discipline further encourages students to establish logicality of design thinking, and then to develop a design methodology for their design works in conventional design curriculum.

2.2. WHAT DIGITAL MEDIA CAN DO FOR CONVENTIONAL DESIGN CURRICULUM

Design is a visual process involving reflective behavior (Schon and Wiggins, 1992). Due to lack of dynamic and immediate visual feedback in a design process, students tend to skip the thoughts of long process of designing and making in real time that demands a lot of time. Such condition causes some limitation for learning spatial composition and inspiring design ideas in conventional design curriculum. By conversation with digital media, diverse visual information can help students to communicate with spatial composition more easily. In addition, the "reality" comes almost instantaneously by reflective visual feedback. Basically, we argue that there are five advantages that provide a seamless cooperation for learning spatial composition in design studio as described below:

- Simulating spatial reality - Digital media offers rapid modeling and rendering advantages to encourage students to simulate spatial reality reflectively, making it easier for students to investigate and understand a spatial composition they create immediately.
- Controlling dynamic viewpoints - In virtual design space, digital media provides dynamic viewpoint control to freely navigate space by walking, flying, world-in-hand, etc. The advantage enhances students' sensibility for experiencing and realizing space in real world.
- Interacting time and space - Spatial experience has a strong relationship with "time" dimension. By taking advantage of digital media, the experience related to time-space interaction can be visualized in continuous image frames. It provides a greater understanding of potential architectural design process.
- Visualizing morphing process - By utilizing digital media, the morphing process can be visualized by a sequence of "intermediate images" from one design state to another. The intermediate images provide students

[1] The architectural components include form, space, light, material, etc. And their relationships include scale, proportion, rhythm, hierarchy, etc.

diverse visualization stimulation and design inspiration to explore new possibilities of spatial sense.

- Revealing design process - Design process is always considered as a "black-box" (Rowe, 1987). However, digital environments can simplify the complex design process that eases the operation interface to make design thinking transparent and logical. This advantage assists students to overlap two design spaces.

In brief, digital media creates a far more interactive design environment to explore spatial composition than conventional media. The above advantages can efficiently and creatively accompany conventional design curriculum to enhance students' design learning.

2.3. THE INTEGRATING FRAMEWORK

Our integrating framework is based on two factors. One factor is related to the discipline of spatial composition for students who have just joined a conventional design curriculum. The other factor is related to digital media, which includes software usage and computer operating techniques. Used in juxtaposition with conventional design curriculum, digital media can elaborate on the traditional disciplines of organization, interpretation, transformation and representation to enhance students' design learning further. For example, morphing process visualization is implemented in relation to transformation of form in design studio learning.

The integrating framework basically is composed with three constituents. They are 1) generation of spatial issues; 2) operation of digital media; 3) representation of spatial compositions. The three constituents are connected together based on the logical design thinking shown in Lai (2002) (Figure 1). Under this framework, we propose a teaching model, called "*e*-Space". The outcomes as well as the possible impacts of these experiments are documented in the following sessions.

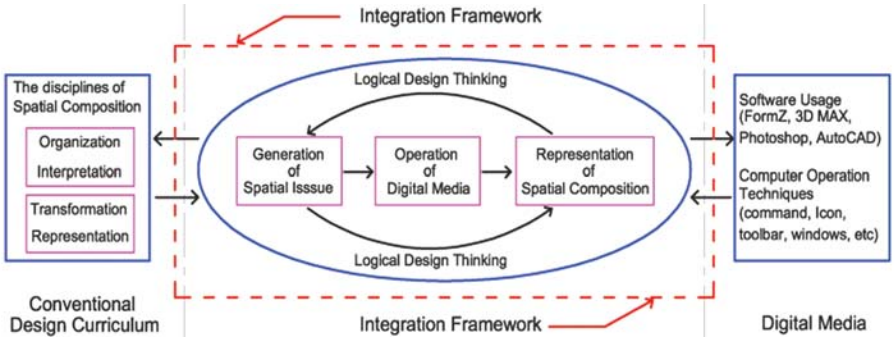

Figure 1. The integration framework diagram

3. The Environment: *e*-Space

Computer technologies are extensively used in teaching and in the student-centered learning in the Department of Architecture at Chaoyang University of Technology in Taiwan. An introductory digital media course, three hours a week during a period of one semester, is designed as a compulsory course for students who are just beginning design studio. During this course, students learn the basic principles and their application towards the architectural design profession. These students are trained with a technical background before they are exposed to the concept of digital design media. The use of computers is concentrated on the production of architectural drawings such as plans, elevations, and sections. Yet, in addition to accompanying conventional design curriculum with digital media, using digital media as design inspiration is another important teaching goal for this course.

We therefore implemented a learning environment according to the teaching model "*e*-Space". Within this environment, we provided students different dimensions of understanding in the abstract spatial concepts with dynamic digital media such as images, shapes, forms and spaces. By taking full advantage of different digital media, e-Space provided a set of exercises to enhance spatial sensibility. In addition, it provided an opportunity for students to explore and sense the possibility of space, such as organization, simulation, interpretation, and transformation. *e*-Space is composed of two phases: *"Discovering Space"* and *"Evolving Space"* (Figure 2). Each phase is composed of different exercises, which are not formulated as separate but rather as a continuous development of the students' design works.

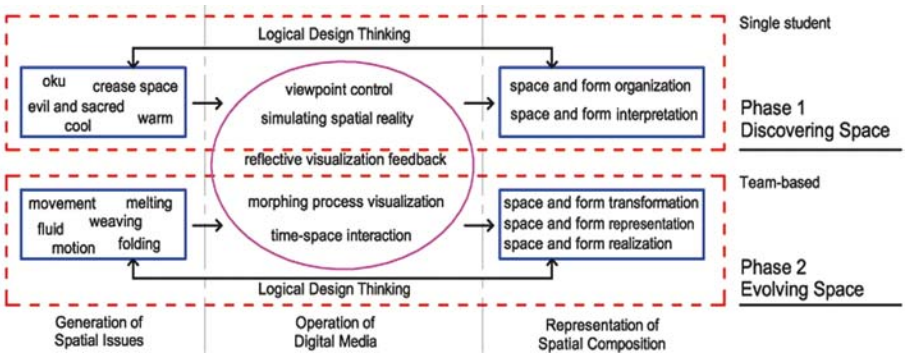

Figure 2. e-Space environment: "*Discovering Space*" and "*Evolving Space*".

3.1. DISCOVERING SPACE

In this phase, students build 3D models to simulate their design works in a virtual environment. Each involves a spatial issue such as “montage” or “crease” to explore space. By using digital media, students are encouraged to explore different possibilities of spatial composition apart from conventional media. The aim of this phase is to make students familiar with the learning environment, and to give them a feeling for the dynamics of a 3D-environment alongside the basic training of 3D modeling. In addition, this phase focuses on enhancing students’ spatial understanding and sensibility. The phase includes two exercises as follows:

1. Organization of spaces and form making – Students create a series of axonometric and perspective views to evaluate the relationship between spaces and forms. Also, they use dynamic viewpoint controls to navigate space, and reorganize these views based on some scenario. Finally, the reorganization inspires them to create various ideas of spatial movement, such as depth space, framing space, spiral space, etc (Figure 3).

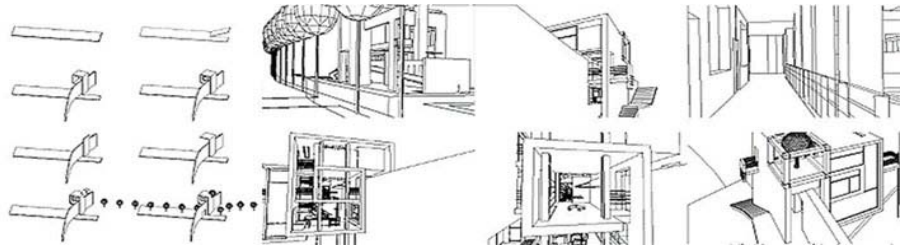

Figure 3. The student reorganizes different views to represent spatial movement.

2. Interpretation of light and materials – Students manipulate 3D rendered images by different parameters of lighting and materials in order to interpret the hidden meaning of spatial senses metaphorically. The example is two-contrast spatial expressions such as sacred and evil, happy and sad, or warm and cool (Figure 4).

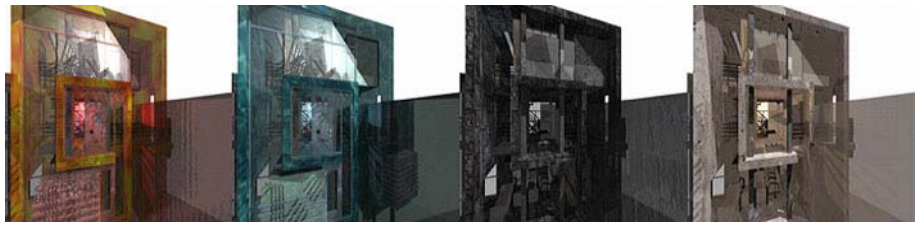

Figure 4. The student interprets two-contrast spatial expressions “sacred and evil”.

3.2. EVOLVING SPACE

The phase "Evolving Space" is composed with three exercises that emphasize the use of digital media for the collection and transformation of visual information. Each team composed of three students selects a substance (such as "fire", "water", "ice", etc), and takes its natural phenomenon (such as "melt", "flow", "diffuse", etc) as an issue to explore dynamic spatial notation (Figure 5). Through the diverse digital media application, students dynamically collect visual information including images, shapes, forms and spaces. The aim of this phase focuses on creating new spatial possibilities and concepts metaphorically, such as infusion instead of binary, seamless instead of collage, interactive instead of transparent and the ideas of folding. In addition, how to integrate between physical design space and virtual design spaces is another crucial issue that should be concerned in this phase.

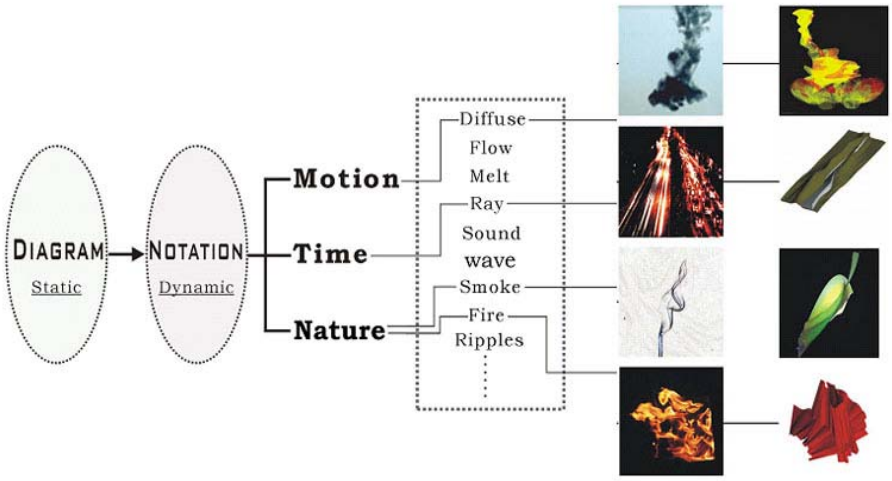

Figure 5. Some nature phenomena as the issues for exploring dynamic spatial notation

1. Transformation of forms in nature – Each team selects a natural substance, and involves a sequential transformation by conversation with different digital media. Based on an individual spatial issue such as "melt", "movement" or "motion", each team collects visual information from static images to dynamic animations. Therefore, students can playfully understand the diverse application of digital media, and freely evolve the new relationship of forms and spaces (Figure 6).

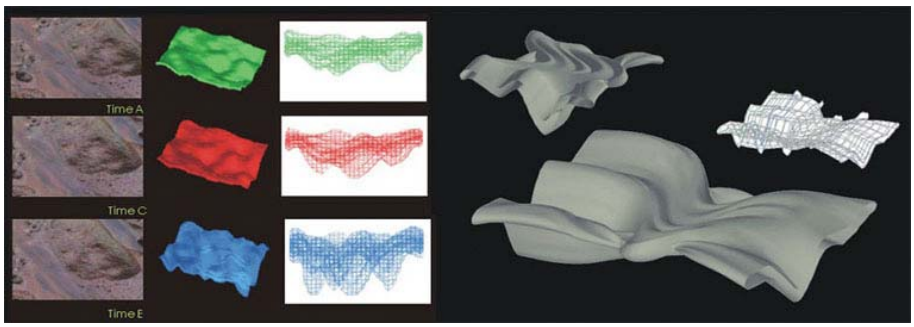

Figure 6. The team involves a sequential transformation process based on a spatial issue "melting space between sand and water".

2. Representation of spatial events – Each team collages some images within the created 3D form to represent specific spatial events based on different spatial scales. Therefore, students not only evaluate the relationship between form and function, but also involve different spatial experiences (Figure 7).

Figure 7. The team collages different images to represent a spatial event "biological garden".

3. Realization of free forms and flow spaces – Each team exploits various materials such as metal, plastic, gypsum or paper to manipulate the "unexpected" free forms generated by digital media in physical design space. Therefore, students can get the idea to integrate two design spaces: physical and virtual (Figure 8, 9).

Figure 8. The team exploits various materials to manipulate the "unexpected" free forms.

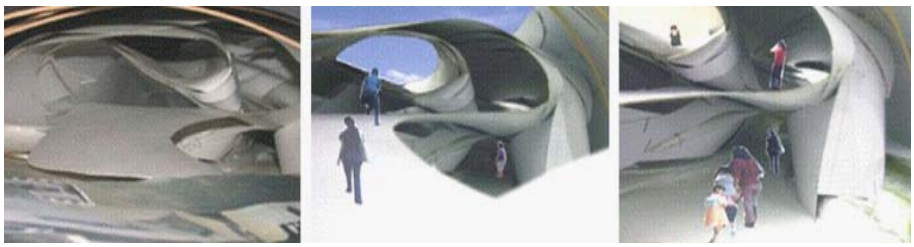

Figure 9. The team exploits various materials to manipulate the "unexpected" flow spaces.

4. Conclusion

Through these exercises, students have varied exposures to the manipulation of architectural design through the interaction between design studio learning and digital media. *e*-Space enhances students' sensibility and capability of making spaces in a very short time. It can also inspire students to generate ideas and approaches to explore spaces, forms, shapes and images. In the learning process, students encourage themselves to use diverse digital media to represent their ideas, and exploit various materials (such as metal, plastic, gypsum, etc) and implementation (such as casting, melting, weaving, etc) that would not be easily visualized previously. The "unexpected" forms generated by digital media give further encouragement for students reevaluating the conventional paradigm of "form follows function".

This study concludes that digital media can create a dynamic design environment, which can accompany the conventional design curriculum effectively. However, we find some limitation of students' understanding of spatial composition, including spatial full-scale experience and real-time interaction. Therefore, two issues should be studied more in-depth in our future research: 1) spatial immersion by integrating another digital media such as virtual reality or augment reality, and 2) spatial interaction by integrating computation learning to explore new behaviors of interaction in virtual space.

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